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Zhicai Zhong
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Preface

Welcome to the Proceedings of the 2nd International Conference on Information Engineering and Applications (IEA 2012), which was held in Chongqing, China, October 26–28, 2012.

As future generation information engineering, information technology and applications become specialized. Information engineering and applications including computer engineering, electrical engineering, communication technology, information computing, service engineering, business intelligence, information education, intelligent system, and applications are growing with ever increasing scale and heterogeneity, and becoming overly complex. The complexity is getting more critical along with the growing applications. To cope with the growing and information engineering and applications focus on intelligent, self-manageable, scalable information systems, engineering and applications to the maximum extent possible without human intervention or guidance.

Information engineering and applications is the field of study concerned with constructing information computing, intelligent system, mathematical models, numerical solution techniques, and using computers and other electronic devices to analyze and solve natural scientific, social scientific, and engineering problems. In practical use, it is typically the application of computer simulation, intelligent system, internet, communication technology, information computing, information education, applications, and other forms of information engineering to problems in various scientific disciplines and engineering. Information engineering and applications is an important underpinning for techniques used in information and computational science and there are many unresolved problems, worth studying.

The IEA 2012 conference provided a forum for engineers and scientists in academia, industry, and government to address the most innovative research and development including technical challenges and social, legal, political, and economic issues, and to present and discuss their ideas, results, work in progress, and experience on all aspects of information engineering and applications.

There was a very large number of paper submissions (1845), and all submissions were reviewed by at least three Program or Technical Committee members or external reviewers. It was extremely difficult to select the presentations for the

conference because there were so many excellent and interesting submissions. In order to allocate as many papers as possible and keep the high quality of the conference, we finally decided to accept 542 papers for presentations, reflecting a 29.4 % acceptance rate. We believe that all of these papers and topics not only provided novel ideas, new results, work in progress, and state-of-the-art techniques in this field, but also stimulated the future research activities in the area of information engineering and applications.

The exciting program for this conference was the result of the hard and excellent work of many others, such as Program and Technical Committee members, external reviewers and Publication Chairs under a very tight schedule. We are also grateful to the members of the Local Organizing Committee for supporting us in handling so many organizational tasks, and to the keynote speakers for accepting to come to the conference with enthusiasm. Last but not least, we hope you enjoyed the conference program and the beautiful attractions of Chongqing, China.

October 2012

Yan Ma
Qingsheng Zhu
Shizhong Yang
General and Program Chairs, IEA 2012

Organization

IEA 2012 was organized by Chongqing Normal University, Chongqing Computer Society, Chongqing Copious Prachanda Cultural Exchange Services Company, Chongqing University, Chongqing University of Science and technology, Yangtze Normal University, Chongqing University of Arts and Sciences, and sponsored by the National Science Foundation of China, Shanghai Jiao Tong University. It was held in cooperation with *Lecture Notes in Electrical Engineering* (LNEE) of Springer.

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Contents

Part I
Business Intelligence and Applications

Chapter 1
Study on Standard of Tuition in Higher Education

Chunfeng Liu, Shanshan Kong, Zhang Ling and Aimin Yang

Abstract There is a lack of a cost constraint mechanism in the current higher education tuition pricing system of our country. The "one size fits all" tuition standard fails to reflect the revenue law and the burden ability problems. First, according to the recent higher education tuition fees data related to quantitative analysis of higher education of our country's college tuition situation, and the comprehensive evaluation of higher education tuition standards is given. Then, the game theory is used to seek higher education fees into the game of students, universities, and the government to achieve a balance of interests. Finally, a single target linear optimization model was established, as the university satisfaction index for target function, two game matrix as constraint conditions.

Keywords Game theory · Game matrix · Single objective optimization

1.1 Introduction

Higher education is to train high-quality talents, enhance national innovation ability, and build a harmonious society in the overall situation. Tuition problems which relate to every student and their family is a sensitive and complicated issue: if the tuition fees are too high it will render many students unable to pay for it, if the tuition fees are too low it cannot guarantee quality. Recently, tuition fees has gained more and more attention and the widespread concern of the government and the community. The culture of quality is a core set of indicators for higher

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education, different disciplines, professional in the setting of different training objectives, its quality to have the funds safeguard. Higher education belongs to compulsory education, and its funds in all countries in the world is obtained by government funding, school raising, social donation, and tuition fee income. For access to higher education students with financial difficulties generally take loans and tuition fees less, free or fill, and high academic achievers who also enjoy the scholarship given by the government, schools, businesses, etc.

From 1977 our country completely broke free higher education system, tuition system arrangement has been gradually embodies the beneficiary pays principle, personal, and national shared tuition. But with the rising tuition fees, personal responsibility of higher education cost ratio increased, more and more people begin to question that the current tuition system of higher education is reasonable, justice, and fair.

1.2 Analysis

Higher education tuition standard is the hot issue of social concern. It is open to question, with many discussions in the media data lacking support and quantitative analysis.

1.2.1 The Current Situation and Problems of China's Higher Education School Tuition

First, we introduce the ratio of the 1998–2010, college tuition and household ability to pay and the school funding situation. The study of data shows that from 1998–2010 the per capita income of urban residents has doubled, the growth of income of rural residents is less than doubled, university tuition fees over the same period has increased fivefold, and tuition increase is far greater than the per capita income growth. The tuition accounts for an urban family of three and a rural family of four with an annual income ratio has decreased. However, the proportion of 42 % is still unbearable for most rural households. Tuition accounts for urban and rural residents' average annual household income ratio have also decreased, from the beginning of 2005. However, from the 1993 level of 12.218 upto 24.739 % in 2010, more than 20 % of the increase is beyond the reach of most families. Hence, the higher education tuition standard should be innovated.

1.2.2 The Determination of Higher Education Fees

The system of the higher education tuition-setting process is a process of balanced national, university, and personal interests of the three. Because of nature of higher education, the country, college, and person bear the cost of the share, so how to

balance the three for tuition interests is a difficult problem in the system of tuition fees [1, 2].

From the school's perspective, the school hopes to raise fees, so they have enough money to improve the public facilities and staff welfare. As a result of our country higher education fees and costs associated with the school, the latter are more likely to increase rather than decrease their running cost, so as to charge more money [3].

For the students, they are unwilling to accept the university tuition increases, and if college tuition is lower, the student financial aid policies will be more perfect, which is better for them [4, 5].

From the perspective of the government, on one hand, the government has improved the charge level to reduce funding aspiration pressure; on the other hand, the government cannot indulge in charges rising too fast, so as not to endanger the social justice and equal opportunity for higher education [6, 7].

For the specific circumstances see Fig. 1.1.

(Where + denotes the benefit, − said the profit and loss)

Thus, optimizing the students, universities, and government interest relationships is the key to determine higher education tuition pricing.

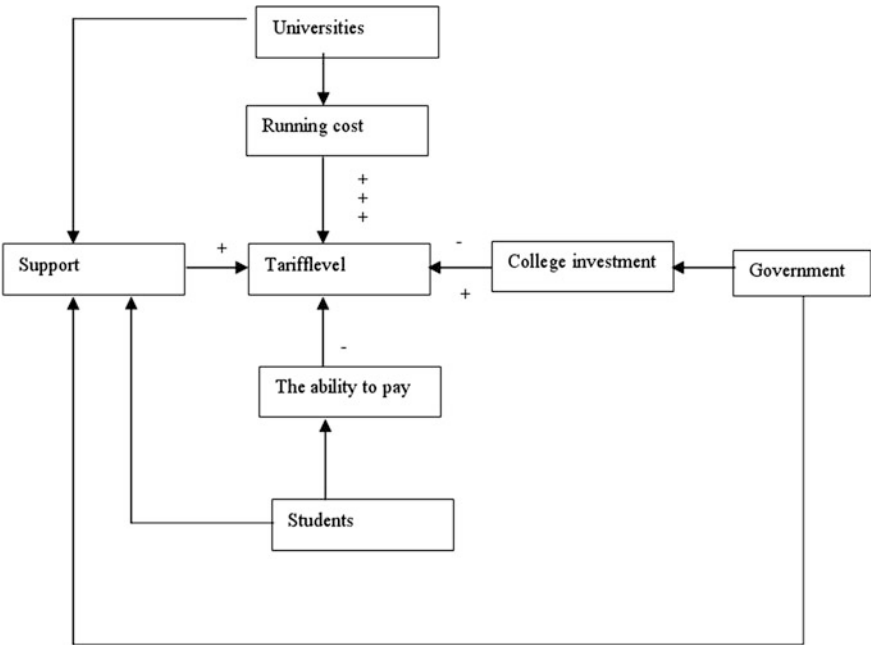

Fig. 1.1 University tuition formation game

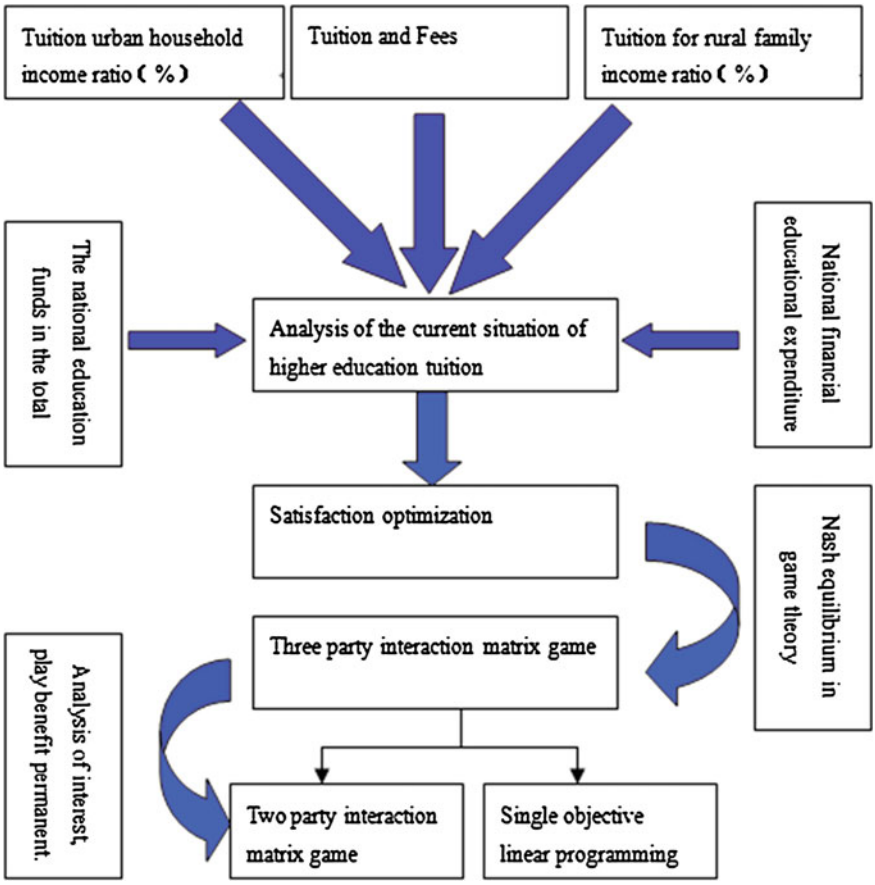

Fig. 1.2 Modeling ideas flowchart

1.2.3 Ideas Flowchart

Figure 1.2 gives the ideas flowchart, which is a microcosm of the modeling method and is able to completely reflect the modeling ideas.

1.3 Model

According to the analysis conclusion, it is inferred that formulating of higher education tuition standards for students, schools, and government must achieve their balance of interests [8, 9].

Because university is the player of residents and government that university is removed from the game and sale tripartite game transformed into a two-party

game problem. College interests are optimized by the family and the government two party games of benefit equilibrium results. In the two party game of this article let the residents be player 1 and the government be player 2, in which player 1 has m strategies, and is denoted by $\alpha_1, \cdots, \alpha_m$, player 2 has n strategies, and is denoted by $\beta_1, \cdots, \beta_n$, their collections respectively by $F_1 \equiv A = \{\alpha_1, \cdots, \alpha_m\}$ and $F_2 \equiv B = \{\beta_1, \cdots, \beta_n\}$. When the player 1, 2 respectively take strategy α_i, β_i, bureau of the results w set Ω probability distribution is denoted as π_{ij}. On the probability distribution of π_{ij}, β_{ij} player 2 (government) satisfaction.

If two player's pecking order, at this time in the game π_{ij} players 1 and player 2 is the most favorable is the same factors, Thus this situation middleman 1, 2 were taken strategy $\alpha_{i_0 j_0}, \beta_{i_0 j_0}$ is optimal. This bureau people strategy number is limited to two person game, available matrix Q

$$\mathrm{Q} = \begin{array}{c} \\ \alpha_1 \\ \alpha_2 \\ \vdots \\ \alpha_m \end{array} \begin{array}{c} \begin{array}{cccc} \beta_1 & \beta_2 & \cdots & \beta_n \end{array} \\ \begin{bmatrix} \pi_{11} & \pi_{12} & \cdots & \pi_{1n} \\ \pi_{21} & \pi_{22} & \cdots & \pi_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ \pi_{m1} & \pi_{m2} & \cdots & \pi_{mn} \end{bmatrix} \end{array} \tag{1.1}$$

According to the above analysis to college satisfaction index objective function, two person game matrix as the constraint condition, to establish a single objective optimization model:

Objective function $\max z = \alpha_{i_0 j_0} + \beta_{i_0 j_0}$

Constraint condition $\mathrm{Q} = \begin{array}{c} \\ \alpha_1 \\ \alpha_2 \\ \vdots \\ \alpha_m \end{array} \begin{array}{c} \begin{array}{cccc} \beta_1 & \beta_2 & \cdots & \beta_n \end{array} \\ \begin{bmatrix} \pi_{11} & \pi_{12} & \cdots & \pi_{1n} \\ \pi_{21} & \pi_{22} & \cdots & \pi_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ \pi_{m1} & \pi_{m2} & \cdots & \pi_{mn} \end{bmatrix} \end{array}$

1.4 The Solution of the Model

First of all, the satisfaction function f_1, f_2 about people 1 and 2 is given, which bureau middleman 1(resident) satisfaction value is

$$\alpha_{ij} = f_1(\alpha_i, \beta_j, \gamma_i) = \gamma_{1i} + \frac{\alpha_i + \beta_j - \psi}{\psi} \tag{1.2}$$

The satisfaction of the players (government) is

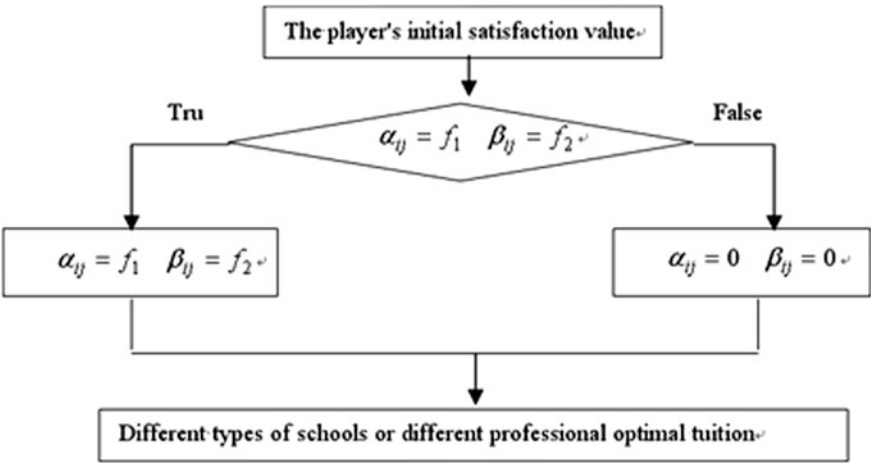

Fig. 1.3 Programming flow chart

$$\beta_{ij} = f_2(a_i, \beta_j, \gamma_j) = \gamma_{2j} + \frac{\alpha_i + \beta_j - \psi}{\psi} \tag{1.3}$$

where γ_{1i} is the bureau initial satisfaction value of the player 1 (residents), γ_{2j} is the value of the initial satisfaction of the player 2 (government), ψ is the minimum cost of university operation [10, 11].

Satisfaction value $(\alpha_{ij}, \beta_{ij})$ can be optimized by using mathematical software according to the above program (Fig. 1.3). This paper selects four kinds of university (Polytechnic University, Comprehensive University, Foreign Language University, Agricultural University), and discusses optimal tuition according to its classification.

First, according to Refs. [5–8], this paper obtained comprehensive university tuition region (from 4500 to 7000Y) and national finance for such students are allocated area (from 8000 to 13000Y), and the satisfactory initial value is shown in Table 1.1.

According to the above procedure, satisfaction value Table 1.2 can be optimized.

Table 1.1 Initial value table of comprehensive university

Tuition	4500	5000	5500	6000	6500	7000
γ_{1i}	6	5	4	3	2	1
Financial student funding	8000	9000	10000	11000	12000	13000
γ_{2j}	6	5	4	3	2	1

Table 1.2 Satisfied matrix of the optimization about the comprehensive university

The optimized value table of the comprehensive university												
	8000		9000		10000		11000		12000		13000	
4500	0	0	0	0	0	0	0	0	0	0	0	0
5000	0	0	0	0	0	0	0	0	0	0	6.013	2.013
5500	0	0	5.013	6.013	5.035	5.035	5.057	4.057	5.07	3.079	5.101	2.101
6000	4.035	7.035	4.057	6.057	4.079	5.079	4.101	4.101	4.121	3.123	4.145	2.145
6500	3.079	7.079	3.101	6.101	3.123	5.121	3.145	4.145	3.167	3.167	3.188	2.188
7000	2.123	7.123	2.145	6.145	2.167	5.167	2.189	4.189	2.210	3.211	2.232	2.232

Table 1.3 Satisfied matrix of the optimization about the polytechnic university

The optimized value table of the polytechnic university								
	7000		8000		9000		10000	
3000	0	0	0	0	0	0	0	0
3500	0	0	0	0	0	0	0	0
4000	0	0	0	0	0	0	0	0
4500	0	0	0	0	4.017	5.017	4.042	4.042
5000	3.01	7.017	3.042	6.042	3.067	5.067	3.093	4.093
5500	2.067	7.067	2.093	6.093	2.118	5.118	2.14	4.14
6000	1.118	7.118	1.14	6.143	1.168	5.168	1.194	4.194

Table 1.4 Satisfied matrix of the optimization about the polytechnic university

The optimized value table of the polytechnic university						
	1100		12000		13000	
3000	0	0	0	0	0	0
3500	0	0	0	0	6.017	1.017
4000	5.017	3.017	5.042	2.042	5.067	1.067
4500	4.068	3.067	4.093	2.093	4.118	1.118
5000	3.118	3.118	3.14	2.14	3.168	1.168
5500	2.168	3.168	2.194	2.194	2.219	1.219
6000	1.219	3.219	1.244	2.244	1.269	1.269

An order of (5.035, 5.035) can be found in Table 1.2, and corresponding to the 5500 element there is the optimal type university tuition. Therefore, the optimal comprehensive university tuition is 5500Y.

Polytechnic University, Foreign Language University and Agricultural University satisfaction value calculation method is the same with the Comprehensive University satisfaction value calculation method.

An order of (4.042, 4.042) can be found in Tables 1.3, 1.4 and corresponding to the 4500 element there is the optimal type university tuition. Therefore, the optimal polytechnic university tuition is 4500Y.

Table 1.5 Satisfied matrix of the optimization about the foreign languages university

The optimized value table of the foreign languages university										
	13000		14000		15000		16000		17000	
11000	0	0	0	0	0	0	0	0	5.164	1.164
12000	0	0	0	0	0	0	4.164	2.164	4.195	1.194
13000	0	0	0	0	3.164	3.1649	3.194	2.194	3.224	1.224
14000	0	0	2.164	4.164	2.195	3.194	2.225	2.225	2.255	1.255
15000	1.164	5.164	1.194	4.194	1.224	3.224	1.255	2.255	1.285	1.285

Table 1.6 Satisfied matrix of the optimization about the agricultural university

The optimized value table of the agricultural university						
	7000		8000		9000	
3500	0	0	0	0	0	0
4000	0	0	0	0	0	0
4500	0	0	3.026	4.026	3.053	3.054
5000	2.053	5.053	2.081	4.081	2.108	3.109
5500	1.108	5.108	1.136	4.136	1.163	3.169
6000	0.163	5.163	0.191	4.191	0.218	3.218

Table 1.7 Satisfied matrix of the optimization about the agricultural university

The optimized value table of the agricultural university						
	10000		11000		12000	
3500	0	0	0	0	5.026	0.026
4000	4.026	2.026	4.053	1.053	4.081	0.081
4500	3.081	2.081	3.108	1.108	3.136	0.136
5000	2.136	2.136	2.163	1.163	2.191	0.191
5500	1.191	2.191	1.218	1.218	1.246	0.246
6000	0.246	2.246	0.274	1.274	0.301	0.301

An order of (2.194, 2.194) can be found in Table 1.5, and corresponding to the 13000 element there is the optimal type university tuition. Therefore, the optimal foreign languages university tuition is 13000 Y.

An order of (3.053, 3.054) can be found in Table 1.6, 1.7 and corresponding to the 4500 element there is the optimal type university tuition. Therefore, the optimal agricultural university tuition is 4500 Y.

So the optimal tuition standard table is shown in Table 1.8:

Table 1.8 The optimal tuition standard table

Universities	Polytechnic university	Comprehensive university	Foreign language university	Agricultural university
Optimal tuition	4500Y	5500Y	13000Y	4500Y

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Chapter 2
Role of Teachers in Oral English Teaching

Wanyu Liu

Abstract In oral English teaching, students are the implementers, while teachers play different roles during this process. Teachers are conductors, guiding students to start activities. They are directors, designing scenarios for the activities and assigning roles to students. They are also critics, evaluating students' oral expression appropriately. The appropriateness of roles that teachers play can change the traditional oral English teaching which is teacher-centered. In this way, teachers can develop students' initiatives to a large extent and improve their abilities of oral expression in English.

Keywords Oral teaching · Role positioning · Initiatives

2.1 Introduction

Language is a subject. It is also a kind of tools and means [1, 2]. Human beings communicate with each other by way of languages, jointly contributing to the formation of the global village [3, 4]. Spoken language is an important form and means to realizing the value of languages. Correspondingly, oral English teaching is one of the most important contents in English teaching [5, 6]. In many colleges in China, classes in oral English are opened or added for students to develop English application talents, which indicates the important status of oral English in English teaching. Teachers are the organizers and implementers in oral English classes. They have great influence on the effects and quality of the classes [7, 8].

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Therefore, it is essential to strengthen the research on the role positioning of teachers in oral English teaching so that the quality of oral English teaching can be improved. It is also very important to improve the forms of oral teaching.

2.2 Mistakes in Oral Teaching

In order to make students study and use English better, many colleges in China have opened oral English classes in English teaching so that students have more chances to speak English. Compared with the dumb English classes before, oral English classes improve students' enthusiasm and interest in learning English. They can also improve students' impression of oral English. However, it is still great far away from the tasks established. Generally speaking, the following mistakes exist in modern oral English teaching. First, the English classes are organized in a dumb way. Because some of the English teachers are relatively old or they have been teaching English in a dumb way for a long time, their oral teaching still focuses on explaining grammars, idioms, memorizing, and reciting. Some of the teachers adopt the methods of reading and writing, spending more time on input. Some even play a monodrama so that students have less time to exercise. Although some teachers have realized that oral teaching should be student-centered, their teaching effects are still not ideal due to the reason that they have not found their right role. Therefore, the oral English of students has not improved obviously. Second, some teachers allow students to take activities freely, making themselves bystanders so that the classes are in the state of complete freedom and the activities lack specific purposes, let alone teaching effects. Third, oral teaching contents are not consistent with students' reality. The purpose of study is to guide students' life and work, so the study contents should be close to the life and work as much as possible. Because there are problems in the material of oral teaching, students' awareness of participation is hard to be aroused and the classes turn out to be deserted. Fourth, the lack of interaction is still the obstacle in oral English teaching. In some oral English classes, students practice individually and communicate unidirectionally. Although some communication seems to be two-way, there is still no inherent connection in their communication, which does not belong to significant interaction due to it not based on listening. For example, teachers raise questions and the students answer them, during which process one says a sentence, while another says another one. Without interaction and cooperation, oral communication loses its essence, let alone to be significantly used. Besides, oral classes have problem that there are some students who participate actively while the majority act as bystanders. Some teachers do not perform their duties properly, ignoring their roles as organizers and guides. In this way, the classes cannot be extended deeply. Some chaos will occur to reduce the efficiency of classroom teaching.

The existence of the above errors influences the effectiveness and quality of teaching of oral English. Therefore, the roles that teachers play are very important.

Only by finding their right position and acting their roles well can they teach vividly an oral English class.

2.3 Correct Positioning

So, how do the teachers position themselves in oral teaching? First, teachers should bear in mind that the protagonists of classroom teaching are students, and not teachers. Therefore, teachers should avoid too much input during the course of teaching, which will affect students' output. At the same time, teachers should be aware that they are also the organizer and implementer in classroom teaching besides being a participant. They can provide advice to students and teach them knowledge and ways of learning, but they should remember that students are the main subject of study. Students' input and output positively are the reflection of excellent teaching results, as John and Morrow 1981 said "The teacher can help, advise and teach, but only the learner can learn." Besides, teachers should play the following roles well—demonstrators, conductors, directors, and commentators.

2.3.1 Demonstrators

In the eyes of students, teachers are their models and tasks to be imitated. Therefore, teachers should be aware of their status in the eyes of students, undertaking responsibilities actively and demonstrating themselves positively. Oral teaching consists of listening and speaking in simple terms. Besides, it also involves body language, rapid response capabilities, and language organization abilities. In oral teaching, teachers should require themselves strictly to correct their pronunciation to make sure they do not pronounce mistakenly. Students mainly listen to the teachers. So teachers are the demonstrators in oral teaching. They should play this role well by developing their oral English levels, pronouncing like native speakers, and training their language. In this way, they can create a better atmosphere for students. By listening, teachers should summarize some effective ways in teaching. They should try their best to speak English in classes by adopting the method of from easy to difficult and from simple to complex. By being taught in English, students can learn more actively. They should also ask students to answer questions in English. In this way, students can learn gradually without notice. They will listen naturally, just like staying in English-speaking countries. Body language is essential during interaction between teachers and students. Sometimes, students may not understand some sentences, but if teachers give some guidance and encourage them to listen carefully, they will tend to understand gradually. As a result, the sense of language will be developed. The gradual transition from listening to speaking will be beneficial for the improvement of students' listening and speaking skills.

2.3.2 Conductors

Conductors in bands play roles of expressing their understanding of music. A good conductor is like a doctor who can point out the band's shortcomings and come up with some improvement. They make the whole band reach the ideal state by adjusting the band. Likewise, for students, teachers are the conductors in classes, while the class is a symphony. Before conducting, teachers should bear in mind the teaching purpose, teaching method and any steps, key points, and difficult points of teaching. For some topics, the key function of conductors is to provide guidance to students on the activities carried out—dialogues between two or group discussion, scenario performance or debate, when to carry out the activities, what activities should be carried out, how to carry them out, and so on. In this way, teachers can activate students' initiatives to expand the variety of teaching activities. The ideal teaching effectiveness can be achieved. At the same time, as a conductor in classes, the teacher should fully understand students' English levels, knowing their interest and focus. They should also be clear about who does well or poorly in study to activate the atmosphere of the whole class. As a result, students will find their own value and be confident about their further study.

2.3.3 Directors

Conductors grasp the general situation of classroom teaching, while the roles of directors are shown in different activities of teaching. Oral classroom teaching is different from writing and reading. It requires students to take part in various activities to achieve different purposes. So how to design activities and how to carry them out have been the questions for teachers to act into the role of directors, arranging roles according to different teaching activities. For example, in Spoken English Course Volume III Unit 3 Part-time Job, teachers can design an activity of finding a job and doing interviews, with two students being the interviewers and some being the interviewees. Students should be divided into groups. Finally, the best group should be selected. In this activity, teachers act as directors, assigning roles, designing situations, and solving problems occurring during the activity. In this way, students' ability to express themselves orally in English can be improved. As directors, teachers should also discover and develop roles besides organizing and coordinating. They should discover the advantages and shortcomings of students so that they encourage students to develop advantages and overcome shortcomings, which can help students to develop themselves comprehensively.

2.3.4 Commentators

The task of conductors is to coordinate students in a macro way, while the job of directors is to grasp the situation in a micro way. It is the task of commentators to evaluate all the teaching activities in a summative way. They should evaluate the advantages and shortcomings comprehensively during students' oral expression to make students more confident. They should let students understand their shortcomings and provide guidance for them so that the same mistakes can be avoided. In order to be more objective and reasonable, commentators should take part in different activities to discover problems and solve them in time. To be a good commentator, teachers should follow one principle. That is, they should not point out the errors during the process of students' expression, which will interrupt their thinking and discourage their confidence. For some simple slip of the tongue, teachers should pay less attention, while for some big mistakes especially those in thinking and being made easily by the majority of students, teachers should point them out in front of all students. In this way, students will pay more attention to the problem. Besides summarizing the past experience, commentators should also predict the future and provide guidance for students. Teachers should know the employment situation in the industry and the trend of future development of oral English talents as well as how to win in the future employment competition. They should guide and develop their students according to the situations above.

2.4 Conclusion

Languages are being developed everyday, while the future is constantly changing. Therefore, in oral teaching, teachers should not play their role passively by teaching according to the textbooks that have been unchanged. On the contrary, they should learn to research and explore unceasingly. Suhomlinski once said that if you want teachers' efforts to bring fun to themselves and to avoid everyday classes from becoming a tedious obligation, you should lead every teacher to the happy road of coordination teaching. Due to its freedom, oral classes are popular among students, which is very significant in improving students' ability to use English in practice. Although oral classes are student-centered, teachers are very important during this process. It is very hard to achieve the ideal performance without the participation of teachers. Both teachers and students can benefit from oral teaching if teachers can play the roles of demonstrators, conductors, directors, and commentators well.

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Chapter 3
Study on Competitive Power of Chinese Retail Chain Company

Qingwen Li

Abstract When wanting to improve competitiveness, what should retail chain companies do—reduce or enlarge? Which has more influence on competitiveness, shop numbers or shop area? Is improving the self-distribution an effective way? This paper tried to answer these questions based on the empirical analysis of the relationship between market share, sale growth rate and shop numbers, shop area, self-distribution.

Keywords Chain retail company · Competitiveness · Chain

3.1 Foreword

There is statistics showing that in 2008 even though the sales of the top 100 Chinese retail chain enterprises had grown to 18.4 %, it was the first time that the growth rate had been below the rate of social total retail sales of consumer goods which was 21.6 %. What is more the growth rate of the top 100 Chinese retail chain enterprises' sales scale also continued to slow down and dropped from 45 % in 2003 to 21 % in 2007. These data suggest that in the development of chain operation in China there has appeared a sign of obvious slowing, which goes against the strategy implementation for the modern circulation system which is mainly based on chain operation, logistics, and e-commerce and the requirements of the development of expanding Chinese domestic demand, which is not harmonious with the development speed of the Chinese economy. How to raise the competitiveness of Chinese retail chain enterprises? We need an urgent answer to

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this question in the background of transforming the economic development mode. As a result, both in theory and in practice, it is extremely significant for the research on the effect from quantity of stores, business area, and owned distribution ratio for competitiveness of Chinese retail chain enterprises.

3.2 Related Theories of Competitiveness of Chinese Retail Chain Enterprises

Scholars both at home and abroad have mainly focused on the reasons for the existence and boundary of the chain and others for retail chain enterprises. Oxenfeldt and Kelly (1968) think that enterprises use the mode of chain operation to get scarce resources that they do not own, because resources for enterprises are limited [1]. The capital financing theory indicates that newly established enterprises can overcome the shortage of capital with the mode of chain operation [2]. Carney and Gedajlovic think that the mode of chain operation is helpful for cost reduction [3]. Martin (1988) indicates that the mode of chain operation is helpful for allocation of risks.

Sun Xun and Tan Xiaoling think that scale operation is the life of enterprises, and they point out that mutual equity, holding stocks, mergers, cooperation, and other forms will be helpful for chain enterprises to expand their advantages [4]. Zou Qian (1999) thinks that we can learn from the German experience, on the basis of researches on retail chain enterprises in Germany. First, the scale operation can give full play to the economic effect. Second, set up various forms of chain stores according to different consumption levels; third, strive to develop the franchising. She also gave suggestions to establish distribution centers to speed up the development of Chinese chains development [5]. Yang Yimiao holds the view that scale operation is the basic condition for chain Enterprises' benefit, which requires chain enterprises' scale to be not smaller than that of minimum economic size (minimum moderate scale for MES), and she points out that the small number of branches is a prominent problem for Chinese retail chains. She also suggested that we need to enhance the construction of distribution centers, strive to develop franchising, and the government should strengthen ite support and guidance [6]. Zheng Wenquan (2002) has researched competitiveness of Chinese retail chain enterprises from the point of economies of scale, information economics, transaction cost economics, and property right economics. He thinks chain operation is an effective shortcut to seek the economies of scale in the field of circulation. What is more, chain operation reduces the uncertainty in terms of organizational design and transaction costs effectively. Xie Qinghua and Huang Peiqing (2004) think to enhance construction of distribution centers and improve concentration distribution rate as the main approaches to raise the competitiveness of Chinese retail chain enterprises. Wu Guoxin and Wan Zhejun (2007) suggest to improve the concentration of industry which is the only way to raise competitiveness. They also point out that large retail chain enterprises can enhance competitiveness

through joiningor merging with other enterprises. Luo Jianhong and Sun Weidong have analyzed the developing trend of Chinese retail chain enterprises from the point of retail distribution and the core competitiveness of the top 100 retail chain enterprises during the "10th Five-Year Plan", and they point out that retail chain enterprises should pay attention to construct, maintain, and enhance core competitiveness and seize change rules and trends of the chain retail so that they can form a lasting competitive advantage.

In terms of the existing research, although we have obtained many achievements, the research on competitiveness of retail chain enterprises is limited by way of qualitative analysis, hence the persuasion is not strong enough. If we can use the way of quantitative analysis, people will not only further understand the factors that have influence on the competitiveness of retail chain enterprises, but can also confirm the degree of influence from various areas on the competitiveness.

3.3 Selection of Variable and Description of Sample Data

This paper studies the relationship among market share, sales growth rate, stores' quantity, area of business, and owned distribution proportion.

Mktsh stands for market share, the ratio of total sales of regional retail chain of total, and the corresponding total retail sales of social consumer goods.

Growthsal stands for sale increase rate, annual total sales of regional retail chain minus previous year's total sales, then dividing the previous year's total sales in regional retail chain, and the price remains unchanged.

Shopnumber is stores' quantity and shoparea is area of business; the unit is million square meters. In order to reduce the interference of different orders of magnitude of variable and heteroscedastic data, we use natural logarithms for the two variables, using lshopnumber and lshoparea for the corresponding variables.

Distripro stands for owned distribution proportion, ratio of purchase number of dispatching goods, and all of the goods.

All the data used in the research are from China statistical yearbook since 2004, because the data needed is only included in China statistical yearbook after 2005, so the author analyzes the data of various regions from 2005 to 2008. There are 30 data 7 for each variable every year, 120 data in all for four years.

3.4 Econometric Model and the Analysis of Empirical Results

3.4.1 Econometric Model

The authors established the following model using China statistical yearbook relevant data since 2004:

1. Model A

$$\text{mktsh} = \alpha_0 + \alpha_1 \text{distripro}_{it} + \alpha_2 \text{lshopnumber}_{it} + \alpha_3 \text{lshoparea}_{it} + a_i + u_{it} \quad (3.1)$$

$$i = 1, 2, \cdots\cdots 30 \quad (3.2)$$

$$t = 2005, 2006, 2007, 2008 \quad (3.3)$$

i represents provinces (municipalities and autonomous regions), t represents year. $\propto_0$ represents intercept, a_i represents the unobserved effects: it represents all factors that influence market share and do not change by time. u_{it} is random error. mktsh and distripro and some other variables have been introduced before in the equation.

2. Model B

$$\text{growthsal} = \beta_0 + \beta_1 \text{distripro}_{it} + \beta_2 \text{lshopnumber}_{it} + \beta_3 \text{lshoparea}_{it} + a_i + u_{it} \quad (3.4)$$

$$i = 1, 2, \cdots\cdots 30 \quad (3.5)$$

$$t = 2005, 2006, 2007, 2008 \quad (3.6)$$

i represents provinces (municipalities and autonomous regions), t represents year. $\propto_0$ represents intercept, a_i represents the unobserved effects: it represents all factors that influence market share and do not change by time. u_{it} is random error. growthsal represents sale increase rate, distripro has the same meaning as in model A.

3.4.2 The Analysis of Empirical Results

The author uses mixed OLS, fixed effect, and random effects to estimate the above model respectively, and the results are as follow:

According to Tables 3.1 and 3.2, though three kinds of measurement methods have shown different results, they still have something in common. And which method is the best? First let us analyze model A.

The way of fixed effects has a judgment coefficient 0.951, which is twice more than that of the other two ways, so it has the best effect. In addition, the article has examined the way of fixed effects and random effects, and the result is that in random effects the Chi Square statistic of Hausman Test is 1.039154, and the probable value is 0.7918; in fixed effects the statistic of F and Chi Square is 31.715777 and 293.829836, and the probable value is 0.0000. The test results indicate that model A should adopt the method of fixed effects, which is the same as model B.

Table 3.1 Three different estimators for model A

Dependent variable: mktsh			
Independent variable	Mixed OLS	Fixed effects	Random effects
distripro	−0.008227	0.010134	0.019682
	(0.480824)	(0.606392)	(1.306366)
	0.6319	0.5459	0.1940
lshopnumber	0.135338	0.055208	0.051995
	(5.933579)	(5.492805)	(5.956125)
	0.0000	0.0000	0.0000
lshoparea	0.041034	0.016795	0.019101
	(2.862186)	(2.593207)	(2.933432)
	0.0053	0.0112	0.0040
n	90	120	120
R^2	0.449354	0.950911	0.451818
F	23.3934	46.49083	31.86956
F(Prob)	0.000000	0.000000	0.000000

Table 3.2 Three different estimators for model B

Dependent variable: mktsh			
Independent variable	Mixed OLS	Fixed effects	Random effects
distripro	−0.173229	(−0.176938)	2.903327
	(−0.117176)	(0.606392)	(2.700008)
	0.9070	0.8600	0.0080
lshopnumber	1.454591	1.463027	−1.338408
	(0.736119)	(1.74186)	(−2.565354)
	0.4625	0.0852	0.0116
lshoparea	0.438465	1.023352	1.047824
	(0.353981)	(1.890877)	(2.312050)
	0.7242	0.0621	0.0225
n	90	120	120
R^2	0.011564	0.486683	0.135499
F	0.335387	2.275473	6.060490
	0.799775	0.001155	0.000720

The above analysis and the corresponding measure results inform that:

Market share and store quantity have a positively related relationship, which is obvious in the statistical result.

Market share and area of business have a positively related relationship, the statistical result is below 0.05.

The relationship between market share and owned proportion of the distribution center gets different results in three kinds of measurement methods, and it is not obvious below 0.10, besides, symbols of coefficients are not uniform. This means the measure results cannot refuse the hypothesis that proportion of the distribution

center has the Zero coefficient to market share, which means the former has little effect on the latter.

The sales increase ratio and the area of business have a positively related relationship, which is obvious below 0.10. Assuming the ratio of the two factors is unchanged, if the store quantity raise 1 %, the sales increase ratio will raise 1.46 %.

Sales increase ratio and store quantity have a positively related relationship, which is obvious below 0.10. Assuming the ratio of the two factors is unchanged, if the area of business raises to 1 %, the sales increase ratio will raise to 1.02 %.

The relationship between sales increase ratio and owned proportion of the distribution center gets different results in three kinds of measurement methods, and it is not obvious only in the method of random effects, besides, symbols of coefficients are not uniform. This means the measure results cannot refuse the hypothesis that the proportion of the distribution center has the Zero coefficient to sales increase ratio, which means the former has an uncertain effect on the latter.

3.5 Conclusions and Enlightenments

We can get some conclusions and enlightenments from the analysis of empirical results as follows:

To increase the retail chain store quantity and expand area of business is helpful for raising the market share. Comparatively speaking, the way of increasing the retail chain store quantity is better.

To increase the retail chain store quantity can not only raise market share but also improve the sales ratio, and the effect on improving sales ratio is more obvious.

Both increasing the retail chain store quantity and expanding the area of business is helpful for raising sales ratio. To increase the retail chain store quantity is more efficient.

Raising the owned proportion of the distribution center has little effect on raising market share and sales ratio. It is suggested that Chinese retail chain enterprises should not build distribution centers aimlessly, but need to pay more attention to increasing the retail chain store quantity and expanding area of business. In addition, they should take advantage of societal forces to develop the delivery. Never invest the delivery aimlessly especially when economics is suffering a downturn.

To raise the market competitiveness, retail chain enterprises should pay attention to increase the store quantity, of course to expand area of business is also important. Comparatively speaking, the former has a better effect. This situation shows that the scale is too small for such a widespread problem for Chinese retail chain enterprises, so the urgent affair for them is to expand the scale of operation.

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Chapter 4
Cultivating Scheme of Students Autonomous Learning in English Listening and Speaking

Xianmei Wei and Yiquan Liu

Abstract According to the present situation, this passage tells the importance of cultivating the students autonomous learning ability. Emphasize the necessity of using multiply resources, computer technology, and the internet resources. The teachers should believe the students' potential, and their speeches should have emotional appeal and encouragement. Teachers should also set examples to the students. These are the key functions of cultivating their autonomous learning ability. Then illustrate the methods of training them English listening and speaking.

Keywords Multiply internet · English listening and speaking · Autonomous learning ability · Cultivate

4.1 Introduction

At present, the students are needed to study English better and better, have the ability to use the language freely and, especially have the strong ability to listen and speak English as we all know, English is learn, not taught [1, 2]. If the students really want to master a foreign language, it is hard for them to achieve it just by listening to the teacher, taking the notes in the class, finishing the exercises offered by teachers. The students must have autonomous learning ability, this is to say, the students must be active, they must be able to study hard without being monitored;

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they must be able to make their our plans, finish the study tasks in time, check the effect of their study, and evaluate their results. They must do more listening, speaking, reading, and writing.

4.2 Make the Best of Computer Technology and the Internet Resources

As the computer technology and the internet resources become more and more popular, more and more schools and teachers use them in class in order to increase the students' English standards. Because the resources in the internet have more event affair materials, more none-language materials; more culture knowledge. These advantages guide the students to study autonomously, which offer good condition to train the students to study actively. Teachers can use the resources in the internet to make PPT. So as to help teach the students, so that, they can increase the students activity, arouse the students interest, and passion of studying English. So that, they can increase the students ability to listen and speak English, to use the language and communicate with others in English freely, using computer technology to make PPT can help teach in class, make the students understand better, learn easier; because the PPT can make the teaching contents interesting, active, and easier for the students to understand. It can offer the students good language situations, so that they can study and master English by listening, speaking, watching and so on. In class, we must download new contents, avoid repetition; for example, listening to English songs, we cannot offer the students the same songs every class, or they will feel boring. We must prepare different songs for the students to listen.

4.3 Dig the Teachers Initiative

4.3.1 The Teacher Should Believe the Students' Potential

The teacher should believe that every student will study English well by practicing. They should use all kinds of methods to make the students overcome chicken heart, so that, they can become bold and confident to speak English. Gradually they will speak English fluently. Teachers should not think that the students are weak in English, and they cannot open their mouth to speak English, no matter what they do, it is impossible for them to speak. If the teachers think like that, they will not take measures to increase the students speaking English. As a result, the students will never open their mouth to speak English. The students potential are waiting for teachers to dig out. The teachers should build up the confidence for them. They should make the students know that no matter how

weak their English spoken language is, they can improve it by practicing. Of course, the teacher should give the students effective methods to improve it, they should give the students the power and encouragement. Some of the students think that their spoken language is originally poor, it is impossible for them to improve, so they do not want to use strategy to improve their English oral language. They never take part in discussing in English, and they never go to the English corner to practice their listening and speaking; they think that it is waste of time to do so. So that, the teachers in high school should let the students know the metacognition knowledge, have them understand language orderliness and characteristic, and the ways and methods of studying the language. This is the precondition to cultivate the autonomic learning competence.

4.3.2 The Teachers Speech Should have Emotional Appeal and Encouragement

If you are the new teacher of a class, when you find that the students are very quiet, and they do not have the consciousness of participatory learning. At that moment, the teacher should try to find ways to improve their enthusiasm, never think there is no way to improve their situation. Because everything is changing all the time, the students are the same. In fact, it is the teacher who has the most important influence for the students. They go-aheadism lies on the teachers talent of organizing and leading. The potential of the students is waiting for the teachers to dig out, enthusiasm of the students is waiting for the teachers to inspired. If it is hard for the students to speak English, the teachers must have confidence, patience, and determination and persistence to guide them. The teachers should raise their enthusiasm and initiative. And teach the students the importance of raising their enthusiasm and initiative. For example using all kinds of their perception can concentrate their attention and strengthen their memory.

4.3.3 Teachers Should Set Examples to the Students

This principle is easy to say, but difficult to do. It is the most important to improve the students listening, speaking, and communicative competence, this is also one of the most important aims. So the teacher should give students more chance to speak English. For example: ask them to answer the questions related to the textbook, require them to retell the stories in it. At the beginning, the students may think it is too difficult to do that, the teacher must think ways to make them believe that they will achieve the goals by studying very hard. If the teachers want the students to reach this requirement, the teacher should practice speaking and listening, and does very well in speaking and listening, he should not only set

examples in the ability, but also set example in hard study, he should influence them by practical action; this is to set examples for them. English corner is the best place to improve the students speaking, teacher should encourage the students to go to the English corner. If the teacher think it is a good way and chance to improve English communicative competence, and go to the English corner actively, have conversation with the students, this is a great encouragement and support for the students, and can also help the students respect the teacher. In order to improve English oral language, it is necessary to practice and train who speak English very hard. If the teacher requires the students to practice English hard, even have the habit of thinking in English, the teacher should achieve it at first. Teachers fluent English will set a good example for the students, and they will be willing to imitate the teacher with the hope that one day they will reach the teachers standards.

4.4 Train the Students Listening and Speaking Skills

4.4.1 Give the Students the Task to Practice Listening and Speaking

In the listening and speaking classes, every time, before the students listening to English materials, the teacher should ask them to listen with tasks, after finishing listening, the students should complete the given exercises, or filling in the blanks while they are listening, or ask them to imitate while they are listening; after that, ask them try to retell the main ideas of the contents so as to train their oral expression. The students will concentrate on studying while they are practicing, listening, and speaking. Every class the teacher should give the students chance to speak English, and teach them how to open their mouth to speak English. For example, guide the students to listen and imitate, while they are reading, they should pay attention to the sound, tone, pause and so on, at the same time, try to memorize the new words, phrases, and sentences. Then the teacher should guide the students to start dialogues. If the students are weak in English speaking, teacher should set examples for the students, after that, choose some of the better students to act in public. So that, they can learn from each other and encourage each other; As in every class, the teacher will ask the students to act in public, so the students will catch time to practice after class, as a result, they will form a good habit to study English by themselves, then improve their ability of speaking and listening as well as the communicative competence.

4.4.2 Improve the Students Participating Consciousness in Class

Increase English oral language and communicative competence is the final goal of English teaching. So teachers should train them oral ability. During the teaching in class, the teacher should pay more attention to the activity. When the teacher asks questions in English, he can require all the students to answer them together in order that all of the students can think and take part in the activity. If the teachers always ask all of the students to answer all of the questions, some of the students may just sit there doing nothing. So the teacher should teach flexibly. Sometimes, they can ask all of the students answer the questions together, sometimes, require one of the students to answer it, sometimes, the teacher can ask the students to discuss the questions. Then choose one of them to answer. So that the students will concentrate on studying without being absent-minded, as a result, their study result will be improved.

In class, teacher should ask the students help each other in class in order that all the students can train their English oral language and improve together. If the teacher find that most of the students like sitting at the back of the classroom, or some of the girls like sitting at the back of the classroom, and they dare not open their mouth to speak English, they always keep silent when others are speaking. At that time, the teacher can ask the students to change their seat, let the students who are good at speaking sit beside the ones who are afraid to open their mouth to speak English so that, all of the students will try to speak English when they try to help each and learn from each other. Their initiative will be improved. Gradually, there will be good English study atmosphere in the classroom.

4.5 Conclusion

The students autonomous ability and habit is waiting for the teachers to guide and monitor, the teacher should use computer technology, design and use the internet resources, change the multiply contents, pictures, Audio materials, make Power-Point, design exercises, tests and so on. During the teaching processes, we should give the students the center position, and the function of the teacher is guiding and organizing, the students are the main body of the study. The time in the classroom is limited, teachers should tell the students the websites of English study, encourage the students to use the English web resources, English classes, practice English listening and speaking, so as to improve the students communicative competence.

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Chapter 5
Research on English Teaching Cohesion Theory

Ke Tu

Abstract To enhance students learning English reading, writing and other basic language skills, improve the level and quality of English teaching, to bridge the theory-based, focused on the non-structural convergence in College English teaching and gives the concrete implementation measures. Application of convergence theory, can train students in English language learning in the sense of convergence, improve English language skills and overall ability, while university teachers teaching guide also has a certain value.

Keywords University · English teaching · Convergence theory · Non-structural convergence

5.1 Introduction

Listening, speaking, reading, and writing basic skills, English is an integral part of the teaching process, in this four session, are all requirements of the continuity of language, requiring convergence of natural language, semantic coherence. Any one chapter is an organic whole, and its integrity is by means of effective convergence and coherence to achieve. Among them, the convergence theory of discourse has been the focus of the research field of linguistics, linguistics and language teaching because of its impact is enormous, and to maintain coherence and cohesion of language has become the basic requirements in English language

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teaching. In recent years, how to effectively use the language of cohesion to the overall level of College English, foreign language teaching has become a research focus which has been widespread concern.

Due to the traditional teacher-centered teaching ideological influence, language, Cohesion, and Coherence Theory in the Teaching of College English has not been enough attention. Cohesion is an important semantic coherence in English means whole, for the internal components to seize the language and layout structure, efficient, and accurate understanding of the meaning of great significance, the traditional teaching of English by the translation impact of law theory, emphasizing the words and grammar, and can the exact phrases and sentences into their mother tongue has a measure of the standard level of understanding, language points explained scattered incoherent, difficult to bear the entire article centers. English teaching reform in the new form will shift the focus to the whole language teaching level up, efforts to train students in the overall semantic analysis, in English teaching on the entire article to understand the convergence and coherence analysis, to choose students who understand levels. Can make students more deeply understand and change the language of thinking, to stimulate student interest in learning, thus contributing to the improvement of English language proficiency.

5.2 Cohesion Theories

Cohesion and coherence in the field of discourse analysis is the two most basic concepts of discourse analysis is an important issue. Focus on cohesion and coherence of the studies undertaken has begun to appear. Jacobson in 1960 by the literary text and repetitive sentence structure formed in parallel to the phenomenon of convergence is the first study [1]. Halliday and Hasan in 1976 in the "convergence of English," a book made: "The interpretation of some element in the discourse is dependent on that of another" [2, 3], a necessary condition for convergence as a coherent, has become an important basis for the theory of convergence between. In 2000, Geoff Thompson in "Introducing Functional Grammar", a book that: "Cohesion refers to the linguistic devices by which the speaker can signal the experiential and interpersonal coherence of the text, which serve a cohesive function" [4].

China's well-known scholar Huang Guowen that: convergence is an important part of textual features, the physical network of discourse [5]. He Shanfen integrated each of said three levels of analysis from the Cohesion means that the connection including the tense and grammatical forms, substitution, ellipsis, and with the structure relations (repetition, adding, alternating, and put together) in four ways. Logical connection is divided into time and space, cause and effect, turning, and delayed four [6].

Convergence theory: when an English-speaking people hear or read some English, he can easily determine this is a complete text or is not related to the

sentence combination. Text is a semantic unit, not a grammatical sentence is greater than units. Not by sentences, discourse, but to achieve through the sentence or to decode the text message. Therefore, the sentence can become a group to see the sentence and the discourse between the existence of different sentences to constitute a link between stylistic rules and mechanisms.

Structural Cohesion and convergence can be divided into non-structural convergence. Structural Cohesion including Theme—thematic structure and information structure of known and unknown information. Rather than structural convergence in the specific discourse reflected reference (reference), omit the (ellipsis), alternative (substitution), connection (conjunction) and other grammatical cohesion and repetition (repetition), synonymous (synonymy), antisepses (antonym), hyponymy (hyponymy) and with (collocation) and other means of lexical cohesion, as well as tone and voice mode phonological layer connection means.

5.3 Non-Structural Convergences

5.3.1 Articulation Phonology

English is a very rich language rhythm; rhyme the use of cell in the language is very common. Phonology interface contains the language's beauty and tidy the United States, making the language of sound and emotion blend, sound and meaning, with strong performance and appeal, the pursuit of beauty of form in English, Rhyme is an important performance. Convergence using the phonological approach, not only the vivid language to read, beautiful sounds, and the formation of the rhythm is like a line of convergence from various parts of the word, so that continuity before and after, easy to understand and remember the audience. Thus, the speech of English speakers is not only a little expression, but also render an important tool and highlight the theme.

For example, U.S. President George W. Bush as the "inaugural speech" also used a lot of phonological convergence. Such as:

Cases 1. Today, we affirm a new commitment to live out our nation's promise through civility, courage, compassion and character.

(Civility, courage, compassion, and character) This group of highly alliterative rhythm, so do the American people in front of spirit.

Cases 2. It is the determined choice of trust over cynicism, of community over chaos.

This is the determined choice-of trust over cynicism; to seek unity in the chaos.

(Cynicism, of community over chaos) the same sound repeated, not only the expression of the indomitable American spirit of the people, and strengthens the appeal of the language and emotional expressiveness.

Example 3. We must show courage in a time of blessing by confronting problems instead of passing them on to future generations.

(Blessing confronting passing) these three words ending in rhyme, not only embodies the pursuit of formal beauty in English, Rhyme, while making President Bush's speech is more contagious.

5.3.2 The Original Word Cohesion

Lexical Cohesion is to achieve an important means of discourse coherence, lexical cohesion refers to the word repetition, synonyms, antisepses, hyponymy, complementary, and total and some other relations, to make the discourse semantic coherence.

Lexical Cohesion in the original word repetition is the most direct way to refer to the same language is repeated in the same unit of discourse, resulting in sentences of convergence within and between sentences, and play functions, such as statements or repeated generally more critical discourse words. Repeat the original words in the text plays a very important role, because people on the message can not be exactly the same degree of attention, it needs to highlight the repeated means one or some of the information. In addition, the structure from the text, starting the efficiency of the exchange of information, people need to use the original word repetition as Coherence, the statement means smooth. Also "inaugural speech" in the paragraph, for example, in this passage, through the story of the original words of the seven repeat, not only to the general audience about the glorious history of the United States, but also your opinions, ideas, and reached the final with the audience in the emotional resonance.

Example 1. We have a place, all of us, in a long story—a story we continue, but those end we will not see. It is the story of a new world that became a friend and liberator of the old, a story of a slave-holding society that became a servant of freedom, the story of a power that went into the world to protect but not possess, to defend but not to conquer.

Example 2. It is the American story—a story of flawed and fallible people, united across the generations by grand and enduring ideals.

The first thrust of the speech is to highlight, emphasize the theme of the speech, to stir the listener enough emotional reaction to the reasoning to the situation and moving. George W. Bush in this section of the original word on the seven story repeated, not only to the general audience about the glorious history of the United States, but also to explain his own views, ideas and, ultimately, to resonate emotionally with the audience.

5.3.3 Synonyms Bridging

Express the same concept or a synonym that is alleged the same thing in different language forms. Synonyms in text form before and after care of, with convergence and cross-sentence bridging the two functions. Synonyms appear in the same

sentence, the sentence can sense two different components to link from, when they appear in different paragraphs, sentences where not only are linked from the sense, and a few small sentences can or sentence from the meaning linked to the relevant paragraphs of each interface. Lexical cohesion in the vocabulary of synonyms is a broad concept.

Cases 1. It is the American story—a story of flawed and fallible people, united across the generations by grand and enduring ideals.

Flawed and fallible have shortcomings and deficiencies of the mean. Repeat these two words, not only the listener are not bored, to better understand the colorful language and rhythm.

Example 2. Through much of the last century, America's faith in freedom and democracy was a rock in a raging sea. Now it is a seed upon the wind, taking root in many nations.

Lexical cohesion in the vocabulary of synonyms is a broad concept, that I have a little rock and seed are referring to "America's belief in freedom and democracy", by alleging the same thing—"America's belief in freedom and democracy", to express the same concept, so that rock, seed become synonymous, and in the sentence before and after the echo, vividly described to the audience's belief in American freedom and democracy, the role of the different historical periods, while the political thinking of the abstract is very specific and vivid.

5.3.4 Antonyms Convergence

Opposite meaning of the word or phrase or a relative called antonyms. Opposite in the same sentence, paragraph or text appear before the formation of Reference so that the two different languages in the sense of composition in sharp contrast, from both positive and negative thing or two describing the phenomenon, so that where the sentence or Text back to back, to the listener or reader to a comprehensive and vivid impression.

Example 1. The peaceful transfer of authority is rare in history, yet common in our country.

Both rare and common meaning of words before and after the care of the contrary, the process is stable in the current U.S. regime.

Example 2. The story of a power that went into the world to protect but not possess, to defend but not to conquer.

Protect—possess, defend—conquer. Antonyms by these two groups form a significant control in the sense that Bush's speech more passionate.

Example 3. Where there is suffering, there is duty. Americans in need are not strangers; they are citizens, not problems, but priorities.

Strangers—citizens, problems—priorities. From both positive and negative descriptions of two things to make the audience on the incoming Bush administration's policies have a more profound understanding of, and Bush, it also means that the American people their political outlook and strategies.

5.4 Measures

In college English teaching, teachers should be properly applied to the cohesion theory in college English teaching, so that students understand the convergence of the important role in the discourse to help students grasp the overall structure of the article chapter, and recognizing the text is written use of various tools and techniques of organizational language skillfully produced organic whole, in order to guide students to accurately grasp the topic, understanding of intentions.

Specific application of the theory of convergence, the authors believe should be the main infiltrate both reading and writing.

5.4.1 Reading

Students of English skills is the most common reading text to read in English class, extra-curricular materials, newspapers, and magazines to read, the CET is the subject of a large proportion of score reading. Convergence theory can effectively address the small vocabulary, new words, difficult words such as affect the reading speed of the problem, help students develop good reading habits, instantly find the topic sentence to read the article and seize articles framework.

Cohesion is the means to achieve semantic coherence of discourse, and English reading is to get real deep discourse semantic coherence between the various elements of the process. Therefore, there is convergence in a variety of surface text link, grasp the discourse within the language component for the layout of the structure, grasp of convergence reached by the deep semantics of discourse coherence, discourse analysis, and thus to make efficient and accurate understanding of a significance.

5.4.2 Writing

Writing in English, the students even if the usual accumulation of a certain vocabulary, clear grammatical structure, writing quality, and speed is still not improved. Therefore, the convergence theory can be appropriately applied to teaching English writing, so that students understand the important role of convergence, to help students grasp the overall structure of the article in the chapter so

that students realize that writing articles is to use various means and techniques to organize the language generated organic whole, and guide students to the most common method applied to the lexical cohesion in English writing, when students understand the pure English chapter is how to use various means to generate the development of convergence, the teacher can be applied to further inspire students in the English writing mimic the interface between the use of certain means to make the article more prominent theme, fluent and smooth.

5.5 Conclusions

In this paper, as U.S. President George W. Bush's "inaugural speech" for example, to bridge the theory-based, focused on the theory of non-structural convergence is important in the practical application value. Through my school proved in recent years, the application of convergence theory for English teaching on the one hand may stimulate interest in reading and writing students, improve student writing skills in English reading, thus contributing to the improvement of English language proficiency, language learning mindset change; the other hand, university teachers, teaching methods and means of providing a useful reference guide has a distinct meaning; same time, the application of convergence theory can help educators of language features, and then discuss the nature of language and generating mechanism.

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Chapter 6
Research on Practicing Teaching of University Students' Political and Ideological Education

Jin Rui Zhao and Xin Ying Zhao

Abstract There are a lot of problems in practicing teaching of political and ideological education in university. It is short of continuity on time, standardability on organization, pragmaticality on implement. So practicing teaching reformation should take efforts to increase practicing methods. It should know information from society and anxiety from students, build the practicing teaching base, combine the practicing teaching resource from on and off campus, develop the positive effect on the practicing teaching base. To promote the practicing teaching activity, we should enhance acquaintance security, management security, organization security and so on.

Keywords Political · Education · Practicing teaching reformation

6.1 Introduction

Nowadays we are facing the most important period of social structure's transformation, with the advanced information transportation technique, different kinds of culture, social problems from the world fiercely shock the college student's heart. They are doubt about how to explain and solve the problem. So our political

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and ideological education faces the new situation, problem and challenge, and we need our students to touch, recognize, know and experience the society. From this, the students can put academic points into practice. They can adapt to the society more easily. Because of this, our central government enacts policies to change the situation. Such as "On further strengthening and improving ideological and political education opinion" and "On further strengthening and improving the college ideological and political theory course opinion" [1].

6.2 Problems in Political and Ideological Education on Today's University

At present, different universities have done different degrees of research and experiments which are very meaningful, they have accumulated precious experience. But on the whole, political and ideological education on today's university has not formed a common and effective mode. It also has some problems: it is short of continuity on time, standard ability on organization, grammaticality on implement.

Be short of continuity on time [2]. Practicing teaching of political and ideological education in many universities is not a necessary part of teaching section, so it does not continue frequently. It is influenced by teacher, leader, and money and so on. Social practice is not actually planed, it is partly at will.

Be short of standard ability on organization. Practicing teaching of political and ideological education always take class outside school, so it is difficult than normal class. It should deals with many factors, just like teachers, students, money, and trainers and so on; it is a long run not a temporary matter, so we should take a rigorous plan. But many universities always demand and require. They do not have a feasible plan.

Be short of grammaticality on implement. Many universities ask students to take social practices on vacation. But they do not know how to make sure the main theme, choose the appropriate way, and write the report and other requirements of social practices. So it leads to the short of grammaticality on implement.

All the situations approves, nowadays we should research and strength the meaning of practicing teaching of political and ideological education.

6.3 Researches in Practicing Teaching of University Students' Political and Ideological Education

We should combine in and out of class and change the single teaching method. We can talk about hot spots of society with students, and initiate the students' thoughts and debates. From this, the students can strong their responsibility with society and

ability of analysis and solve problems. Students would like to take part in the social practice.

Make good use of resource and put it into practice teaching on campus [3]. Practice teaching on campus is mainly at school, according to the content of theory, take good use of all kinds of resource of practicing teaching, as follows:

At first, talk about feelings through watching movies. For examples, watching Chairman Mao's movies can make students know more about Mao and our party's character. After watching it, ask students write more than 1000 words passage.

Second, read some original books and communicate in groups. The teacher provide to students "Zedong Mao's Anthology", "Xiaoping Deng's Selected Works", "Zemin Jiang's Selected Works", "Textbook of Scientific Outlook on Development" and require students to select at least three papers carefully read and write an essay. The students of class can have mutual communication, elect representative, no repeat articles, and make a censor speech in class. As students illustrate the principle contents themselves, they strengthens the content of grasping, deepened understand the theory. Thus, it can not only develop student's vision, improve students' interest, and theoretical cultivation of students' ability to think independently, but also may strengthen students' ability of self-study, comprehension, and comprehensive ability [4].

Third, developing subject education activities. Practical teaching is often limited by funds, vehicles, safety factors so it cannot be put into effect on large area. So we can invite experts related to this course, scholars and off-campus model worker, successful people (including distinguished alumni), spiritual civilization construction advanced collective or advanced individual, local government officials from do project report, etc., to communicate with students. Such can improve students' social identity, enrich the teaching content, and encouraging them to experience in the era of knowledge economy, enhance the importance of assiduous study of urgency and social responsibility.

Fourth, developing student society activities actively combine the ideological and political theory courses extends to student associations. Such as establish "Deng xiaoping theory" and "the important thought of three represents" research, cultivate a group of students learning theory, promote the backbone of entire school student theoretical study, established the "youth volunteer association" "work-study association" education committee and "self societies", lets the student contact the society, raises the student the idea of serving the people.

Fifth, organization campus cultural practice activity. Campus practice contents and campus culture activity is connected, it asks students in accordance with the requirements of teachers, and actively participate in the social activity or campus large-scale activity, that participate in the activities must be studied and theoretical knowledge related content, request write activity of summary report. Including activity process records, activity report, and activities in the process of thoughts and conclude the activity result. Such as taking the large academic seminar of experience, social debates, etc. Combine the ideological and political theory course teaching, determining the appropriate theme, hosting adapt to the curriculum content requirements essay contest, debate, toastmasters, film and TV

commentary, the moot court and other activities, and broaden and deepen teaching content. These activities can not only satisfy the requirements of the development of student's individuation, and still can mobilize students' learning theory of interest, give full play to the role of ideological and political education.

Sixth, actively developing Internet-based ideological and political education activities [5]. Make full use of campus network platform, especially relying on thought politics theory class teacher department website for positions; actively develop the Internet-based ideological and political education activities. In the online campus BBS "open" politics "concern" column, lets the student independently choose interested in BBS on issues, yet, free talk and teacher can also give correct guidance and evaluation, and guide to help students in learning discussion after comparison choice, and gradually establish a correct world outlook, the outlook on life and values.

6.4 Actively Developing Off-Campus Practice Teaching Activities

Go out for social practice to student's influence is direct and vivid. "Come on the paper end sleep shallow; absolutely know this matter to on acts". On-the-spot visit, research to give students the impression that more profound, the thought of touches bigger, education effect is more ideal. We can not use time, funds, traffic, and security for the practice teaching form confined to classroom practice, watch video. Of course, in the current real condition, large-scale organization students out social practice do have some difficulty, but we should pay more attention to social practice research, go out to social practice, other practical form mutual coordination practical model transformation, for real ascension of ideological and political theory of practice teaching effect and diligently.

First, established stable long-term practical teaching bases. The campus practice teaching and the social practice, compared the enthusiasm of students, the latter is higher. Practical teaching base of choosing, should has certain representative ness and typicality, such as revolutionary historical events occurred and historical characters of activities, these places of historic significance and commemorative meaning, recognized by the people of the whole country. Select this base, rich in content and the representative of strong, have typical significance, the students education function can receive the good result. Therefore, school departments should be active in contact with local relevant units, strengthen cooperation, to establish long-term stability of ideological and political theory course, establish perfect practical teaching base network. Especially must take use of local advantages in resources, organize the students to school education significance of nearby places to visit and broaden students' view, rich ideological and political theory course teaching contents.

Second, organization holiday social practice activity effectively. Summer social practice activity are college students deeply society, goes down to the basic unit,

comprehending the custom of important channel, and also one of college students to study the theory knowledge relation actual social reality, growth of talent important ways. Outside social practice, its available plenty time, flexible, practical rich resources, and the requirements of the organization weak funding low, students full-staff-oriented participation is strong, examination easily, facilitate insist for a long time, should be the teaching theory, the main way of social practice activity. College students' holiday especially summer vacation time is longer, to the thought politics theory class teaching practice provides plenty of time, and it is the most economical practical teaching mode, thus holiday social practice activity should also be thought politics theory class teaching practice is an important link.

6.5 Safeguard Measures for Political and Ideological Practical Education

6.5.1 Ensure of Cognition

To solve the problem of ideology for political and ideological practical education, we should pay attention the high status of political and ideological practical education in education. It is a part of the political and ideological education just the same as the teaching of theory and we cannot divide them into two parts because theory education is the theoretic basis of practical education. They both rely on Marxist philosophy principle and sever for it finally. Only realize the importance of political and ideological practical education radically can we change the actuality of the short of practical education in many universities.

6.5.2 Ensure of Administration

We must strengthen the standard ability of political and ideological practical education. Political and ideological practical education is not only a necessary part of political and ideological education but also the stretching in teaching room of political and ideological education. It consists of many different related parts, so we must consummate the administration of its all teaches and make a standard principle for the education of practical education. It is necessary to implement regular teaching administration. As for college teaching, it is formulated that practical education should possess a number of proportions which is the expression of abundant cognition in education section for political and ideological practical education. Actually, however, in many universities, these class hours are not well used, and some even delete these class hours and no practical operation available. So we need a standard principle to standardize administration.

6.5.3 Ensure of Organization

It necessary to strengthen the organization word for political and ideological practical education. It is a kind of new work and is in the condition of trying and initial operation model. In practical operation, practical education model needs certain ensure of funds and a team of experienced conductive teachers, most important is a right period of time to make the whole plan reasonable. All of these call for not only the efforts of education section but also the help of schools'.

6.6 Summary

In a word, the teachers of political and ideological education should be good at having the aid of advantageous social environment and take good advantage of them, take active movements to activate all kinds of teaching resource to serve for practical education. What's more, we should optimize diffident kinds of social resource which is the guarantee for promoting optimum practical education.

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Chapter 7
Reformation of University Students' Political and Ideological Courses

Jin Rui Zhao and Hui Jian Liang

Abstract There are many measures we should take to reform university students' political and ideological courses such as widen the multi-media teaching, enrich the teaching content, strengthen key points of teaching, combine diffident kinds of views to face up to the problems and contradictions in our real life. By facing to answer but not to avoid these problems, we will build the necessary ideology and enrich teaching content by latest theory. Moreover, making connections among national conditions, patriotism, collectivity, and different related courses can build the proper comprehension and attitude toward this lesson. Then, one text of diffident forms will check the students' acceptance ability and the consequence of teaching. Above all, the reformation of a combination of different education form helps express the main position of university students' political and ideological courses.

Keywords Political · Education · Teaching reformation

7.1 Introduction

The influence that political and ideological courses have on university students can not be underestimated [1]. University students fight out of the tense college entrance examination and come to a new world. The course which influences their

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values of life first is political and ideological courses. How to take this precious chance, use the proletariat's value of world guide the students and lead them to the road of construction of Chinese modern socialism becomes the aim of political teaching. So an embedded reformation is necessary which combines students and the theory, moreover, much attention should be laid on the student's acceptability, to make teaching actively.

7.2 Widen the Multi-media Teaching

Multi-media teaching represent the directions of modern education which combine words, pictures, sounds, animation, and movie [2]. Especially the movies can help teach lively, making classes infect the students as they had experienced themselves.

Teachers should participate in Multi-media teaching to master process of Multi-media teaching. They can increase vigor for collection of material and update the structure for knowledge. Multi-media teaching can really work well when utilized properly.

7.3 Enrich the Teaching Content and Strengthen Key Points of Teaching

The teaching material of political and ideological courses is very abundant. It is not easy for the teachers to find the appropriate material. As a result, the teachers of political and ideological courses should do lots of logical researches, discuss the problems on face, and solve them by Marxist philosophy principle reasonably. As there is unchangeable relations in China between the history of revolution and the modern times of construction and political and ideological courses lay in answering the questions about reality, we must contribute to the society according to the speech of Zemin Jiang in the Sixteenth Conference of China, learning the ideology of "The three representative" and "New San Jin" is also very important to show the importance of the ideology of the proletariat [3]. Measures below should be done.

Only recognize the topographical features both in our country and foreign country can be build pertinence in our teaching. As times went by, our life became more and more prosperous and our country became more and more developed. It is the Chinese Communist Party who brings this kind of life to us and two giant named Zedong Mao, Xiaoping Deng lead us to the road of prosper. The teaching of political and ideological courses is to tell us these real achievements in theory, proving the truth of the theory of Zedong Mao and Xiaoping Deng. Concerning internationality, it is the rapid development that causes the fear of China among western countries especially America, aiming to block the development of China.

On one hand, it proves the right of Chinese choosing the road of development. On the other hand, it tells us we have to make efforts to realize the aim of piece and development. So we should make connection with the teaching of political and ideological courses and topographical features of the world follow the theory of Zedong Mao and Xiaoping Deng to make contributions to our world.

Then we must face up to the problems and contradictions in our life and try to solve them directly instead of avoiding correctly according to the theory of Zedong Mao and Xiaoping Deng. For example, the problem of corruption, we should not only admit its existence but realize it is not the inevitable phenomenon of the society as the theory of Zedong Mao and Xiaoping Deng says. Instead it results from many complex social reasons and need to be consummated.

Moreover, indispensable ideology for political and ideological courses should be built. Every time we talk about how to inculcate Marxism to students, it is a matter of rigid teaching and even a deny of teaching. It is a kind of misunderstanding in fact, as Marxism is the original crystallization of human's ideology. Leni came up with the right attitude toward inculcate Marxism to students; it is an important task of the proletariat's party but not a rigid teaching way. So we must keep the way of teaching in class taking advantage of teacher's dominant impact.

Concerning about how to inculcate and how to inculcate effectively, it is pivotal to us, which calls for the teachers to attempt new methods and new mentality to improve effect for every class. Keep away from making too many debates during class which leads to the opposite road of teaching effectively. Of course we'd better lay more emphasis on the way of teaching, making classes full of interest helps a lot to inculcate Marxism to students actually.

Third is about the form of practice teaching outside such as visit, volunteer action [4], and social investigation and so on.

(1) Visiting and investigation. According to the theory of teaching content arrangement, organization students outside the campus, visit the revolutionary tradition education and patriotism education base, such as visiting great native place, the revolutionary relics, memorial and martyr cemetery, and other important historical memorials. For example the 1911 revolution in Shaanxi was the earliest response watching uprising of two provinces is one of the world-famous Sian incident occurred, but also the Chinese communist party leadership in the anti-Japanese national revolutionary war to victory bedrock. Yanan, enjoy an excellent reputation as a revolutionary sanctuary Yanan was located by the CPC central committee, Chinese people's struggle for liberation ZongHouFang. The Chinese revolution is starts here, from victory to victory. These are Shaanxi unique scarce resources, will constitute the for undergraduate education of national conditions good practice base. Xian offices of the eighth route army, Bei Lin, history museum, Li Quan xian yang museum, YuanGuCun, etc. are college students to practice teaching of good base. Also can further the red flag canal and other neighboring provinces of resources as the education of college students practice base. Inspects mines, shopping malls, companies, rural, understand since reform and opening in China in

various aspects of profound changes occur. Visit as of classroom teaching, the students with intuitive corroborated purpose, back to write about it and investigation report, but also to other students in the class feelings and experience, achieves the preaching of spots and face.

(2) Volunteer action. Encourages students to participate in social activities, make full use of community resources, and participate in public welfare work. If the Franco Prussian propaganda, anti-drug publicity, environmental awareness and sympathy for the disabled, poor old man, to offer the compassion activity, attend legal consultation, etc., make the students get real exercise activities.

(3) Social investigation. By having students witnessed, hands-on, achieve understanding, strengthen memory, and consciously practice purposes. Make students learn in books learnt something, see the gap of reality, recognize yourself.

Fourth, build an effective evaluation mechanism.

Effective evaluation mechanism is the ideological and political theory course implementation of practice teaching is an important condition. Ideological and political theory course teaching practice, and emphasize is effectiveness evaluation a student in ideological and political theory course teaching, benefit degree, the simple text report is hard as fair and reasonable judgment basis. To combine the advanced practical and formulate feasible evaluation system, namely, objective and fair, arouse teachers and students' initiative, enthusiasm, and convenient for operation, really play to the thought politics theory class practice teaching goals inspection role. One is to put the practice teaching result according to certain score into universities thought politics theory class assessment, and with ripe conditions, gradually increasing practical teaching evaluation score, and to improve students' attention. Assessment should not only lays emphasis on the process of the students in the practice process 'behavior, such as students' moral cultivation, teamwork, innovation, integrated ability; etc. But we must take the students solve problem conclusion. Teachers according to the requirements of the earnest investigation report, comments selection was awarded outstanding person to give the reward, and combining with teaching practice conducting class discussion, broaden students' view, initiates student deep thinking. Teachers should prompt summary, with the right theory viewpoint and method of thinking question guiding student, achieve make students correct recognition and understanding of the social purposes.

Finally, we can enrich the material of class by the theory of The Three Represents by Zemin Jiang. The Three Represents is not only the requirement of The Party in the new time, but it is also to summarize about the history. It is the combination of Marxism-Leninism and our country that represents Chinese majority people's basic benefit and leads us to the road of harmony. As a result, lying stress on The Three Represents by Zemin Jiang actually and culturally can strengthen students' comprehension and acceptance of the teaching achievements about the Party.

7.4 Strengthen Key Points of Teaching, Combine Diffident Kinds of Views

7.4.1 Make Connections Among National Conditions, Patriotism, and Collectivity

During the practice education of political and ideological courses, we not only learns the national conditions of China culturally which expresses the great patriotism in the country, but we also knows the national conditions of China naturally which tells us it is certain for China to has its unique revolutionary feature. The national conditions of China decide the way of revolution differs from Russia and the way of development only can center on the economic construction, resist on sustainable development strategy, the four cardinal principles, and development of the west regions. Only promote the spirit of patriotism collectivity fight for our country can China develop vigorously nation gain self-improvement.

7.4.2 Combine Collectivity and Different Related Courses

Nowadays, the relationship between collectivity and different related courses is becoming closer which calls for the teachers to know other related courses like politics, administration, sociology, management, psychology, and so on. Only then can teachers arouse student's interests and widen their horizon by new train of thought. For example, using political mobilizing to express Chinese choosing right road of revolution, showing the path of sum revolution road by administration, and taking management as an example to explain about the primary phase of socialism which leads to deeper comprehension.

7.4.3 One Text of Diffident Forms to Check the Students' Acceptance

The aim of text is not itself, but it's the direct stick of education. To improve students' synthesized quality, we take many measures like writing what one has learned from work, reading notes, dissected thesis and social reports in order to make comprehensive measure for students, reflect their grasp level, and the consequence of teaching actually.

7.5 Conclusions

In brief, the affect of political and ideological courses to students can not be neglected. Improving the quality of teaching and consummate the way of teaching continuously can help improve Marxism level among students, strengthen students' analysis ability, and foster large quantities of talents for the construction of Chinese socialism. At the same time, we need the help of the whole society to make the teaching of political and ideological courses a perfect education model.

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Chapter 8
Building of E-Commerce Trading Platform Based on Web Data Mining

Ruihui Mu

Abstract Web Data Mining is the application of data mining technology in the Web environment collections, and potentially useful patterns or information found in the relevant data to browse the site from a large number of Web documents. E-commerce is becoming increasingly important in modern business activities, business data processing, highlighting the importance of data mining. This article discusses the main methods of Web data mining in detail and the function and application of data mining techniques in e-commerce trading platform. Web Usage mining excavation left in the server-side access records when the user accesses the Web. The paper presents the building of e-commerce trading platform based on Web data mining.

Keywords E-commerce · Data mining · Trading platform · Web mining

8.1 Introduction

With the widespread rapid development of the Internet, online shopping habits have formed. B2C e-commerce website has become the business of choice for network marketing model. It has become the "site + company + logistics + sale" of trend of shopping mode. The network-based trading platform interacts and exchanges at this stage to provide customers with better service

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delivery model and interaction. There has been a vertical network service model as the online shopping market segmentation is vertical [1].

Vertical network service models provide customers with more comprehensive and accurate service, website shopping guide, shopping, search, online shopping community, site rebates, and discount on network model website. At the same time, along with the rise in the online community and social networking service (SNS), it is making consumers more recognizable on the network service model. Today, online shopping and WEB2.0 combine community-based service model into the B2C, and has become the mainstream online trading platform.

For these reasons, the "personalized" business marketing site has grown. Based on personalized content for users the recommended service is of utmost importance because it can change the "popular" way to provide users with personalized information [2].

For the development of a collaborative e-commerce trading platform for large and medium-sized enterprises, the platform has catalog procurement, tender inquiry, vendor management, and other functions, taking into account system integration and other related e-commerce platform and joint procurement purposes. This paper first introduces the characteristics of collaborative e-commerce transaction platform at home and abroad and is currently the more popular support technology. Platform functional model, the establishment of platform architecture and software architecture, and a detailed discussion is related to each module. The paper presents the building of e-commerce trading platform based on Web data mining.

8.2 Web Data Mining in E-Commerce

Web Data Mining is the application of data mining technology in the Web environment, collections, and potentially useful patterns of information found in the relevant data to browse the site from a large number of Web documents.

Although in the form of Web mining and research emerging, with the emergence of electronic commerce and the rapid development of Web mining is an important application in the direction of e-commerce systems [3]. One of the most closely related to e-commerce relationships is Web Usage Mining, as shown by Eq. 8.1.

$$\overline{\bigcup_{j=-\infty}^{\infty} V_j} = L^2(R), \quad \bigcap_{j=-\infty}^{\infty} V_j = \{0\} \tag{8.1}$$

On the Web can be used data mining and analysis of many data many types. The following types of data can be used for Web data mining technology to produce a variety of knowledge models. Query data is a typical data generated by e-commerce sites on the server. For example, the online customer may search for products or advertising information, query information through cookies or registration information to connect to the server's access log. Such online market data is

a traditional relational database to store the e-commerce site information, user purchase information, product information and other data, as shown by Eq. 8.2 [4].

$$\int_{-\infty}^{\infty} \frac{\left|\hat{\psi}(\omega)\right|^2}{\omega} d\omega < \infty \tag{8.2}$$

The knowledge models are as follows: the use of Web data mining technology can be excavated on the site path analysis, discovery of association rules, sequential pattern discovery, discovery of classification rules, and clustering analysis. Web Data Mining in e-commerce applications are as follows: 1. Identify potential customers, users on the site browsing behavior to reflect the user's interest and purchase intent. For an e-commerce site, understand concern volumes. The customer base is very important, but many visitors found that the potential customer base is also very critical. If you find that some customers as a potential customer base for such customers are in order to the implementation of certain strategies to enable them to become a registered customer group [5]. This means the increase in the number of orders for an e-commerce site may increase effectively, as shown by Eq. 8.3.

$$\varphi(t) \in V_j \Leftrightarrow \varphi(t - 2^j k) \in V_j, \quad \forall k \in Z \tag{8.3}$$

To provide quality personalized service, increase customer loyalty and the space between traditional customers and vendors in e-commerce, distance to customers who have ceased to exist, the customer converted from e-commerce sites to competitors over there, with only a few clicks of the mouse. The site's content and level, words, title, reward programs, services, and any one place are likely to attract customers, but also may become factors of losing customers. Mining customers to access information are able to know the customer's browsing behavior in order to identify a user's loyalty, preferences, satisfaction, understanding of customer interest, and demand to dynamically adjust the Web page in order to meet customer needs. A typical sequence in the e-commerce on the Internet, just on behalf of a shopping page is in the form of navigation on the site, so we can use the sequence pattern discovery in data mining techniques to carry out excavation., as shown by Eq. 8.4.

$$\begin{aligned} V_j &= V_{j-1} \oplus W_{j-1} \\ &= V_{j-2} \oplus W_{j-2} \oplus W_{j-1} \\ &\cdots \\ &= V_0 \oplus W_0 \oplus W_1 \oplus \ldots \oplus W_{j-2} \oplus W_{j-1} \end{aligned} \tag{8.4}$$

To improve the site design of Web site link structure optimization, three dimensions are to be considered: (1) through mining of Web Log find the user to access the page, thus adding links between pages of close contact, user use (2) the use of path analysis to determine the most frequent access path in a Web site can be considered an important product information on these pages, improved page

design and site structure, and enhance the attractiveness to customers, improve sales. (3) Web Log mining to find the location of the user's expectations [6]. If the access frequency is higher than the actual location of the access frequency the desired position can be considered in the desired position and actual position of the navigation links on the Web site structure optimization, as shown by Eq. 8.5.

$$f(t) = f_L(t) + w_L(t) + \cdots + w_{M-2}(t) + w_{M-1}(t) = f_L(t) + \sum_{l=L}^{M-1} w_l \tag{8.5}$$

Use of Web data mining technology to tap the e-commerce sites on the various data sources found that some of the knowledge models can guide companies to better operate the site and to provide better personalized service to effectively improve the business site competitiveness.

Cluster client, many companies are on the enterprise customer, market, sales, service and support information at a deep level excavations and analysis, customer value, classification, and the discovery of new market opportunities, increase revenues and profits. In e-commerce, customer clustering is an important aspect [7]. By grouping similar to the browsing behavior of customers and analyze the common features of the group of customers, e-commerce can help the organizers to better understand their customers, timely adjustment of the pages and page content to the business activities to a certain extent, to meet customer requirements to provide customers with more suitable, more customer-oriented service, to make business activities more meaningful for customers and vendors, as shown by Eq. 8.6.

$$W_f(a,b) = \frac{1}{\sqrt{|a|}} \int_{-\infty}^{\infty} f(x) \overline{\psi\left(\frac{x-b}{a}\right)} dx \tag{8.6}$$

Users frequently access paths many times in a period of time browsing the continuous page sequence, which best reflects the user's browsing interest in this period. Therefore, the mining of user frequent access path for understanding the user's current interest, to provide users with personalized service has a very important significance. Frequent access path mining algorithm input data for the results of the transaction identification: the set of users of MFP. The output is collection of the frequent user access paths and the corresponding support. Conclusion accordingly, it is the user's interest model, the relevant definitions and concepts.

8.3 Building of E-Commerce Trading Platform

The definition of four candidate paths: If two consecutive k-1 long sub-path {xj, … xj k-2} and {xj… xj k-1} are elements of FPK-1, that is, their degree of support not less than Pk-1_.m. Support, then {xj… xj k-1} for FKk of candidate paths.

Such as session S contains two MFPs: {a, b, c, d, e} and {f, g}, the path of a candidate looking for FP3 needs to consider three sub-paths {a, b, c} {b, and c, d} {c, d, e}, {a, b} {b, c} is namely FP2 frequent access path, then {a, b, c} is a FP3 candidate path. Frequent access path mining algorithm, mining length k, frequent access path is to try to construct FPk. The main idea of the algorithm is based on the concept of candidate paths from the MFP to identify the length of k candidate paths {xj, … xj k-1}, and then calculate its degree of support in all sessions of the user. Support of collection of the maximum M-path is FKk_m [8].

The E-commerce services industry applies information technology and economic development needs, based on an important leading role in the emerging industry for social global and sustainable development. Chinese e-commerce is in a period of rapid development. To strengthen the construction of e-commerce standardization is of great significance for the promotion of economic growth pattern and sound and rapid economic development, as given by Eq. 8.7.

$$\psi_{a,\,b}(t) = \frac{1}{\sqrt{|a|}}\psi\left(\frac{t-a}{b}\right) \tag{8.7}$$

The E-commerce trading platform plays a decisive role in the development of the e-commerce services industry. The transaction platform not only communicates with buyers and sellers on online trading channels,with a significant reduction in transaction costs, but also opens up a new field of e-commerce services sector. Strengthening e-commerce transaction platform service specification for the maintenance of the order of e-commerce transactions, and to promote the healthy development of e-commerce has a very important role, as given by Eq. 8.8.

$$W_{2j}f(n) = 2^{-j/2}\int_{-\infty}^{\infty} f(x)\overline{\psi(2^{-j}x-k)}dx \tag{8.8}$$

Platform operators deal with transactions on its platform of reasonable care management: (1) engaged in business activities on the platform, should be publicized operated products made of license, certification and product names, producers, and other information, (2 product information) displayed on the website must be true. Physical (tangible) goods shall be demonstrated from the multi-angle multifaceted, non-display product color, size, proportion, distorted or wrong; defective goods should be given adequate explanation by the pictures shown. It was found that the station operators advertising in violation of laws, regulations, promptly take measures to stop you can stop, if necessary, to provide online trading platform services.

When the user and e-commerce businesses fully enjoy quick and easy e-commerce, they also face some new problems. On the one hand, users face an array of many commodities available on the website; they are only interested in part of the goods. For users to achieve the purchase, it is necessary to browse numerous pages and commodity classifications to find the goods they need; on the other hand, the problems of businesses is that many users do not know the interests and requirements

of the goods [9]. Therefore, e-commerce businesses cannot promptly adjust the site's page structure which is available to all users on the same interface. The lack of personalized service has become the key issue constraining the development of e-commerce. The Web-based data mining technology for the e-commerce recommendation system provides an effective solution.

8.4 Building of E-Commerce Trading Platform Based on Web Data Mining

Web Data Mining data sources: The Web page content on the page of text, images, video and audio information, the user click on browse data records generated by these information. The Web link structure mainly refers to the various pages between link structure. Users access Web sites and interact with a lot of links on Web pages which bring convenience to customers browsing the site. Web log files, mainly refer to the Web server logs and proxy server logs that extract secondary data.

With the development of electronic commerce, many companies have established their own e-commerce sites. Every day a different customer or customers frequently visit this e-commerce website and produce large amounts of Web data, while this e-commerce site could generate hundreds of millions of transactions every day, generating a large number of log files and registration forms, etc. Businesses are submerged in a lot of information for the customer to spend a lot of time to search and browse information of interest [10].

To provide customers with an intelligent search engine, application of Web data mining technology, development of intelligent product search engine, based on customer interest in preference to expand the customer enter your search keywords to make the search results more close to the customer the desired results, or you can browse information based on customer history analysis of customer interest in the use of intelligent product search engine, to improve the quality of search results. This can greatly reduce the time cost of the customer search, the spirit of the costs, and physical costs, thereby increasing the satisfaction of the customer of the e-commerce site, as shown by Eq. 8.9.

$$P_{j-1}f = P_j f + Q_j f = \sum_k c_k^j \varphi_{jk} + \sum_k d_k^j \psi_{jk} \tag{8.9}$$

Mining CRM data in a more customer-centric, Web data mining techniques on data stored in the CRM system, you can analyze customer behavior, needs and transactions, but also can analyze the customer's response to the corporate marketing, and service to enable enterprises and customers for effective communication, coordination and cooperation, so that e-commerce businesses to be more customer-centric, so as to provide customers with better service [11].

Web services to provide customers with optimized use of Web data mining technology to analyze customer access to information and access mode, the

performance and structure of the site redesign, reflecting the interests of the customer, so that customers feel is in their own way visit the site, but also can enhance the customer on the site of visual satisfaction, as is shown by Eq. 8.10.

$$H_{1,L}(f) = 2\sin^{L}(\pi f)\sum_{l=0}^{L/2-1}\binom{L/2-1+l}{l}\cos^{2l}(\pi f) \tag{8.10}$$

To provide customers with personalized product recommendation service, personalized product recommendation service is to provide customers with their interest, but not their direct search to find the product. Web data mining techniques can browse the search for product information to the customer data mining, development of personalized product recommendation services, mainly through two phases: first access based on historical records, as well as users' personal information, user clustering and classification, frequent access path analysis, and then use the recommended method, by digging into the customer's personalized information, the user access mode requirements, and requests a page combined with the similarity of the user base access to forecasts and commodity recommended. This personalized product recommendation service can be well verified [12].

In this paper, the Web server log file data processing and analysis, the use of data mining methods from the user's frequent access path to understand the characteristics and habits of the user's shopping, so as to achieve the purpose of the products recommended to each user. Web mining is a complex, but promising technology with wide applications in many areas for our study, as shown by Eq. 8.11.

$$W_{j,k} = \sum_{l=0}^{L_j-1} h_{j,l} X_{2^j(k+1)-l-1 \bmod N_j - 1} \tag{8.11}$$

In today's society, e-commerce is no longer a stranger. Everyday, a lot of people visit many websites to conduct their own e-commerce transactions and access, browse, and trade in e-commerce businesses. At the same time they are updated on product information. The online Web produces a lot of data; the network is filled with these data, with e-commerce businesses, and with customers. Only from the valuable massive data mining information can companies provide better services in order to attract and retain customers, and improve their effectiveness.

This paper presents the building of an e-commerce trading platform based on Web data mining. Data mining refers to established business objectives of enterprises. A large number of enterprise data exploration and analyses reveal the hidden, unknown or verifiable data for purposes of regularity and for further modeling of advanced and effective methods. E-commerce is the inevitable result of development of modern information technology, but also an inevitable choice for the mode of commercial operation. Increasingly, with huge amount of corporate data, the real value there is little information, using data mining technology from the large amounts of data through in-depth analysis, which is conducive to business operations, improves

competitiveness of information, gives unique advantages to the enterprise, and promotes management and technological innovation.

8.5 Conclusions

This paper presents the building of an e-commerce trading platform based on Web data mining. E-commerce is carried out using Electronic Data Interchange (EDI), e-mail, electronic funds transfer (EFT) and Internet technology in personal, corporate, and paperless exchange of information between countries, including product information, ordering information, financial information and payment information, security, and authentication information. The ultimate goal is the business activities of the network, automation, and intelligent. E-commerce becoming increasingly important in modern business activities, business data processing, highlighting the importance of data mining. This article discusses the main methods of data mining in detail and the function and application of data mining techniques in the e-commerce trading platform.

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Chapter 9
Study on Professional Education in Liberal Arts Colleges

Ping-an Wang

Abstract In recent years, in order to bring up qualified military personnel, all the military academies promote the transformation of college education vigorously, transformation and construction of professional teaching have taken solid steps, training level and the quality of bringing up personnel have been promoting continuously. In recent days, the transformation of professional education has entered into critical period, various contradictions intervene with each other, and the task of transformation is still very difficult and important. In order to bring up military personnel who adapt to information war, we must face the appearing contradictions and issues carefully, and we should promote the deep development of professional education vigorously with forward-looking vision, developing perspectives, science initiatives, and strengthen the power of reform and information.

Keywords Military personnel · Professional education · College education

9.1 Introduction

Since 2003, all the military colleges have transformed from basing on academic education to professional education, the prototype of professional education has transformed, in the procedure of transformation, although we reach some inspiring achievement, there are also some problems which need to be solved [1, 2]. This

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article discusses some problems which need to be solved in liberal arts' professional education classes' gap development.

9.2 Numbers of People in Professional Education Classes

One important feature of professional education is to integrate closely with the actual needs of the workplace and improve the ability of students' operational control and taking office. Therefore, professional colleges must choose case study and discussions and other teaching methods [3, 4]. But if we want to make teaching methods achieve effective results with both appearance and spirit, we must adjust and compress the scale of professional education classes. First, it is beneficial to realize various teaching methods [5, 6]. According to the present teaching methods, every class of every time will have about 100 students, every topic will have 150 min, if every learner speak for a minute, the teacher's teaching time will be at most 50 min, while it is unrealistic to teach all the topic and make students master the whole material. Second, we can prevent from the appearance of students who are "in business" or "in holiday", we even have the phenomenon that many cadres in a division-level unites study in a same college [7]. There are many reasons of this case, but the main one is that the quota of people of cadre training is overfull. As to the army, if opportunities of cadre training are overfull, leaders will prevent some capable cadres from studying in colleges with various pretexts, they always think that the organization is very busy, and people are much needed; there are many opportunities for training in the future. As a result, people who want to get training cannot come and the idlers of the training get education instead of them, the important point is that these people do not participate actively in colleges or study vigorously; they go on holiday by the name of study. This not only causes the waste of educational material, but also makes the capable cadres loose the opportunities for further study.

9.3 Issues About Professional Educational Teaching Methods

In order to supply high qualified, very capable and sound proficient military talents for the army, we must reform the present teaching method. Although discussions and case study are advocated, as to the interaction of the class, learners are basically being taught, not participate actively. One of the reasons is that the theme belongs to new knowledge, and students never learn it before, thus they cannot answer the instructors' questions. The second reason is that learners never consider the instructors' questions carefully or look into materials, they are afraid of answering incorrectly, so they choose being silent. The third reason is that students' learning

initiative is not very high; they are not willing to answer the instructors' questions. In terms of this phenomenon, teachers can only force students to answer questions by reading the name list, this will not make atmosphere active, quality and effect of teaching is weakened largely.

Students like case study course, discussion course, and practice course instead of teaching course, the main reason is that in the former courses, they can express their own ideas, acquire other learners' analysis, and have opportunities of debating, while in the later class, they can only listen to the teaching of the instructors, as to practical experiences, they can only pursue by themselves. In order to change this embarrassing situation, we must transform the present teaching method. In order to mobilize the enthusiasm of the students' learning and make them participate in the whole teaching actively, we should make teaching and communication interact with each other, every topic divides into teaching, discussing, topic speaking, and other sections. The time of every morning is divided into two periods, one is teaching period, time is adjusted to 120 min (special courses are not included). The second one is discussing period, time is also 120 min, the discussion is appropriate in the next day or afterwards. In discussion, teachers should base on the last course's questions mainly, speaking should be individual or team as a unit, instructors should organize students have deep discussion combined with forces. To be specific, in teaching period, instructors introduce the general knowledge of the topic, research results, and developing trend and so on. As to the division of the relative contents, we should sum up various topics' actual situation and cannot have interference forcedly. That is to say, to some topics, principles are the focuses, to other topics, research results are the focuses, to some other topics, and further development should be the focus. The questions of every topic should integrate with the current situation of the army, they should be targeted, and teachers should make every student have individual ideas. In discussing period, instructors (professional instructors are not necessarily) lead the students to have discussion of the last course's questions. If the number of people in training class is overfull, the students should speak by team as a unit, each team competes with each other, and we choose the team which has distinguished ideas. As the topics of discussions are overfull, the entire members are required to make preparation carefully. In order to prevent individual students from meeting the job, the speaker of the team every time is chosen at a random. The reason of arranging discussing time in the next day or afterwards is that the new knowledge which is taught by the instructor is still staying in the student's brain, and instructors should give students rich time to prepare, they can search, sort out, analyze, and deal with various references, in this way, students can involve into the discussion and communication actively, the type of study changes from passive study to active study, students' study initiative is thus promoted. In topic discussion, the instructor is only the host who guide the student to discuss problems, as long as there are no issues related to the principle, no staying from the point, no personal attacks, students are allowed to develop freely, instructors cannot intervene forcedly but make comments, reward the active

speaker or the team which also has quick thinking, exclusive ideas, they correct the irregularities appropriately in order to make other topic discussion progress more soundly.

9.4 Issues About Professional Education Course Design

Professional education is the practical education which is based on training teachers' professional ability and its final object is to bring up military personnel who have high quality. Therefore, teaching system of professional system should be focused on the professional ability, constituting course structure according to the ability, choosing teaching contents carefully around ability training, forming innovative training method sticking to ability. At present, the course structure of professional education is generally the standard module structure system. The advantages are that teaching system is very stable, time is rich, teaching quality has been ensured, if the party, country, and army carry out new paths, measures, policies, and regulations and so on, learners will not understand and master them at first time. As a result, we must transform the present course system, and implement "menu" course system. The so-called "menu" course system means increasing the related topic anytime according to the trend of situation and demand of students; this applies to the feature and rules of the development of professional education. While it is unrealistic to take the method of "menu" teaching to all the topics in professional educational classes, although the current new topics stick closely to the current status and students' demand, the number of new topics is limited, the second reason is tight time, and in addition to that, restrictions about various elements cannot ensure the teaching method. Therefore, it is the opportunity to combine standardized module structure with "menu" topics. In order to implement this total new teaching method, we must do the next work well: one is that headquarters' regulations about professional courses' time should stick to the principles of rigor integrating with loose. That is to say, after headquarters determining the entire times of professional education, some individual necessary courses, the rest course time will be determined according to the specific situation of every college's professional educational class, what's more, the set of curriculum can adjust by individual colleges according to the party central committee's decision, the deployment of the central military commission, the developing trend of foreign military, and the time of training classes. The second point is that the set of every college's professional educational courses' topics should stick to the principle of flexibility. At present, every professional educational course's topics and amount of hours are all arranged before the register of the students, and there are no reservation hours, if people want to arrange new topics, students' individual studying time must be occupied. Therefore, the new teaching method requires that except from the low limit of the professional education's amount of fixed hours, the high limit is also needed, that is to say, some proportion of reservation is needed (for example: from 10 to 20 %, that's depending on the times of

professional education), and so as to setting up new topics according to the new demand. The third point is that the increased topics should stick to the principle of putting quality before quantity. Every year, our party, country, and military convene important meetings, in addition to that, the latest foreign developing trend—war theories, tactical strategies, talent training laws and regulations, and so on can all be introduced to the students. There is one point which needs to be noted, the entire "menu" course should be integrated closely with every professional educational time's guiding principles and training target, focusing on the large instead of the small, prevent from the unqualified setting up. In order to ensure teaching method, "menu" topics should fulfill most trainers' demand, a month after opening school, new topics and amount of numbers should be determined, and the preparing time should not be less than a month.

9.5 Issues About the Construction of the Team of Teachers in Professional Education

First, we should keep the door of "enter" carefully. In recent days, many instructors of all the military colleges take the office in the army, many officers in the army teach in the college, according to the situation from various aspects, there are quite a lot of advantages, but problems are not less. If we discuss the reason deeply, one is that instructors are required to see more, listen more, say less or no saying before taking office in the army, at this moment, they determine themselves as outsides, thus the gap between officers and soldiers is widened. The second is that instructors or officers teaching in colleges are mostly regarded as the guests who are stopping for a rest; they focus on life instead of work. The third is that instructors' posts mostly have the occupation without right; they have no speaking right and decision making right to most of the questions, even if they get some few opportunities to express their ideas, they have to appreciate quite a lot. As to the instructors coming to the colleges, they achieve little; teach a topic symbolically, while officers' work experiences in the army are rarely taught to the students. Unfortunately, some officers face the issue of changing jobs for they have no post when they return to the army. This phenomenon illustrates that when we study the foreign military, we must understand the deep spirit on the occasion of integrating with our military's actual situation, regulate the related regulations instead of copying directly. As to the current problems, except from making related regulations perfect, we should make relative adjustment about the time of taking the office. Anyone who comes to a new organization, they should have longer time to understand and know new organizations and their related staffs well. Consequently, in order to ensure instructor and officer work carefully, their working time should be adjusted to 2 years, and their posts will be designated by headquarters' or the regions' for the reason that they issue the document. In 2 years' time, from understanding, knowing well to integrating and involving oneself into a member of

the army or the college and taking part in the decision finally. In the working time, all the relationships (except the file) are transferred into their short term organization, and they involve into the new organization actually, transfer the post, raise the post and their posts are not being influenced. Only in this way, can instructors understand the truth of the army, and acquire some practical experiences. At the same time, instructors can also learn the related principles and knowledge in colleges and direct the work in the army.

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Chapter 10
Reform of College Advertising Teaching

Ying Guo

Abstract The advertising industry has been one of China's most important industries for decades. Advertising higher education has offered a strong support on the development of the Chinese advertising industry through providing the qualified workforce needs. Through reviewing and analysis the brief history and current major changes of China's college advertising teaching, the research indicated that the China's college advertising teaching has. Reformed and developed responding to social and economic development needs; on the other hand, the relationship between college advertising teaching and advertising industry is interactive.

Keywords College advertising teaching · Reform · Curriculum

10.1 Introduction

The advertising industry, which is currently one of the most globalized industries in terms of production, distribution, and consumption, has played important role in the development of economy and society in China for decades [1]. The college advertising teaching, born in early 1980s, has laid a solid foundation for China's advertising manufacturing industry [2].

During the past two decades, China's college advertising teaching has experienced significant transformations to accommodate the development of society and economy [3]. In a new century, the fast increasing of higher education, the

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application of high technology,and China's increasing participation in global economy has speeded up the development of advertising industry and education of advertising majors in China [4]. However, the challenges of new society and problems of employability have been critical. Some of the problems have been predicted and identified by many researchers [5].

New challenges and problems have urged the further reform in college advertising teaching. One purpose of this chapter is to analyze the current changes in college advertising teaching during the past two decades [6]. Another purpose is to identify the new challenges and problems met in terms of globalization, mass higher education, and higher technological revolution, and to explore the areas emergent to reform. The paper was organized into the following three themes with regard to China's T&C higher education: brief history, reform and development, new challenges and further reform needed [7].

10.2 Reform and Development

Since the implementation of nationwide reform of higher education in late 1990s, the college advertising teaching has made significant development.

10.2.1 Advertising Specialty Adjustment

To solve problems that existed in former higher education such as meticulous division of majors and extremely narrowed specialty ranges [8], the new round of reservation of undergraduate specialty catalogue taken charge by the Ministry of Education, began in 1997, completed and issued in July of 1998, with the total number of specialties reduced from 504 to 249. In accordance to the adjustment of specialty adjustment, fashion/advertising design was transferred from a single structural specialty to a specialty orientation of the art design specialty, with clear guiding ideal to strengthen basic, dilute the professional, expand knowledge, and to train personnel with integrated high quality. The current advertising related programs, according to 1998 undergraduate discipline catalogue, are listed in Table 10.1. From Table 10.1, there are three advertising related area, which belong to three specialty, in current college advertising teaching system: fashion/advertising design and engineering, a specialty within category of light industry, awarded with bachelor degree of engineering or literature; fashion/advertising design, a specialty orientation of art design specialty, within category of arts; fashion performing and design/marketing, a specialty orientation of art design specialty, within category of arts.

Table 10.1 Current undergraduate specialties catalogs of advertising programs in China

Discipline categories	Categories	Specialties/ orientation
Engineering science	Light industry	Advertising design and engineering (note: bachelor degree of be engineering or literature can be awarded)
Literature	Arts	Art design (fashion design) Art design (fashion show fashion design)

10.2.2 Reform of Teaching Contents and Curriculum in Advertising Programs

During the periods 1980s and 1990s, that is, the early stage of development of college advertising teaching, as an emerging specialty, advertising programs have had problems of low qualification teachers, school education and industrial development out of line, irrational course structure, outdated teaching contents, and so on. At that time, students major in advertising design, who usually focused on creative design but neglected product design, were highly skilled in fashion drawing but quite weak in advertising technology; on the other hand, students major in advertising design and engineering, who usually focused on theoretical learning but neglected practice, were poor at practical ability, hardly to adapt to clothing industry rapidly. In response to these problems, higher education institutes with advertising programs launched reform of teaching in succession, and the situation was significant changed.

First, through in-service training, offering in-service degree education, selecting teachers to go aboard for advanced studies and carrying out cooperative research, the knowledge structural of teachers has been adjusted. Many young teachers with Ph.D and masters awarded by institution abroad or at home, have been replenished, and the degree structure of teachers has been improved.

Second, in the light of diversity training objectives, a new curriculum structure of "platform + module" have been adopted (see Fig. 10.1). The platform curriculum, which is designed in the light of discipline feature and common development needs of students, consists of public basic courses (namely general education courses), basic courses of curriculum consists of a set of module courses of specialty orientation, which is designed in the light of occupational characteristics and individual requirements of personnel training. For instance, according to 2010 curriculum at Zhejiang SCI-TECH University, four modules of specialty orientation, including men's wear design, shoe and bag design, knit wear design,

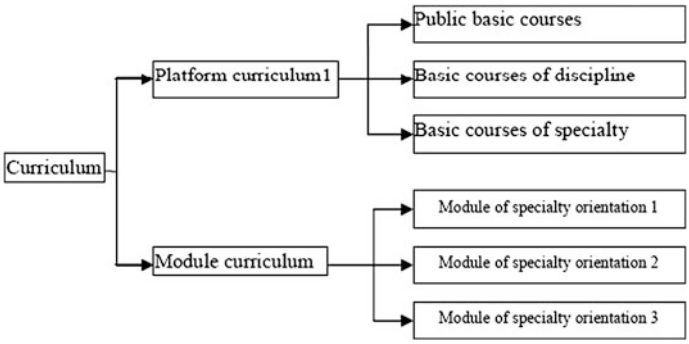

Fig. 10.1 Curriculum structure of "platform + module"

and high fashion design, are involved in art design (fashion design) specialty; on the other hand, three modules of specialty orientation, including advertising technology and management, fashion merchandising, and advertising international trade, are involved in advertising design and engineering specialty.

Third, through integrating new technology and new knowledge into curriculum, the relatively advanced teaching contents have been shaped. With rapid progress in information technology, the computer skills have been required for qualified personnel, and new courses concerned with computer-aided design. Manufacturing management has been involved in curriculum of advertising program. In recent years, China garment industry has shifted from traditional production-based to brand-based, which requires graduates to have some sense of the market and brand awareness. Adapting to this, fashion marketing and merchandizing courses were introduced to teaching area of advertising. By boosting combination of engineering, art design, economy and management, advertising program becomes multi interdisciplinary.

10.2.3 Development of International Cooperation and Exchanges

Since the accession to the WTO, China's increasing participation in global economy and world affairs has speeded up the globalization of clothing industry, which impact on the strong demand of local clothing professionals with international competitiveness for clothing industry, pushing the international cooperation, and exchanges of advertising higher education to become more and more active in China. Various forms of international cooperation and exchanges emerge, including: Educational institutions of international cooperation, for instance, Raffles design institute, Shanghai, which is an international design institute cooperated by Donghua University and Raffles design cooperation of Singapore; Educational projects of international cooperation, for instance, Donghua

University and Bunka Fashion College of Japan in cooperation with the fashion design project for undergraduate education, Zhejiang SCI-TECH University and New York State University Fashion Institute of Technology in cooperation with the fashion design project/advertising design and engineering project for undergraduate education; Other forms, such as 1 year or 2 year exchange project, international exchange course regularly taught by foreign professors, Overseas visits, and exchanges, etc.

In recent years, China fashion institute and department, focusing on training excellent local talent with international version, have learned and introduced international advanced education concepts and methods through international cooperation and exchanges, prompting the internationalization and development of college advertising teaching.

10.3 Current Challenge and Further Reform Needed

In response to the emergency of mass higher education, the influence of globalization, the advance of economic, and clothing industry, there are current challenges and problems that the restructured and transformed Chinese clothing higher education are striving to meet or overcome, which will be discussed below.

10.3.1 Challenges of Globalization

The process of globalization is making higher education more important than ever before, and the neglect of this sector seriously threatens development. Globalization exerts new pressures on college advertising teaching, making reform essential [9]. In the era of globalization, the college advertising teaching system should be adjusted to satisfy both the requirements of the global labor market and domestic social and economic needs. With globalization, the industry has more considerable impact on the global economy. Accordingly, advertising education should encourage comprehensive understanding of the global market as a site for production, sourcing, marketing, and consumption.

In a global environment and knowledge-based society, today's world requires problem-solving skills and flexibility to match the fast-changing world. College advertising teaching institutions must teach their students not only what is known now, but also how to keep their knowledge up to date. Accordingly, the creativity education accompanying with lifelong learning ideals should be focused instead of rote learning supported by memory.

Globalization makes opportunity for people to burrow out of the confines of their own institutions and link up with others to solve problems, through cross-institutional and cross-border networks. College advertising teaching systems should grab hold of the opportunities offered by global integration through further international cooperation and exchanges.

10.3.2 Challenges of Employability

The second major challenge comes from the development of mass higher education in China. Since 1999, China has expanded its higher education at a remarkable speed, the college enrollment of new students and number of students at school is more doubled than those in previous years. The same thing has happened in the sector of advertising majors, resulting in poorer levels of education among the students admitted. Increased numbers of students, a shortage of well-fitted professional teachers, the lack of teaching resources and inadequate instruction in larger classes are likely to bring about poor results, consequently affecting the competitiveness of graduates in the job market.

Since rapid progress in China's advertising industry, the scale of advertising industry, including number of employees, output value, and foreign exchange earned through export has been increased quickly resulting in strong demand of well-trained professional talent. However, the employability problem, which is attributed to a lack of labor market intelligence and knowledge gaps between higher education institutions/graduates and regional employers, has been a critical challenge for current advertising higher education. In terms of the problem of labor market matching, the advertising educator should keep in mind the mission of producing graduates who have the right skills and competencies to match employer needs and improve education quality through further comprehensive reform Challenge of information technology revolution.

The third major challenge comes from the development of information technology. In recent years, since the advertising industry is being revolutionized by information technology. The use of this technology exists in all phases of the soft goods chain- from design through production to distribution and retailing. Accordingly, colleges' education future advertising talents must prepare their graduates to work not only in a creative capacity, but also in a technologically sophisticated workplace.

Current computer use in advertising program in higher education is increasing. Students receive computer instruction through general education curricula and professional curricula. But the discrepancy exists between industry and the educational institutions that train students. In order to keep abreast with an increasingly computerized advertising industry, curriculum should be updated, shifting from traditional course to new course with further computer application, for instance, computer technology applications to advertising design, pattern making, marking and grading; computer-aided experimental learning for visual merchandising: using AutoCAD for retail store planning, layout, and design.

10.3.3 Curricula Updating and Diversification

In terms of globalization and employability, Curriculum reform is widely recognized as being necessary to ensure higher education institutions to produce graduates capable of participating and competing in the emerging global society.

The curricula uphold the mission foci through appropriate courses offerings that address segments of the textile-advertising-retail pipeline [10]. The current textile-advertising-retail pipeline is the long and complex global supply chain which encompasses all of the production activities of the textile-advertising complex as well as the functions of distribution and retail operations to the end users/consumers (Fig. 10.2). In light of strong demand of professionals with high quality in various segments of industry, the curriculum ought to encompass the segments of textile-advertising-retail, addressing the areas of advertising design, advertising production, fashion merchandising, business management and marketing. Table 10.2 lists the current advertising related programs in USA in accordance with the latest Classification of Instructional Programs (CIP 2000), which show the diversity of the programs encompassing segments of the entire advertising chain. According to statistics, the undergraduates who are enrolled in fashion merchandising are much more than in any other specialization within adverting design, moreover fashion merchandizing is the largest major at various institutes.

However, since for a long period, the china advertising industry have focused on manufacturing, corresponding, China's college advertising teaching emphasized the upper stream activities of the textile-advertising supply chain, such as advertising design and manufacturing, but neglected the downstream activities like marketing, retailing, and consumer research. According to four scholars' investigation, there is not a clear academic identity in regard to fashion merchandizing programs in China.

Therefore, fashion merchandizing major/specialty should be constructed and merchandizing, marketing, and global resourcing education should be strengthen,

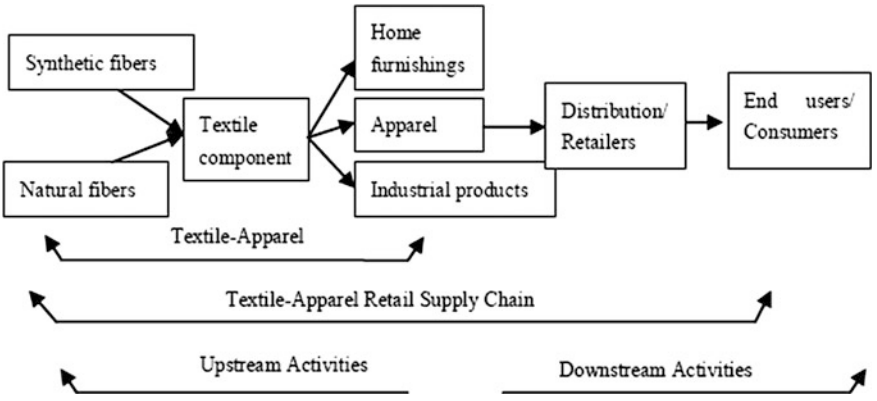

Fig. 10.2 Comprehensive textile-advertising-retail pipeline

Table 10.2 Current undergraduate specialty catalog of advertising programs in use

Discipline categories	Categories	Specialties/ orientation
Family and consumer sciences	Advertising	Advertising
Business, management, marketing, and related support services	Specialized sales, merchandizing and marketing operations	Fashion merchandizing
Visual and performing arts	Design and applied arts	Fashion/ advertising design

through introduction of fashion merchandizing curriculum from advanced countries of advertising higher education and in-depth reform continually.

10.3.4 Seamless Linkage of Knowledge

In the past, each segment in the textile-advertising-retail complex operated more or less separately, producing intermediate products for the next stage of the production chain. Corresponding, the higher education of different major and specialization also shows dependent on their knowledge, lacking of interlink. For instance, the curriculum of fashion design neglects the knowledge of clothing manufacturing process, and the curriculum of advertising design and engineering tends to be too technical and product-oriented in lack of sourcing, marketing, and consumption education.

The updating clothing industry and the development of increasing integrated industry chain proposed new requirements on graduates. To solve problems faced in real world requires the graduates to be equipped with complete knowledge structure. It means seamless linkage of knowledge in advertising education of different majors should be constructed through offering a general knowledge of advertising area for all different advertising majors to understand each other and communicate efficiently which is very important in vocation. On the other hand, professional education should be concentrated to help graduates to meet employment qualification.

10.4 Conclusions

In the twenty first century, the college advertising teaching is meeting new challenges and problems in terms of globalization, mass higher education, and higher technological revolution. In order to improve China's advertising industry competitiveness in the global textile-advertising supply chain, and to produce

graduates capable of participating and competing in the emerging global society, China college advertising teaching should conduct complicated reform and reconstruction, including further international cooperation and exchanges, further computer application in curriculum, strengthening merchandizing, marketing and global resourcing education, curricula updating and diversification, and seamless Linkage of knowledge of different major and specialization.

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Chapter 11
Study of Comprehensive Training in Import and Export Business in Higher Vocational College

Yuying Zhu

Abstract Comprehensive Training in Import and Export Business is an operating practice curriculum for students in International Trade Major, which includes extensive professional knowledge, multifarious contents and is teaching demanding. Develop and construct the curriculum by aiming at Comprehensive Training in Import and Export Business, discussing the course arrangement and organizing implementation of comprehensive training from thinking and practice two aspects. Introduce the foreign trade business environment into school and innovate the mode of "teaching-business".

Keywords Training course · Curriculum development · Curriculum construction · Teaching practice

11.1 Introduction

Vocational technical education is different from the general education, of which the goal is to train high technology applicative talents that meet the demands of front-line production and service, making students master the skills required in practical work at school and achieving a seamless link without gap between school capacity-building and capacity that required by the employers [1, 2].

International trade is a major of strong practicality [3, 4]. It is difficult for students to understand and master the professional content and rely solely on classroom teaching, which requires students in relevant specialties can be trained

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by system operation on the transaction procedures of various trade modes, customary closing conditions, and form of settlement after completing the main professional courses. But most colleges and universities can not provide such systematic training for students in the major international trade. There are mainly two reasons in the following.

11.1.1 As May Involve Trade Secrets

Student internships cannot bring benefits to the enterprise and other reason, the general foreign trade enterprises are not welcome students to practice, resulting students in the major of international trade difficult to practice.

11.1.2 Even If the Students Practice in Foreign Trade Enterprises, Due To Their Different Nature

There are some limitations on the types of the foreign trade business [5, 6]. For example, in a foreign trade enterprise of pure trading, it is difficult for them to come into contact with the processing operation, which makes students to only practice in a single trade mode in their internship [7, 8].

In view of solving the above considerations, it is necessary for us to add Comprehensive Training in Import and Export Business course as an additional professional training program to enable students build simulating environment of foreign trade business in school with practicality, applicability and integrity, playing different roles in the foreign trade business, exercising the simulating practice of import and export business operations according to the actual operation of the business process, completing a variety of trade-related business operations after finishing the professional-related courses. Let students on the scene personally face with practical problems, integrate all knowledge of various subjects what they have learned,and thus enhance the comprehensive professional capacity for the upcoming internships and making preparations on social employment.

11.2 A Train of Thought on Curriculum Development and Construction

Starting such a comprehensive training courses must meet three conditions: a high degree of simulation of the foreign trade business workplace environment; the declared software by enterprises from relevant government departments; the transaction background conditions that students should know while training; the related operation files such as training guide books.

11.2.1 A High Degree of Simulation of the Foreign Trade Business Workplace Environment

Business environment provides adequate conditions to cultivate professional ability. To enable students systematically, comprehensively, standardized master all aspects of import and export trade skills and methods of operation, creating a high degree of simulation professional environment of foreign trade business is indispensable.

11.2.2 Declared Software That Integrate Every B2G Process

In practical work, there is a process of network declaration (i.e., B2G) by an enterprise through software platforms such as China Electronic Port, etc., for Administration of Exchange Control, the Customs, and other government departments along with different aspects of foreign trade, while such platforms do not open to colleges and universities, and which can only be used by the real business that is licensed and approved by the relevant authorities. In the training process, we also need to cooperate with such a declaration software, and only through such declaration software, can we provide students a business environment same with the practical business operations.

11.2.3 Typical Import and Export Operational Projects and the Relevant Working Documents

International trade business is of high specialization, involving a large number of international operating rules and policies changing quickly, if the modes of trade, customary closing conditions, and payment terms are different, the business processes are different with complex operational procedures, various types of complicated documents, a variety of risks, and uncertainties. To enable students have a systematic operation training under various different transaction procedures and comprehensively improve their vocational technical skills, approach capability and social competence, the contents of training must be overall designed.

11.3 The Practice of Course Development and Construction

11.3.1 Condition Construction of the Comprehensive Training Course

From the years 2007–2008, International Trade Major at Nanjing Institute of Industry Technology takes the construction of characteristic major of the first national demonstration higher vocational colleges as an opportunity.

11.3.1.1 Highly Emulation of the Foreign Trade Business Workplace Environment

An import and export business is often through market research, business negotiation, contract fulfillment, and other operation processes, for this reason, we built an international trade comprehensive training center of 400 square meters, which has trade negotiating room, the sample show room, import and export department, general manager's office, and with integrated services of import and export business lobby of nearly 20 departments' stations such as commodity inspection, customs, banks, insurance companies, freight forwarding, shipping companies, and so on. In order to enhance the simulation of training and operability, it is also equipped with the necessary office equipment and workplace environment was arranged carefully, for example, there are office desks and chairs that are used in the office premises, printers used for printing documents, telephone facsimile machine for students while they do business negotiations, sales responsibilities on the corresponding station wall, etc., in import and export department, all these have strengthened the fictionalization of the training environment and the layout of the workplace.

11.3.1.2 Declared Software That Integrates Every B2G Process

The declared software that integrates every B2G process is through more than a year of research and development with the professional software company which can apply for licenses, certificate of origin, and can perform commodity inspection, customs declaration, verification of export earnings, import verification, and tax reimbursement, etc.

11.3.1.3 Typical Import and Export Business Items and Related Working Documents

The key to achieve the objectives of comprehensive training course lies in the great care while compiling the training projects and effective organization. To this end, we transfer the dual-qualified teachers with rich foreign trade experience to form a specialized project development team, tracking typical business operation deeply into the training base unit, and converting it into six representative teaching projects that are practical in schools, and with controllable processes which covering a variety of import and export flows, losing conditions, settlement, regulatory conditions, and industry product distribution (3 general trade export items, 2 general trade import items and 1 processing program). After finishing the compiling, and then expound and prove the working documents such as project content, organization and implementation, and the teacher's tutorial manual, student handbook, project charter, teaching standards of the training course, etc. by team teachers and experts from the foreign trade enterprises to ensure the authenticity of the content, controllability, and ordered training arrangements.

11.3.2 Course Arrangement of the Comprehensive Training and Organizing the Implementation

11.3.2.1 Course Arrangement

This course is arranged in the fifth semester after students finish the professional curriculum and before the internship for 5 weeks.

Conduct 2 day training on approach abilities and social skills by business experts at the beginning of the course, and then carry out specific training projects in sequence, about 3.5 days for each project.

11.3.2.2 Organizing the Implementation of Each Training Item of the Course

Each training item is approximately organized and implemented according to the following procedure:

Issuing the assignment—guiding the project implementation—implementing the project—commenting on the program

Issuing the Assignment

The instructor of the training program should issue the paper assignment or electronic manuscript in advance through campus network to the training classes

not later than a week before training. Familiarize students with the project content and let them get early access to the relevant trade background information ahead of time such as consulting the main markets of the products, price quotations and restraint of import and export trade, etc. Get students do cost accounting, prepare and get aware of the business negotiation while training.

Guiding the Project Implementation

The advisor of the project should make layout description on grouping, role allocation, implementation requirements, and the necessary precautions while formally implementing the project.

Implementing the Project

Students should complete the project mandate according to the actual import and export business process by entering into their designated roles in the working position.

Commenting on the Program

In the project implementation process, the instructor would comment on the completion of the whole project after finishing each training project.

In the period of training, except inviting the experts in practice base unit to train students abilities on interpersonal communication, negotiation and communication, team work, and so on, we also arrange for the morning assembly every day, asking students to train with the given work cards and sit in the working position, and require the students to act consistently with the role of identity and in proper demeanor and pay attention to the sanitation of office environment, etc. and demand students to switch roles among different projects. In this way, based on grasping the specialized knowledge, let students perceive the operations management of the actual foreign trade enterprises earlier, so as to enhance the vocational and technical ability of students, the methods ability to complete the job and interpersonal and communication skills, good psychological quality to overcome difficulties and setbacks and other social abilities.

By means of simulating foreign trade links, this course has strong simulation and practicality by letting students simulate each step of the actual operation. After nearly 2 years of preparation and construction, the course of Comprehensive Training in International Business in our college has been put into use for more than 200 students in the major of International Business since the second half of last year. Students participated in the comprehensive training generally reflect: after comprehensive training in our college, there is no panic while encountering the real business problems in the practice unit, and review the comprehensive

training program participated, the solution to the problem can be found by considering the practical situation; the enterprises that accepted our internships who received comprehensive training reflect that the internships from our college can get started quickly, with strong adaptability and practical ability, and can quickly finish the specific trade orders independently under the leadership of the master. From the feedback from students and employers point of view, the course of Construction of Comprehensive Training in Import and Export Business in our college has got preliminary achievements

11.4 Several Issues Should Be Noticed in the Curriculum Development and Implementation

This course draws on the teaching and factory pattern of Singapore Nanyang Polytechnic, introduce the foreign trade business environment into school, innovate the "teaching business" mode, and hope to provide certain reference of problems on "the unity of learning and working" in courses of international trade category and even business administration. But the following aspects of problems should be concerned:

To ensure that training is not out of line with actual business operations, project content should be timely amended based on the continuous development of trade modes and adjustment of national trade policies to ensure the timeliness and novelty of the training programs.

The student's evaluation and assessment methods and student performance evaluation criteria should be clearly defined in the teaching documents. In training process, the instructor should completely record the examination of each training session for students.

Training organization, Due to different roles have different volumes of business, the instructor should make a round consideration, reasonable arrangements and ensure that each student has full training workload

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Part II
Communication Technology and Applications

Chapter 12
Reliable and Energy-Efficient Routing Protocol for Wireless Sensor Network

Liwei Tan

Abstract This paper gives hop based routing protocol a detailed analysis, then a new routing policy—Reliable and Energy-efficient Routing Protocol for WSN (REERP) is proposed. In data transmission phase, REERP makes parents and siblings as forward selection; relying on a formula for evaluating the routing quality, routing mechanism has a comprehensive consideration of the forward selection; trigger update mechanism is used to maintain dynamic network topology and avoid "routing hole"; data packets act as a part of routing packets, which can reduce network maintenance cost. Compared with, DD, join-MHC in omnet ++ simulation tool, REERP proves its strength in load balancing, congestion avoidance, extending network lifetime, reliability, and low routing overhead.

Keywords Wireless sensor networks · Hopbased routing protocol · Load balancing

12.1 Introduction

Routing protocol design is an important research area in wireless sensor networks, reliable, low-cost, and easy to maintain are design goals of WSN routing protocol, Single path routing algorithms in WSN focus on picking up an energy efficiency path from interconnect sensor nodes network, e.g., DD [1, 2], Minimum Cost Forwarding [3, 4]. They make sure data is transmitted on optimized path and

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prolong the lifetime of the network. Besides energy efficiency, multipath routing take advantage of interconnect nodes network to enhance data throughput and packet delivery ratio. Hop-based routing protocol has been receiving extensive attention for its simple and effective design ideas.

In WSN, both suddenly burst large amount of information and frequent event reporting will rapidly create shortage of resource (buffer space, energy) which leads to congestion and consequently packet drops. Congestion often happen in the middle or near the sink node of the network, it causes the reduction of node throughput and packet delivery ratio. It also increases time delay and energy wastage. Congestion control in WSN is particularly difficult as data is periodically collected in response to detected event. In Wireless Multimedia Sensor Networks (WMSN) [5, 6], video sensors are used to enhance the capability of event description [7]. Video sensors can generate image and video streaming data, which with heavy load require higher transmitting capability (bandwidth). Since high transmit rate is required for multimedia packages, congestion in WMSN is more prone to happen. So, congestion control is of prime importance in WMSN.

The problem of congestion control has been addressed in many works, e.g., CODA, ESRT. They analyze how to detect and control congestion but mainly under transport layer. For addressing multimedia packets transmitting congestion problem and assure reliably, we believe cross-layer scheme which considering under the whole framework will benefit in solving this problem. In this work, we not only consider proposing a routing algorithm underneath in WMSN but also the congestion problem following this algorithm. For this target, we proposed a Minimum Hop Disjoint Multipath routing algorithm with Time Slice load balancing congestion control scheme (MHDMwTS) to ensure reliability in WMSN.

The concept of minimum hop count (MHC) routing is introduced in papers [8], sink flooding package to whole sensor field to form gradient hop count field. Considering energy, the source transmits data only from bigger hop count number nodes to small number nodes. The strength is that every node in the field can easily find an energy efficient route to sink. But by sending packets to all available neighbors will cause short network lifetime for wasting too much energy in nodes. Also no specified multiple paths to transmit multimedia packets will easily cause congestion at the nodes near sink. In our work, after minimum hop count field formed, most efficient disjoint paths with least time delay will be selected to transmit packets.

Fully disjoint path from source to sink is not easy to form at building up phase of sensor network. Considering resilient and energy, after primary path is constructed, without global topology knowledge, disjoint paths are dynamically constructed. It requires much computation and time in nodes to find the alternate path and the path found could be long. In our proposition, the computation is happened at sink and the alternate path is chosen quickly after primary path constructed. And the length of the paths is all under minimum hop field control. The simplicity and time is of prime importance in our routing algorithm.

In this paper, an improved hop-based routing protocol (REERP) is proposed. Like MHC [2] protocol, REERP divides network work cycle into gradient phase and data transmission phase. In gradient phase, nodes delay in sending gradient packets to avoid redundancy packets and reduce cost of establishing gradient; in data transmission phase, REERP makes parents and siblings as forward selection; a formula (routeScore) makes comprehensive consideration of the forward selection. A trigger update mechanism guarantees a real-time dynamic network topology.

12.2 Strategies of REERP

REERP also belongs to a hop-based routing protocol in that it utilizes "hop count information" of sensors towards a sink for packet forwarding. The protocol has two phases: Gradient setup phase, Data transmission phase, and also has own routing update mechanism.

12.2.1 Gradient Setup Phase

Step 1 When a sensor (source) is activated, it will send out the path build request package to the neighbors where hop count is smaller than the sink. The neighbors receive the request package and add node number of itself into the package, also add the timestamp of this node, then send out to its smaller hop count neighbors. This package which contain the route node number and transmit from high hop count to low will finally reach to the sink. The first package reaches the sink which with least time delay contains the primary path information. Each sensor node starts Time Out timer when it receives first INIT packet, the timer composes of two fractions, one fraction will be chosen proportional to the measured LQI-value in the incoming INIT packet, the other fraction will be a coefficient $\mu(1)$, go to step 3)

Step 2 After the first package reach the sink, there still have other packages coming from different routes to the sink. When a new package arrives, extract the route and compare to the primary path. The comparison is simple. If there is joint node, then discard the package. If not, the alternate path is found. Continue to receive package and compare with both primary and alternate path to find the backup path. If after a timeout the backup path is not found, then give up on backup path. At last, paths are found

Step 3 Put each INIT packet information into alternative queue, then compare HC_{self} with $HC_{INIT\ packet}$ plus 1, if $HC_{self} > HC_{INIT\ packet} + 1$ or HC_{self} is NULL, then to HC_{self} set $HC_{INIT\ packet} + 1$, otherwise do not update HC_{self}

Step 4 If the timer times out, then broadcasts own INIT packet with own information, then go to step 4), otherwise go to step 2);

Step 5 Check alternative queue, put the node information whose $HC_{INIT\ packet} = HC_{self} + 1$ into parent table, and put the node information whose $HC_{INIT\ packet} = HC_{self}$ into sibling table, silently drop any other node information

12.2.2 Data Transmission Phase

One sensor node's state goes into data transmission phase if the following conditions meet: HC_{self} is not NULL; alternative queue is empty. This can ensure that: current node has own HC; current node's two tables have been completed in part; current node will not process data packet before the condition above.

The sensor nodes will collect and send data periodically and forward data packet whose relay node ID is they. When choosing relay node, source node considers parent nodes and take priority of sibling nodes; in parent or sibling table, source node chooses only one optimal relay node considering rest energy, communication capacity and history record, which is defined in a formula, routeScore. Relay node needs to reply ack if it forwards data packet successfully.

Source node will choose relay node that has the highest route Score in one table (parent or sibling). rest Energy and LQI are got from INIT or ack packets of related next hop node; success Rate is transmission success rate (0–100), initialized as 100, the rate of related next hop node will be reduced by 1 if one time the source node doesn't get ack reply. α, β and γ are weighted coefficients. The sum of weights, α, β and γ, is set to 1, and α has highest weight because current rest energy of relay node is the most critical index of evaluating node capacity.

Sensor node selects unique relay node to forward data at one time, which avoids redundancy of data packets; ack mechanism not only offers transmission reliability, but also helps source node update tables timely; rest energy and LQI value represent current capacity of relay node, success Rate represents history forwarding record of relay node, so considering these two aspects, source node can have a more optimal choice.

12.2.3 Topology Maintenance and Update

Network topology will change with the node energy consumption and other factors, so the initial routing tables can not reflect the current network topology. In REERP, data packet has a new bool field: update and the default value are FALSE. In data transmission phase, sensor node checked HC value of every data packet

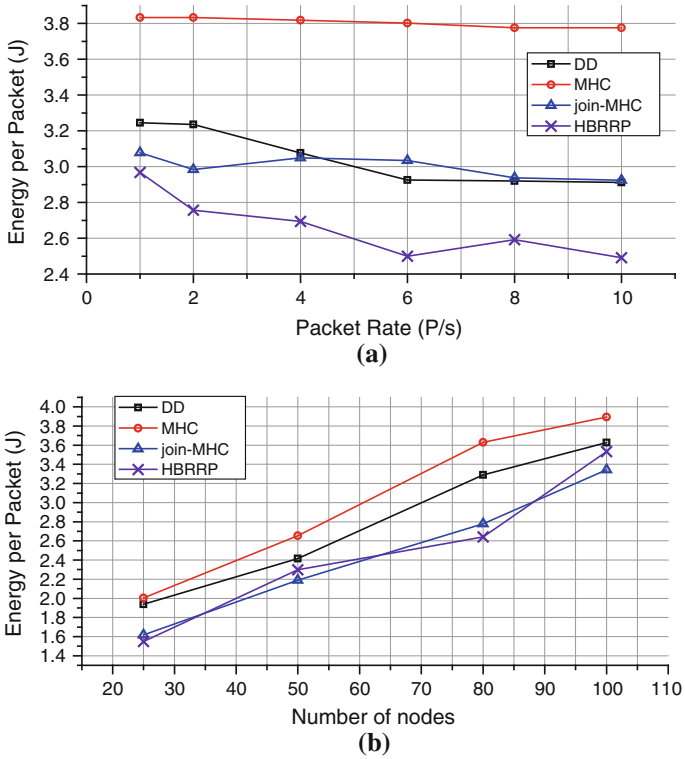

Fig. 12.1 Energy per packet value at: **a** different packet rate and **b** different number of nodes

received, if HC $\geq$ HC_{self} + 2 or HC $\leq$ HC_{self}-2, proves that the node receives data packets except parent, sibling and child nodes, which means topology is changed. The paper regards this as trigger update condition, then the node sets update field of next data packet to TRUE, chooses a relay node in tables and broadcasts this data packet, meanwhile clears up two tables. The neighbors reply ack packet if receive this "update" data packet to help the source node rebuilds two tables.

12.3 Simulations and Results

12.3.1 Simulation Setting

Omnet ++ 4.1 [9] is the simulation tool to simulate and analyze simulation results. The simulation was implemented with OMNet ++. We considered a square sensor field of size 400 × 400 m^2 where 28 static sensor nodes are randomly deployed, channel delay is 100 ms, packet size is 16 bytes, packet loss rate is 5 %, TTL

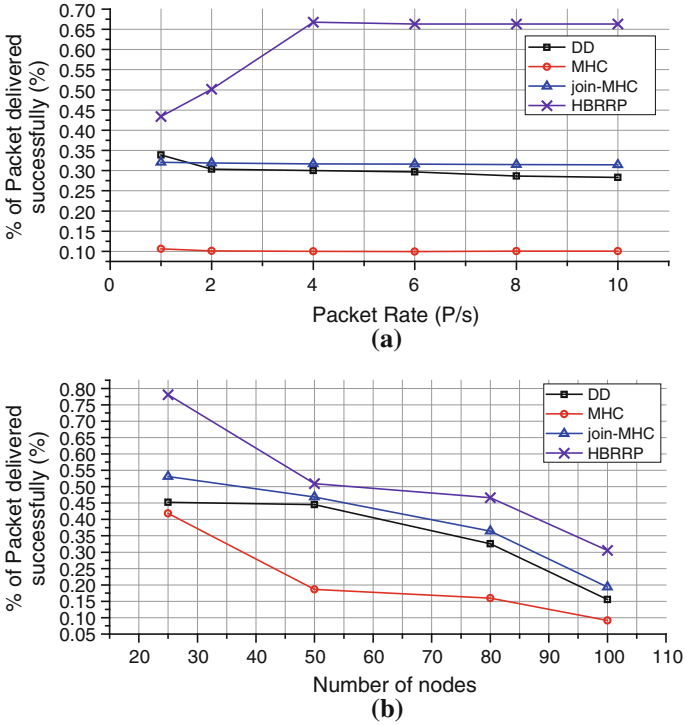

Fig. 12.2 Packet delivery ratio value at: **a** different packet rate and **b** different number of nodes

(time to live) is eight, initialized energy capacity is 1,000 units, sending one packet consumes one unit, receiving one packet consumes 0.5 unit, sensor node is regarded as "dead" if energy under 300 units. In radiation layout, 25 nodes are randomly distributed in sensor nodes area, and the horizontal coordinate is frequency to send packets, namely packet rate; this simulation has contribution to analyze the affects of different packet rate in a fixed network. In surrounded layout, the horizontal coordinate is the number of sensor nodes; this simulation has contribution to analyze the affects of different network size.

Simulation factors including:

- Network lifetime: the simulation duration.
- Energy per packet: measure the energy expended per delivered data packet.
- First Node Dead (FND): measure average number of packets delivered to sink when first sensor node is dead.
- Packet delivery ratio: measure the percentage of data packets generated by the nodes that are successfully routed to sink.
- Network maintenance cost: measure the proportion of routing packets and data packets generated.

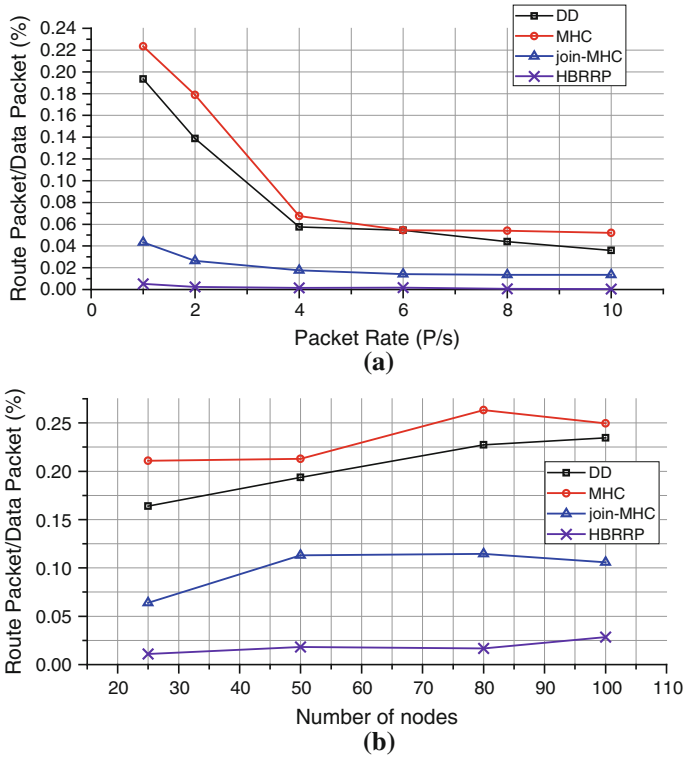

Fig. 12.3 Network maintenance cost at: **a** different packet rate and **b** different number of nodes

12.3.2 Simulation Results

Figure 12.1 shows average energy consumption of one data packet in different routing protocols. Figure 12.2a shows that REERP can transfer data more efficiently than other protocols in higher packet rate. Figure 12.2b shows that in fixed packet rate, with growth in the number of nodes, average energy consumption is growing in all protocols, and the result of REERP is similar with that of join-MHC.

The simulation results of Fig. 12.3 show that REERP makes sink receive more nonrepetitive data packets from entire network in not only different packet rate but also different network size, which is ensured by parent-sibling design, route Score formula, and ack mechanism.

Figure 12.4 shows the cost of building and maintaining network in different packet rate and different network size. Figures 12.4a, b both prove that REERP pays a minimum price to maintain network topology, which is ensured by the delay forwarding in gradient phase and trigger update mechanism in data

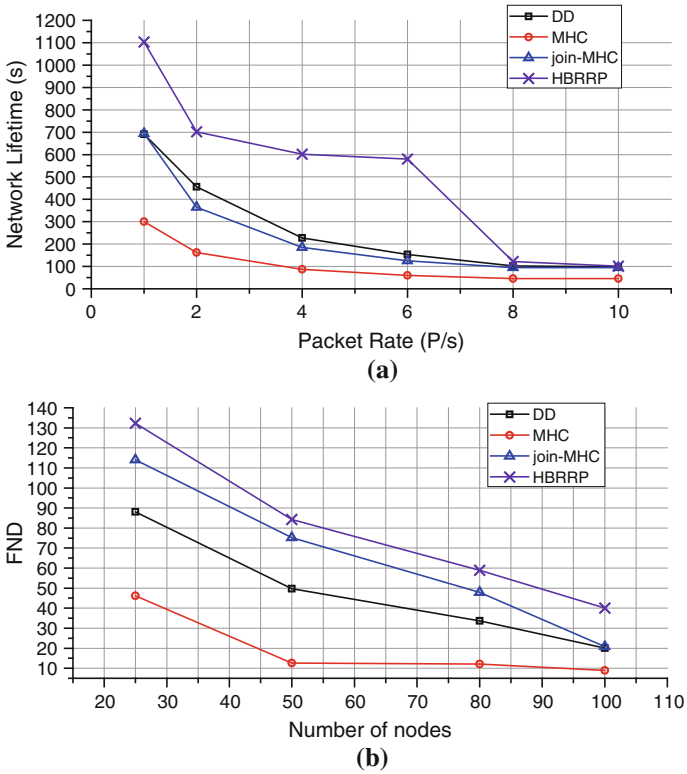

Fig. 12.4 **a** Network lifetime at different packet rate and **b** FND value at different number of nodes

transmission phase. In Join-MHC, more useless join packets generates in gradient phase, and in data transmission phase sensor nodes also update routing information periodically.

12.4 Conclusion

This paper summarizes the status of hop-based routing protocols for WSN, and analyses strengths and weaknesses of them, and then designs a new routing strategy, REERP. We have demonstrated through the simulation that our proposition achieves higher data receive rate and longer network life time, which more reliable than normal multipath without congestion control. But under higher package transmit rate from source, both receive rate and network life time will drop fast. And the redundancy is low in our design. These problems affect the

reliability of our design and which need further study. The design of a more reliable routing protocol, which apples to large-scale dynamic network, is the next step focus.

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Chapter 13
Research on Minimum Coverage Algorithm in Wiriness Sensor Network

Gang Hong and Xiao-qin Pan

Abstract A distributed algorithm based on sensing region pixels (ABSRP) is discussed aiming at the problems of low efficiency to find redundant nodes in wireless sensor network (WSN). To find the redundant nodes, node sensing region is converted into a series of pixels. Comparative experiments to existing algorithm show that this algorithm will affect the initial cover set slightly, and the redundant nodes can be selected out effectively.

Keywords Wireless sensor networks · Redundant node · Minimum coverage set · Sensing region pixels

13.1 Introduction

Recent advances in micro-electro-mechanical systems, digital electronics, and wireless communications have led to the emergence of wireless sensor networks (WSNs) which consist of a large number of sensing devices each capable of sensing, processing, and transmitting environmental information. Wireless sensor network normally consists of a large number of distributed nodes that organize themselves into a multi-hop wireless network [1, 2]. It is always desirable to extend the lifetime of sensor network nodes without sacrificing their functionality. Due to their deployment in potentially harsh scenarios, nodes in sensor networks

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are usually powered by batteries with finite capacity. Thus, the study of power management is particularly important.

In WSNs, all nodes share common sensing tasks. This implies that not all sensors are required to perform the sensing task during the whole system lifetime. All nodes have three modes of operation. In the active mode, a sensor can observe the environment and communicate with other sensors (or with the base station). The energy consumption of radio frequency module is the highest in the transmission mode [3, 4]. In the sleep mode, a sensor cannot monitor or transmit data. The node can change to the active mode, whenever it receives the appropriate signal (either from another sensor or from the base station) [5, 6]. Obviously, in the sleep mode a sensor consumes much less energy than in the active mode. Finally, in the off mode, the nodes are completely turned off. If all the sensor nodes operate in the active mode simultaneously, an excessive amount of energy will be wasted and the data collected will be redundant and turning off some nodes or some nodes sleeping does not affect the overall system function as long as there are enough working nodes to assure it.

The key idea of this paper is to maintain the full coverage in large sensor networks by a small number of sensor nodes. The scheduling algorithm should allow as many nodes as possible to be turned off in most of the time, and at the same time, it should not reduce the current coverage rate and guarantee the network connectivity. In this paper, a distributed algorithm based on sensing region pixels (ABSRP) is discussed. Sensing region of node is converted into a series of points, which is called pixels. When there are enough pixels, we can think that the pixel lattice is the sensing region. If all pixels in the lattice are covered by other neighbor node, the node is redundant. After we find out all redundant nodes, that is, maximum redundant node set, its complementary set—the minimum cover set, is easy to find out. ABSRP converts a complex NP problem into a location relation between point and circle, so that the problem has been greatly simplified. The feasibility and performance of the algorithm is analyzed, and experiment shows that the algorithm is correct. Comparison experiment with literature shows that ABSRP can select more redundant node out than existing algorithm [7, 8].

13.2 Problem Description

The coverage of this study is followed by the following basic assumptions:

1) Wireless sensor networks is deployed in a two-dimensional (2D) target rectangular area R, and its side length is A.
2) Each sensor node can obtain its own location information through some kind of positioning algorithm (e.g., GPS).
3) We assume that all nodes have the same sensing range, each node knows its sensing range r, and its sensing region is a circle with radius r.
4) We assume that communication distance of node is R_c, $2r \leq R_c$.

As discussed above, the main objective of this algorithm is to minimize the number of active nodes, as well as maintain the original sensing coverage.

To facilitate the calculation, we only consider the neighbors whose distance from the current node is equal to or less than the sensing radius r as shown in definition 1

Definition 1 Neighbor Set.

The neighbor set of node i is defined as:

$$N_i = \{n \in S | d(i,j) \leq r, n \neq i\}$$

S is node set in the deployment region, $S = \{s_1, s_2, \ldots s_n\}$.

d (s_i, s_j) denotes the distance between node s_i and node s_j.

Definition 2 Minimum Cover Set.

Given an area R and node set S, if R is covered by S', and R can not be covered by any true subset of S' (S' is a subset of S ($S' \in S$)). We define Set S' is a minimal cover set of S. If the node number of S' is the least, we call S' is the minimum cover set.

Definition 3 Redundant Node.

If the sensing region of a node is covered by its neighbors, it is redundant.

As discussed above, sensing region of node is a disk with radius r. We place K lines horizontally and K lines vertically with equidistant (usually K is odd). The points that lines intersect lines or lines intersect the circle are called pixels. A discrete sensing region with 13 rows and 13 columns is shown in Fig. 13.1 Each node can obtain its own location information, and according to K, coordinate of each pixel can be found out easily. An array is used to save the coordinate information of the discrete sensing region. If the value of K is large enough to meet the computational accuracy, the discrete sensing region can approximate the initial sensing region well. Then we can say that the discrete sensing region is the initial sensing region. When we want to judge whether a node is redundant, we use the point in array instead of the circle, and we only need to calculate the distance between each pixel and other neighbor node. So this algorithm is easy to realize.

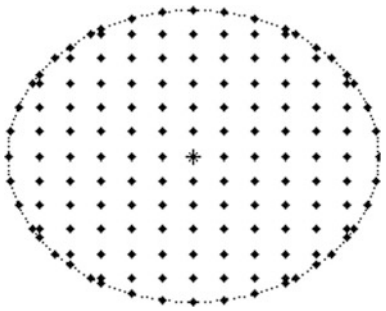


Fig. 13.1 Discrete sensing region

In theory, with the increasing of the K value, the number of pixels will increase, the distance of pixels will reduce, and the error of calculation becomes small. When K tends to infinity, the error tends to zero.

Theorem 1 *Given: Pixels set of node* s_i: $C_i = \{p_1, p_2 \ldots p_k \ldots p_m\}$, p_k *is the pixels of node* s_i

Neighbor node set of node s_i: $N_i = \{s_m, s_n \ldots s_x \ldots s_t\}$, s_x *is neighbor node of* s_i.

When the K value is large enough.

If $\forall p_k, p_k \in s_i, \exists s_x, s_x \in N_i$, *there is a* $d(p_k, s_x)$, $d(p_k, s_x) \leq r$.

Here, $d(p_k, s_x)$ *is the distance between* p_k and s_x.

Then the node s_i *is redundant. That is, for every* p_k, *the distance between* p_k *and* s_x *is less than r, we can say that the sensing region of node* s_i *is covered by its neighbor nodes. So node* s_i *is redundant.*

As we have known, if the distance between a pixel p_k *and a node* s_x *is less than the node's radius r, that is,* $d(p_k, s_x) \leq$ r, *this pixel is covered by the node.*

And now, when the K value is large enough, node's sensing region is substituted by pixels set C_i. *If all pixels in a node's sensing region are covered by its neighbors, this means that its sensing region is covered. According to definition 3, it is redundant.*

We can judge whether a node is redundant from Theorem 1. That is, when all pixels are covered by its neighbors, it is redundant. On the contrary, if any of its pixels can not be covered, it is an active node. A redundant node with 7*7 pixels is shown in Fig. 13.2. As we see, all pixels in its sensing region are covered by s2, s3, s4, and s5, so it is redundant.

13.3 Algorithm Based on Sensing Region Pixels

As we have discussed above, we save a node's sensing region using a series pixels. And according to Theorem 1, a node with all pixels covered is redundant. So an algorithm based on sensing region is realized.

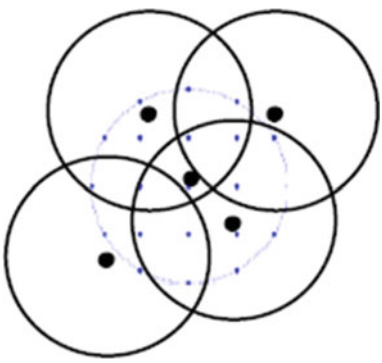


Fig. 13.2 Redundant node

It is a distributed algorithm, and every node calculates and saves its pixels independently. If a node is redundant according to theorem 1, it gets sleep to save energy. At last, all active nodes are rested. There are four steps to judge a redundant node:

Step 1 Every node is set to be active

Step 2 Node distributes and saves its sensing region pixels according to K value and its position

Step 3 Node sends neighbor finding message, then receives neighbors' message to find neighbor and save neighbors' information

Step 4 Node judges' redundant according to theorem 1 and redundant node gets sleep

13.4 Simulation Experiment

In this section, first, we verify the influence of K value, and then K value is chosen. Then the performance of ABSRP in judging the redundant node is compared to the performance of an implementation of CPNSS [6], GECPNSS [7], and Chi-fu Huang [8]. We describe that implementation, the simulation environment, and the simulation results.

13.4.1 The K Value

As we have known, the greater the K value, the lesser the error of algorithm is. That is, more redundant nodes are found. But the algorithm needs more time on calculation. So we must find a K value which can select out enough redundant nodes, at the same time, the time cost on the calculation is acceptable.

In our experiment, we set the sensing region radio $r = 10$ m. 100 nodes are scattered randomly in a 100×100 m rectangle. We calculate the average of redundant node in 100 time experiments to reduce the influence of accidental error.

The relationship between K and active node number is shown in Fig. 13.3 and Fig. 13.4. When K is small, with the increase of K value, the number is increasing. After $K > 11$, the number increases little. That is, when the K value is small, there are some active nodes considered to be redundant incorrectly. When K value is large enough, the number tends to be 67 and changes rarely. So we can say that all redundant nodes are selected without error rarely.

The time of calculation per experiment is shown in Fig. 13.5. With the increase of K value, the time raises quickly. Algorism needs more and more time to calculate a node redundant in Figs. 13.3 and 13.4.

Considering with the analysis above, we choose the K value to be 13. It can select all redundant nodes correctly, and at the same time, the cost of time is

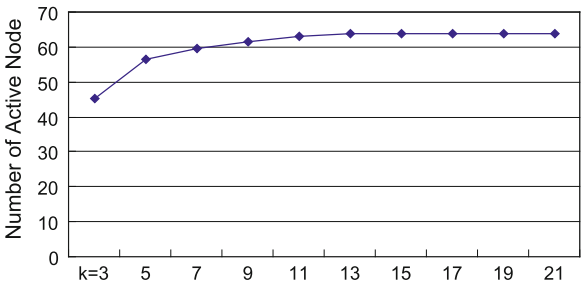


Fig. 13.3 Chart of K-active node number

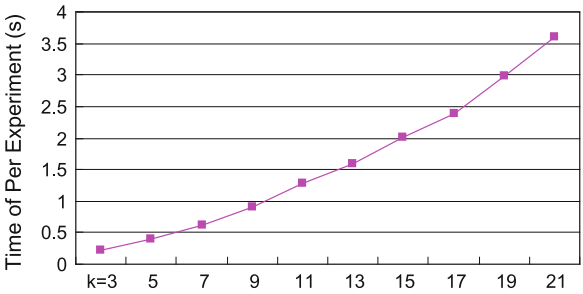


Fig. 13.4 Chart of K-time

acceptable. An experiment result is shown in Fig. 13.5. And we can see that the coverage of the experiment area is not changed if we turn off the redundant nodes.

13.4.2 Comparative Experiments

13.4.2.1 Experiment of Constant Radius

Simulation Parameters: Number of node is set n = {20, 40, …, 200}. Sensing region radius r = 10 m. The number of active nodes is compared with CPNSS and GECPNSS.

When CPNSS and GECPNSS judge a node redundant, neighbor nodes in its sensing region are considered, and neighbor nodes out of its sensing region are ignored. Thus there are some redundant nodes failed to be chosen, and they are still on work. ABDSR can select all redundant nodes out, so number of active nodes is less than CPNSS and GECPNSS (Fig. 13.6).

13.4.2.2 Experiment of Random Radius

The sensing radius in real network will decrease after a long time, so the sensing radius changes. In this experiment, we simulate the radius a random number.

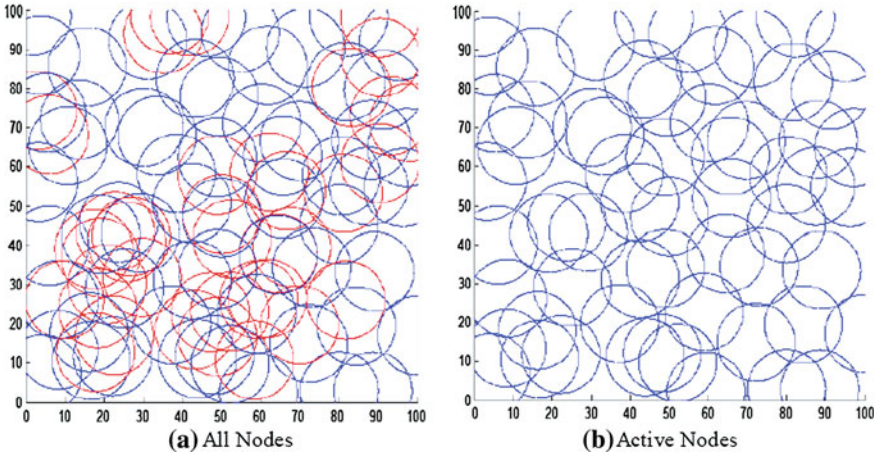
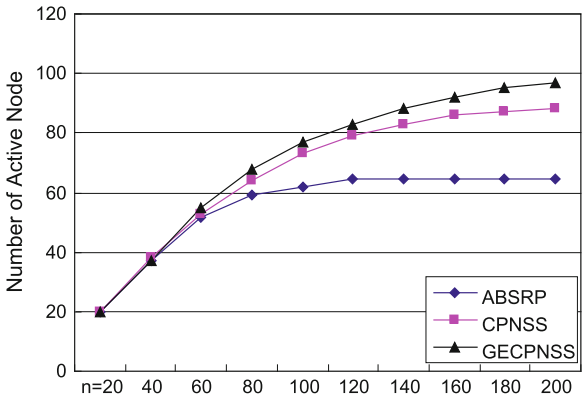


Fig. 13.5 An experiment result

Fig. 13.6 Active node number with constant radio



We set radius of node:

$$r = 10 * \lambda_i$$

$\lfloor_i$: a random number from 0.5 to 1.

That is, we set node radius a random number from 5 to 10.

We compare DSR with GECPNSS and Chi-fu Huang, and comparison of the active nodes number is shown in Fig. 13.7.

The number of GECPNSS is equal to Chi-fu Huang approximately, and the number is increasing when number of nodes gets rising. Number of ABDSR is less than them, and tends to be stable. There are more redundant node still working in GECPNSS and Chi-fu Huang.

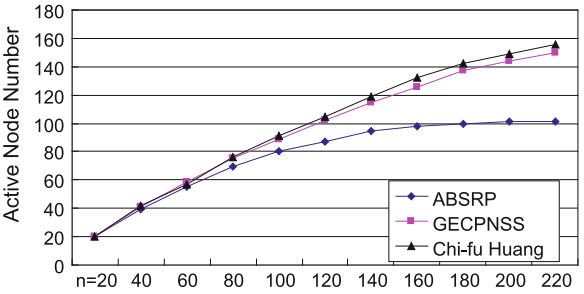


Fig. 13.7 Active node number with random radio

13.5 Conclusions

This paper proposed a distributed nodes scheduling algorithm. It can effectively determine the redundant nodes, and the result is better than the existing algorithms.

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Chapter 14
Quantum Secure Direct Communication Protocol Based on Four-Qubit Cluster State

Xianzhong Li, Guotian He, Mingxin Gu and Pengfei Dai

Abstract In order to improve the reliability and security of quantum direct communication, this paper proposed a new quantum secure direct communication protocol based on the entanglement properties of cluster state and EPR entangled pairs. This protocol takes four-quit cluster state as the information carrier, using unitary transformation, through quantum information states to do the Bell-based measurements to interpret the secret messages. The cluster state is better than W state of entanglement properties, has a higher efficiency of the communication, and is more comfortable to use for information carrier.

Keywords Quantum cryptography · Cluster state · Quantum secure direct communication protocol · Bell basis measurement

14.1 Introduction

Quantum communication has been a rapidly developing area of research in the past 20 years, and is a new interdisciplinary study which unifies the quantum–mechanical theory, and computer science. After the BB84 [1] and B92 [2] protocol, a lot of quantum key distribution protocols were proposed.

Compared with QKD [3–5], QSDC [6–8] can delivery secret messages directly without prior agreement key. It is not necessay to encrypt the message, and thus improve the efficiency of communication. According to the information carrier, the

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QSDC [9] protocol can be divided into two kinds: one based on the single photon system and the other based on the entanglement system. Now, the majority of QSDC take entangled state as the information carrier. In 2006, Lee Hayman et al. proposed two kinds of self- certified QSDC protocols [10], which first confirms the correspondent's legal identity and then carries on the communication.

This article takes a four-quit cluster state as information carrier and completes QSDC with the help of classical channel. The plan chosen is cluster state rather than entangled state, as the cluster state interrelatedness and entanglement stubbornness is biggest, increases communication efficiency, and in addition, before the formal coding communication, the introduction of the test photon is once again determined to improve the safety performance of the communication protocol security.

14.2 Prerequisite Knowledge

$\{|0\rangle, |1\rangle\}$, is a standard orthogonal basis, called Z-based, now let$|+\rangle = \frac{1}{\sqrt{2}}(|0\rangle + |1\rangle)$,$|-\rangle = \frac{1}{\sqrt{2}}(|0\rangle - |1\rangle)$, which is called X–based. Four Bell states can be expressed as:

$$\begin{aligned} |\beta_{01}\rangle &= \frac{1}{\sqrt{2}}(|01\rangle + |10\rangle), |\beta_{00}\rangle = \frac{1}{\sqrt{2}}(|00\rangle + |11\rangle), \\ |\beta_{10}\rangle &= \frac{1}{\sqrt{2}}(|00\rangle - |11\rangle), |\beta_{11}\rangle = \frac{1}{\sqrt{2}}(|01\rangle - |10\rangle), \end{aligned} \tag{14.1}$$

Record the four-quit cluster state as follows:

$$|\psi\rangle_{1234} = \frac{1}{2}(|0000\rangle + |0011\rangle + |1100\rangle - |1111\rangle) \tag{14.2}$$

14.3 Protocol Description

The protocol's purpose is Alice sends secret message 0 or 1 to Bob by the quantum channel security. It is not necessary to take into account the identity of the parties.

14.3.1 Interceptive Examination Stage

The sender Alice prepares orderly 2n four-quit cluster states$|\psi\rangle_{1234}$, then stochastically carries out the unitary transformation U_I or U_X where, $U_I = I \otimes I \otimes I \otimes I$, $U_X = \sigma_X \otimes \sigma_X \otimes \sigma_X \otimes \sigma_X$.

After completing the operation, Alice randomly chooses n-States in the cluster state as a checking sequence, and records its location, then hold the unitary transformation stochastically I or H.

Alice gets the checked sequence's particles 1, 2, to compose sequence for QA, and 3, 4, for QB, where:

$$Q_A = \{P_1(1) \otimes P_1(2), \ldots, P_n(1) \otimes P_n(2)\} \tag{14.3}$$

$$Q_B = \{P_1(3) \otimes P_1(4), \ldots, P_n(3) \otimes P_n(4)\} \tag{14.4}$$

And then sends QB to Bob, after which Bob will select randomly X -based or Z -based to measure the sequence, and tells the results to Alice. After Alice receives, informs Bob, Bob then tells Alice about the selected measure base. Alice measures the particles in his own hand with the measure base of Bob's, and compares the results with Bob. According to Eq. (14.2), combines with entanglement properties [12] of the four-quit cluster state, analyses of error rates. If the error rate is higher than the pre-set value, then give up the communication protocol and restart from the first step.

14.3.2 Formal Communication Stage

14.3.2.1 Code Part

Alice takes the left n four-quit cluster states as code sequence. Now the n states that Alice held are: $U_I|\psi\rangle_{1234}$ or$U_X|\psi\rangle_{1234}$=$|\psi'\rangle_{1234}$.

Before coding, Alice has left 3 and 4 particles composed sequence SB, particles 1 and 2 for SA. Where:

$$S_A = \{P_1(1) \otimes P_1(2), \ldots, P_n(1) \otimes P_n(2)\} \tag{14.5}$$

$$S_A = \{P_1(3) \otimes P_1(4), \ldots, P_n(3) \otimes P_n(4)\} \tag{14.6}$$

At the same time, Alice prepares n test photons, which are chosen randomly from$\{|0\rangle, |1\rangle, |+\rangle, |-\rangle\}$, and installed in S_B and then composed the sequence Sc, and record the location of the test photon and the corresponding state. Alice sends Sc to Bob; when Bob receives, he informs Alice. Alice then announces the location and state of the test photon. Bob selects Z-based to measure the test photon, and compared with the results Alice announces, then Bob analyzes the error rate. If the error rate is lower than expected, notify Alice to encode the SA.

The coding rules are as follows:

If Alicee wants to send a secret message its bit is 0, to perform a $\sigma_0 = I$ transformation on particle 2.

If Alice wants to send a secret message its bit is 1, to perform a $\sigma_1 = \sigma_Z$ transformation on particle 2.

Table 14.1 Coding details

Coding cluster state send information content	The coding on particle 1	The coding on particle 2	After the coding
0	I	I	$\sigma_0 \otimes \sigma_0 \otimes \sigma_0 \otimes \sigma_0 \|\psi\rangle_{1234}$
0	σ_Z	I	$\sigma_Z \otimes \sigma_0 \otimes \sigma_0 \otimes \sigma_0 \|\psi\rangle_{1234}$
1	I	σ_X	$\sigma_0 \otimes \sigma_X \otimes \sigma_0 \otimes \sigma_0 \|\psi\rangle_{1234}$
1	σ_Z	σ_X	$\sigma_Z \otimes \sigma_X \otimes \sigma_0 \otimes \sigma_0 \|\psi\rangle_{1234}$

Note: At the same time Alice performs a random transformation $\sigma_0 = I$ or $\sigma_1 = \sigma_Z$ on particles 1. Its purpose is, in theory, the Bell-based measurement results released by the decode stage equally probability to appear $|\beta_{00}\rangle$, $|\beta_{01}\rangle$, $|\beta_{10}\rangle$ and $|\beta_{11}\rangle$. Which can prevent the eavesdropper on the measurement results from the public get sends information; the coding on the particle 2 has no effect with the coding on secret messages.

Assume that Alice has the n state is: $U_I|\psi\rangle_{1234}=|\psi\rangle_{1234}$.

The coding details are shown in Table 14.1.

14.3.2.2 Decoding Parts

After Alice's coding, then Alice and Bob simultaneously joint Bell-based [11] measurement, Alice sends the measurement results through the classical channel to Bob. Bob deciphers the secret message and decodes control rules as shown in Table 14.2. Decode control rules are shown in Table 14.2:

Similarly assuming that Alice has the n states is $U_X|\psi\rangle_{1234}=|\psi'\rangle_{1234}$.

The coding scheme is shown in Table 14.1.

Decode control rules is the same as in Table 14 2.

Hypothesis by four particle W states as information carrier, after the coding and decoding, decode rule table is as shown in Table 14.3.

In theory, the cluster state is better than W state of entanglement properties and more comfortable to use for information carrier. Through Tables 2 and table 3 to be known, the cluster state as information carrier combination measurement results have eight kinds, and W state a dozen states, redundancy combination more. Obviously with the cluster state as information carrier have a higher efficiency of the communication.

Table 14.2 Decode control rules

Alice	$\|\beta_{00}\rangle$	$\|\beta_{01}\rangle$	$\|\beta_{10}\rangle$	$\|\beta_{11}\rangle$
$\|\beta_{00}\rangle$	0	×	0	×
$\|\beta_{01}\rangle$	1	×	1	×
$\|\beta_{10}\rangle$	0	×	0	×
$\|\beta_{11}\rangle$	1	×	1	×

Note The " ×" says it will not appear this kind of measuring combination results

Table 14.3 Decode rule

Alice	$\|\beta_{00}\rangle$	$\|\beta_{01}\rangle$	$\|\beta_{10}\rangle$	$\|\beta_{11}\rangle$
$\|\beta_{00}\rangle$	1	0	1	×
$\|\beta_{01}\rangle$	0	1	0	×
$\|\beta_{10}\rangle$	1	0	1	×
$\|\beta_{11}\rangle$	0	1	0	×

Note The " ×" says it will not appear this kind of measuring combination results

14.4 The Protocol Security Analysis

The security of the protocol is to establish the security on the basis of the QA, QB sequence and SA, SC sequence transmitted. The communicating parties use the X-based or Z-based measurements to detect eavesdropping; this method is the same as BBM92 protocol. The protocol BBM92 has proved to be unconditionally secure. This paper's protocol security and protocol BBM92 are equivalent from the perspective of information theory. We can be more straightforward; Eve cannot escape the detection of the communicating parties. Assuming Eve does not take any eavesdropping measures, Alice according to the news of the secret message bit value 0 or 1 does transform respectively. In this, assuming that Alice sends secret message 0 or 1 probability is 1/2. Because the encoding and decoding part in the communication process does not require any auxiliary classical information, Eve does not get any useful classical information. So, Eve guesses the probability of Alice sends a secret message can only be 1/2, thus you can get Alice and Eve's mutual information:

$$I(A,E) = H(A) - H(A|E) = 1 - \frac{1}{2}H\left(\frac{1}{2}\right) - \frac{1}{2}H\left(\frac{1}{2}\right) = 0 \tag{14.7}$$

Where, H is the Shannon entropy. Similarly, $I(B,E) = 0$ So Eve can easily be detected.

Next, analyze the safety of the strongest attacks. Suppose the eavesdropper Eve sends to each particle placed as detector in the quantum channel. When Alice coding is complete, Eve is ready to steal the secret message that Alice sends to Bob. We may assume that the initial state of the detector is $|0\rangle_e$, the state after the interaction of the detector with the Four-Quit Cluster State $|\psi\rangle_{1234}$, the whole system density operator is $\rho_{1234e} = U|\psi\rangle|00\rangle\langle 00|\langle\psi|U^{\dagger}$, for which the U is an execution unitary transformation of Eve. Eve in the placement of the detectors, at the same time, the cluster state will disturbance that is $U \neq I$ For a single particle and detector interaction, according to Schmidt decomposition theorem [13, 14] available:

$$U(|0\rangle \otimes |0\rangle_e) = |0\rangle|a_{00}\rangle_e + |1\rangle|a_{01}\rangle_e \tag{14.8}$$

$$U(|1\rangle \otimes |0\rangle_e) = |0\rangle|a_{10}\rangle_e + |1\rangle|a_{11}\rangle_e \tag{14.9}$$

$$U(|+\rangle \otimes |0\rangle_e) = |+\rangle|b_{00}\rangle_e + |-\rangle|b_{01}\rangle_e \tag{14.10}$$

$$U(|-\rangle \otimes |0\rangle_e) = |+\rangle|b_{10}\rangle_e + |-\rangle|b_{11}\rangle_e \tag{14.11}$$

where, $\langle a_{00}|a_{01}\rangle = 0$, $\langle a_{10}|a_{11}\rangle = 0$, $\langle b_{00}|b_{01}\rangle = 0$, $\langle b_{10}|b_{11}\rangle = 0$.

For a single particle and detector interaction, according to Schmidt decomposition theorem available:

(1). When subscript 0 and 1 swap inner product in a variety of $|a_{ij}\rangle$and $|b_{ij}\rangle$ remain unchanged, $i, j \in \{0, 1\}$

(2). When subscript a and b swap, inner product in a variety of $|a_{ij}\rangle$ and $|b_{ij}\rangle$ remain unchanged,$i, j \in \{0, 1\}$

Available by the symmetry conditions (1):

$$\langle a_{00}|a_{00}\rangle = \langle a_{11}|a_{11}\rangle \quad \langle a_{01}|a_{01}\rangle = \langle a_{10}|a_{10}\rangle$$

$$\langle b_{00}|b_{00}\rangle = \langle b_{11}|b_{11}\rangle \quad \langle b_{01}|b_{01}\rangle = \langle b_{10}|b_{10}\rangle \tag{14.12}$$

Available by the symmetry conditions (2)

$$\langle a_{00}|a_{00}\rangle = \langle b_{00}|b_{00}\rangle \quad \langle a_{01}|a_{01}\rangle = \langle b_{01}|b_{01}\rangle \tag{14.13}$$

According to the above two equations, make:

$$F = \langle a_{00}|a_{00}\rangle = \langle a_{11}|a_{11}\rangle = \langle b_{00}|b_{00}\rangle = \langle b_{11}|b_{11}\rangle > 0 \tag{14.14}$$

$$D = \langle a_{01}|a_{01}\rangle = \langle a_{10}|a_{10}\rangle = \langle b_{01}|b_{01}\rangle = \langle b_{10}|b_{10}\rangle > 0 \tag{14.15}$$

On both sides of (14.14) and (14.15) equations of their respective take inner product we can get:

$$F + D = 1 \tag{14.16}$$

Let$|a_{ii}\rangle = \sqrt{F}|\hat{a}_{ii}\rangle, |b_{ii}\rangle = \sqrt{F}|\hat{b}_{ii}\rangle, |a_{ij}\rangle = \sqrt{D}|\hat{a}_{ij}\rangle, |b_{ij}\rangle = \sqrt{D}|\hat{b}_{ij}\rangle, i, j \in \{0, 1\}$, where, $\langle \hat{a}_{ii}|\hat{a}_{ii}\rangle = \langle \hat{b}_{ii}|\hat{b}_{ii}\rangle = \langle \hat{a}_{ij}|\hat{a}_{ij}\rangle = \langle \hat{b}_{ij}|\hat{b}_{ij}\rangle = 1$.

Equations (14.16)–((14.19) can be expressed as:

$$U(|0\rangle \otimes |0\rangle_e) = \sqrt{F}|0\rangle|\hat{a}_{00}\rangle_e + \sqrt{D}|1\rangle|\hat{a}_{01}\rangle_e \tag{14.17}$$

$$U(|1\rangle \otimes |0\rangle_e) = \sqrt{F}|1\rangle|\hat{a}_{11}\rangle_e + \sqrt{D}|0\rangle|\hat{a}_{10}\rangle_e \tag{14.18}$$

$$U(|+\rangle \otimes |0\rangle_e) = \sqrt{F}|+\rangle|\hat{b}_{00}\rangle_e + \sqrt{D}|-\rangle|\hat{b}_{01}\rangle_e \tag{14.19}$$

$$U(|-\rangle \otimes |0\rangle_e) = \sqrt{F}|-\rangle|\hat{b}_{11}\rangle_e + \sqrt{D}|+\rangle|\hat{b}_{01}\rangle_e \tag{14.20}$$

Among them, F is fidelity and D is the bit error ratio. Alice sends check sequence that the state is: $IU_I|\psi\rangle_{1234}$ Eve sends to each particle placing a detector in the quantum channel, and then the entire quantum channel system by Z-based can be expressed as:

So, when Alice and Bob choose Z-based measuring the check sequence, the error ratio is 2FD. Similarly, Alice sends another check sequence and chooses Z-based measurement; the error ratio is also 2FD.

In conclusion, Alice on the analysis of four-quit cluster State entanglement properties, Eve inevitably disturbance cluster State. Being tapped test, in theory, 2FD > 0, Alice can detect the existence of Eve. In addition, in the formal communication stage, introduce the test photons, its secrecy by quantum No-Cloning Theorem and quantum uncertainty principle guarantee. Therefore, there will also be found Eve eavesdropping, ensure the confidentiality of further communication.

$$\begin{aligned}
|\psi\rangle_{1234E} = \frac{1}{2}\Big[& |0000\rangle\left(F|\hat{a}_{00}\rangle_{e3}|\hat{a}_{00}\rangle_{e4} + D|\hat{a}_{10}\rangle_{e3}|\hat{a}_{10}\rangle_{e4}\right) + \\
& |0001\rangle\sqrt{FD}\left(|\hat{a}_{00}\rangle_{e3}|\hat{a}_{01}\rangle_{e4} + |\hat{a}_{10}\rangle_{e3}|\hat{a}_{11}\rangle_{e4}\right) + \\
& 0010\rangle\sqrt{FD}\left(|\hat{a}_{01}\rangle_{e3}|\hat{a}_{00}\rangle_{e4} + |\hat{a}_{11}\rangle_{e3}|\hat{a}_{10}\rangle_{e4}\right) + \\
& |0011\rangle\left(F|\hat{a}_{11}\rangle_{e3}|\hat{a}_{11}\rangle_{e4} + D|\hat{a}_{01}\rangle_{e3}|\hat{a}_{01}\rangle_{e4}\right) + \\
& 1100\rangle\left(F|\hat{a}_{00}\rangle_{e3}|\hat{a}_{00}\rangle_{e4} - D|\hat{a}_{10}\rangle_{e3}|\hat{a}_{10}\rangle_{e4}\right) + \\
& |1101\rangle\sqrt{FD}\left(|\hat{a}_{00}\rangle_{e3}|\hat{a}_{01}\rangle_{e4} - |\hat{a}_{10}\rangle_{e3}|\hat{a}_{11}\rangle_{e4}\right) + \\
& 1110\rangle\sqrt{FD}\left(|\hat{a}_{01}\rangle_{e3}|\hat{a}_{00}\rangle_{e4} - |\hat{a}_{11}\rangle_{e3}|\hat{a}_{10}\rangle_{e4}\right) + \\
& |1111\rangle\left(F|\hat{a}_{11}\rangle_{e3}|\hat{a}_{11}\rangle_{e4} - D|\hat{a}_{01}\rangle_{e3}|\hat{a}_{01}\rangle_{e4}\right)
\end{aligned} \tag{14.21}$$

14.5 Conclusion

Through the above analysis of the security protocol, in the ideal channel, the protocol for non-coherent attack is safe. In the actual conditions, the safety of the protocol depends on the actual noise level of the channel. The advantages of the protocol are:

1. Inserted into the test photons in the communication phase, strengthen the communication of safety performance.
2. Ensure the security of quantum channel conditions, the cluster state as an information carrier, maximum entanglement, the highest correlation.

Along with the continuous quantum communication understanding and thorough research, more schemes will be out; I believe the actual quantum communication will be widely applied in the near future.

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Chapter 15
An On-Demand QoS Routing Algorithm in Multiservice Scenarios

Yanjing Li and Li Li

Abstract The trend that Internet applications are becoming more various puts forward higher request on Quality of Service (QoS) of coexisting multiservices in modern networks. An on-demand QoS path selection algorithm (marked as BW-cost algorithm) satisfying constrained conditions of both bandwidth and cost is proposed innovatively in this paper, and its usage procedures in OSPF is claimed accordingly. The core idea of the algorithm is choosing the best route satisfying certain bandwidth requirement with smallest cost in order to achieve the goal of splitting streams and balancing load. Simulation results shows the BW-cost algorithm can successfully guarantee multiservices' QoS demands as well as has much better performance in some targets such as throughput and network utility, comparing to traditional Dijkstra algorithm. It also exceeds en existing on-demand QoS algorithm.

Keywords OSPF · Qos routing · Dijkstra algorithm · Multiservice scenario

15.1 Introduction

A multiservice scenario has become the mainstream study scene in today's networks as IP networks are demanded for more satisfying data services. Routing protocols which are using traditional algorithms to provide best-effort services can no longer meet the user's QoS needs any more. For instance of the Dijkstra algorithm used in OSPF protocol, which is one of the most classic shortest path

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first algorithms, it always leads to the overuse of calculated paths with minimum hop counts and consequently the congestion at this best path when some high-quality-demanding data services trying to pass through. So some QoS mechanisms must be used to balance the load of the network and improve the transmission efficiency.

QoS routing has been studied for a while. In [1] a cheapest path algorithm from one source to all destinations when links have two weights (cost and delay) is presented. Some other solutions use source routing along with shortest path routing to achieve the goal [2]. Anirudha presented a load sensitive routing (LSR) algorithm based on Dijkstra's shortest path algorithm [2]. In [3], Karima et al. claimed that MPLS and traffic engineering provide indeed an adequate mean to establish constrained routes which satisfy application requirements like bandwidth. A novel two-phase load balanced shortest path routing (LB-SPR) is proposed in [4], where each phase uses the standard SPR protocol. In [5], authors described a path precomputation selection algorithm. A feature of it is that in each iteration, the intermediate results must be stored in the QoS routing table, which inevitably increases the expenses in terms of storage.

Another algorithm authors put forward is an on-demand BW-hop based QoS algorithm feasible when number of requests for QoS routes is limited [6]. They described how a standard Dijkstra algorithm can, for a given destination and bandwidth requirement, generate a minimum hop path that can accommodate the required bandwidth.

Through analysis OSPF protocol and current QoS algorithms, this paper puts forward a routing strategy capable of ensuring QoS (bandwidth requirement mainly). The core idea of the algorithm is choosing the best route satisfying certain bandwidth requirement with smallest cost. Simulation results show that the improved on-demand BW-cost routing algorithm proposed in this paper solves the QoS routing problem better than the algorithm in [6] while much exceeds the traditional Dijkstra algorithm.

The rest of this paper is organized like this: in Sect. 15.2, the BW-cost algorithm and its operation procedure in OSPF are illustrated in details; in Sect. 15.3, simulation results among different scenarios are analyzed and compared; eventually a conclusion is drawn in Sect. 15.4.

15.2 An On-Demand BW-Cost QoS Algorithm

15.2.1 QoS Routing Procedures Design

A routing starter computes the QoS route if there is a resource reservation request. If not, it remains calculating routes using normal Dijkstra algorithm. Elaborate procedure operated when QoS routing is applied is illustrated as below:

Each router sets up a bandwidth request queue, a current bandwidth request, a value of request threshold and a variable of the state of request queue. The request threshold means the maximum number of acceptable bandwidth requests supported by one router and should be identical for all routers in an OSPF area. The state of request queue is set to be REQ_FREE initially.

If there is no bandwidth request from upper applications, the original Dijkstra algorithm is applied directly. Every time the initiating router receives a bandwidth reservation request, it looks up the standard routing table to determine whether the destination address is reachable. If the destination address is unreachable, then the router denies this request. If the destination is reachable while the state of request queue is REQ_FULL at the same time, the router should deny the request as well. Otherwise resource request ID adds up by 1, which starts from 1, and the request is pushed into the bandwidth request queue. If the number of requests in the bandwidth request queue is already equal to the threshold value, the state of it is turned to REQ_FULL.

Whenever a router receives a request LSA, it firstly determines whether the state of the bandwidth request queue is empty. If empty, it directly sends out bandwidth response LSA and regards this received bandwidth request as current request. Then it checks if the state of request queue is REQ_FULL. If so, it compares the priority of the latest request to the most inferior request in the queue. If the priority of the latest request is higher, it discards the most inferior request in the queue and inserts the latest one into the queue based on the priority mechanism. Otherwise, it discards the latest request.

A router receives a bandwidth response LSA. If the router is the initiating router and the LSA is the response to current request, it puts the LSA into the database, which is used to store link states in OSPF, otherwise discards it simply. Whenever the database has contained bandwidth response LSAs from all the routers in the domain, the router applies the improved BW-cost QoS algorithm proposed in this paper, based on the information in the database. During the computation process, only links able to provide adequate bandwidth are taken into account, otherwise the link is thought unreachable. If the output of the algorithm is empty, then the router will deny the resource reservation request. If not, the router generates bandwidth allocation LSAs and then distributes them.

If a router receives a bandwidth allocation LSA, it checks itself if is part of the QoS route. If the answer is positive, it constructs a QoS route and reserves required bandwidth at related interfaces.

A router processes the bandwidth request with highest priority in the queue if it is not empty. If the router is the initiating one of the request, it sends out the bandwidth request LSA. Otherwise, it sends corresponding bandwidth response LSA. If the state of request queue is REQ_FULL, it is turned to REQ_FREE.

When a router receives a bandwidth release LSA, it checks itself if is part of the QoS route based on information in the LSA. If the answer is positive, it deletes related QoS routes and releases bandwidth at related interfaces.

If some OSPF link is broken, standard OSPF procedures are responsible for flooding all the messages through the whole domain. The initiating router examines all the requests which have already utilized QoS routes with participation of the broken link and sends corresponding bandwidth release LSAs. After that, it reapplies for required bandwidth to construct a new QoS route.

15.2.2 QoS Path Selection Algorithm

The core idea of the algorithm is to perform a minimum cost path computation on a preprocessed graph whose links without enough bandwidth for services are deleted from the topology. The pseudo code of the algorithm is illustrated in the following.

```
Inputs:
V = set of vertices, L = set of edges, s = source vertex (at which the algorithm is executed), d = destination
Struct tab_entry:
{hops = integer,
prevnode = integer 1..N,
ontree = boolean.}
Variables:
TT[1..N]: topology table, its (n) entry is a tab_entry record; S: list of candidate vertices; v: vertex under consideration; b(n,m): available bandwidth on edge (n,m); N: the number of paths being stored; cost(n,m): cost value of link (n,m).
Algorithm begins:
Function qos_djk:{
for n = 1 : N do/* Initialization */
TT[n].hops = Inf;
TT[n].prevnode = null;
TT[n].ontree = FALSE;
TT[s].hops = 0;
v = s;
while v ! == d do
begin:
TT[v].ontree = TRUE;
for all edges (v,m) in L and b(v,m) >= B{
if (!TT[m].ontree & TT[m].hops > TT[v].hops+1)
{
S = S union {m};
TT[m].hops = TT[v].hops + 1;
TT[m].prevnode = v;
}
}
```

```
if S is EMPTY
v = d; path = −1;/* This will end the algorithm */
else
v = S(1); S = S - {v};
end./*for while*/}/*end for function*/
   - - - - - - - - - - - - - - -
if (path!==−1)then store path;
id = 1;/*initialization, used to indicate which node is checked now*/
while path!==−1 do
begin:
w=path(id);/*element under consideration*/
k=path(id+1);/*next element on path*/
if (for any node m, m!==w & m!==k & b(w,m)>=B){
b(w,k)=0;/*fail the original selecte link*/
re-do Function qos_djk;
if (path!==-1)then store path;
id=1;/*reset to the first node*/
}/*end for if*/
else
id++;/*check next node on path*/
end;/*for while*/
cost=Function sum(path(1));
path_final=path(1);/*initialization*/
for x=2:N do{
if(cost>Function sum(path(x));) then
path_final=path(x);
}/*find the least costy path from all paths*/
- - - - - - - - - -
Function sum:{
cst=0;/*initialization, used as a temp value for cost*/
for z=1:(length(path)-1)
cst=cost(path(z),path(z+1))+cst;
}/*The function is used to sum the costs*/
```

15.3 Simulation and Analysis

In the simulation, the network is constructed in OPNET. The topology is shown in Fig. 15.1. Four traffic flows are considered during the simulation, the ID number is also the bandwidth requirement value of a specific traffic with unit Kbps. This design also adapts to the following sections when network parameters are collected for traffic statistics.

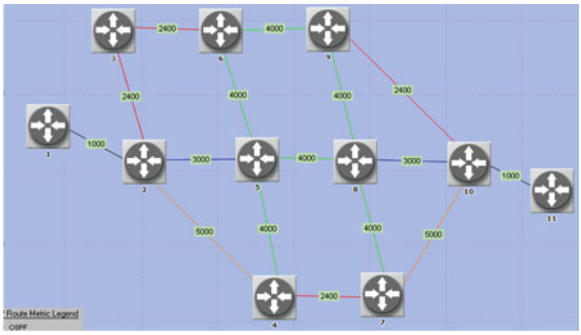

Fig. 15.1 Network topology

Three algorithms, the original Dijkstra algorithm (marked as standard Djk), the QoS algorithm proposed in [7] (marked as on-demand QoS Djk), and the algorithm proposed in this paper (marked as BW-cost QoS Djk) are simulated.

15.3.1 Simulation Results of QoS Routes

The path selection results of three algorithms are shown in Table 15.1.

From Table 15.1, we can get the conclusion that the improved BW-cost algorithm proposed perfectly balances load of multiple services from one shortest cost path to several QoS routes with second minimal cost value satisfying bandwidth demands at the same time.

15.3.2 Simulation Results of Throughput

The simulation results of throughput are shown in Fig. 15.2. From it we can see that when routers adopting either on-demand QoS algorithm, all 4 services' bandwidth requirements are guaranteed (light & dark green bars); while under the SPF algorithm circumstances, only two services with ID 850 and ID 550 are delivered successfully, huge traffic loss can be found for other two services as presented as red bars.

Table 15.1 Selected paths in different scenarios with various bandwidth requirements

	ID 1100	ID 850	ID 550	ID 350
Standard Djk	2-5-8-10	2-5-8-10	2-5-8-10	2-5-8-10
On-demand QoS Djk	2-5-8-10	2-4-7-10	2-3-6-9-10	2-4-7-10
BW-cost QoS Djk	2-5-8-10	2-3-6-9-10	2-3-6-9-10	2-4-7-10

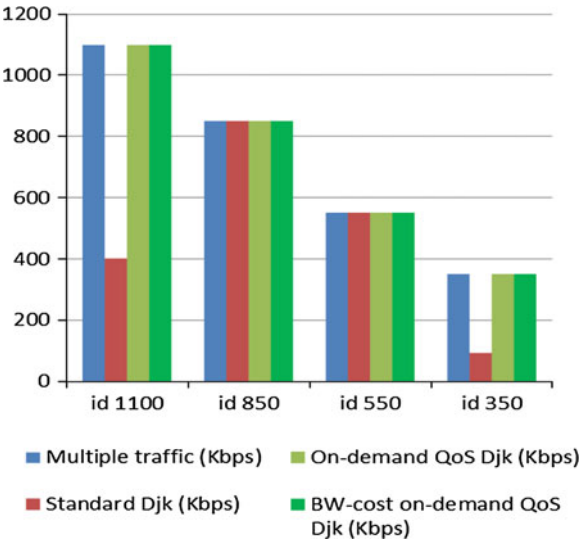

Fig. 15.2 Throughput comparison

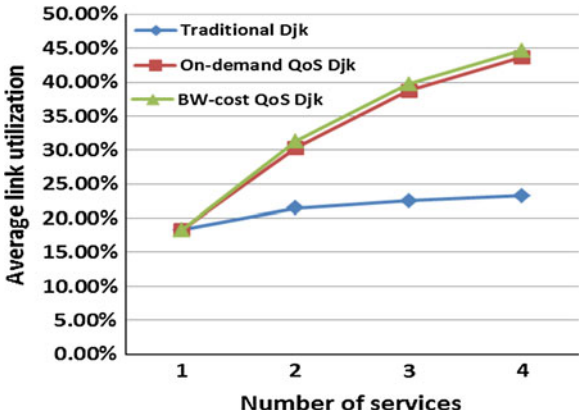

Fig. 15.3 Average link utilization

15.3.3 Simulation Results of Average Link Utilization

The computing method of average link bandwidth utilization is given as the following formula [7]:

$$U = \sum_{(i,j)\in L} \frac{u(i,j)}{|L|} \tag{15.1}$$

Where u (i,j) is ratio of occupied bandwidth to initial link bandwidth on link (i,j), L is the set of all links in the network. The results are shown in Fig. 15.3.

From Fig. 15.3, we can see that when adopting the traditional SPF algorithm, the link utilization of the whole network does not improve obviously (no higher

than 25 %). When it comes to the on-demand QoS scenarios, the average utilization rises significantly as the number of services increases gradually and the new BW-cost QoS algorithm proposed in this paper has 1 % higher utilization than the existing on-demand QoS algorithm at multiple stages.

15.4 Conclusion

In this paper, elaborate illustrations are put on the proposed on-demand BW-cost QoS algorithm and its according working procedures to make QoS metrics compatible with OSPF flooding mechanism. Eventually, the simulation results show that QoS routing extension to OSPF protocol we proposed in this paper is a more effective mechanism to guarantee services' quality in multiservice scenario than the existing one.

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Chapter 16
Large-Scale Test of 4G TD-LTE Network

Jiankang Zhang, Yuwen Liu, Yangli Gu and Lijuan Su

Abstract To have a better understanding of the market concerns, promotion method as well as its problem in the commercial promotion of 4G TD-LTE network in China, this study made a depth research into Hangzhou, the first city in China to promote 4G TD-LTE on its second phase large-scale trial by means of depth interviews and focus groups. It reveals that the Chinese government and enterprises are now attaching more importance to the independent intellectual property rights of technology standards and global application in terms of the value orientation and as for its implementation methods; it appeals to smooth evolution technology for rapid development. Despite some technical difficulties, 4G TD-LTE network is changing the culture of Hangzhou and improving the quality of the local inhabitants' life. Based on interviews with core managers and participants involved in the 4G TD-LTE project, the research results will contribute to the understanding of practical problems in the promotion of 4G TD-LTE in China and provide proposals for other cities to apply this technology in the world.

Keywords 4G TD-LTE · 2nd phase large-scale trial · Commercial trial · Free trial

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16.1 Introduction

Time division-long-term evolution (TD-LTE) is the 4th generation homegrown mobile communication technology developed by Datang Telecom Technology and Industry Group in China [1]. It has been incorporated into the 4G international standard by International Telecommunication Union (ITU) since October, 2010. In April, 2012, China Mobile chose Hangzhou as the first city in China to try this technology on the 2nd phase large-scale trial before commercial trial and there are trial spots in Hangzhou are mainly hotspots, including restaurants, inns, scenic spots, business centers and communities, such as Rapid Route B1, Pudding Inn, three teahouses around the West Lake, an import and export company and an inhabitant in a certain community. All the inhabitants can try 4G TD-LTE free as long as the net backs Wi-Fi, whether in or out of the network, with no flow limit, no certification, with smart phones, or iPad or portable computers.

This research will probe into the market concerns, promotion methods, and its problems in the 2nd phase large-scale trial of 4G TD-LTE in Hangzhou by means of depth interviews and focus groups.

16.2 Research Methods

16.2.1 Depth Interviews

This research adopts direct, one-on-one depth interviews with people involved in this project in Hangzhou, including participants in the 4G TD-LTE network project, government clerks, technicians, and market participants so as to know about their personal opinions and attitudes toward the 4G TD-LTE network before its commercial trial.

16.2.2 Focus Groups

Focus group is a very popular method in current social research projects in China. It has advantages over a questionnaire in that the participants are like attending a brain-inspiring meeting where questions are asked in an interactive group setting and participants are free to talk with other group members which may inspire new concepts and ideas more easily and efficiently to gain more comprehensive and unexpected information while in a questionnaire the interviewees tend to hide their real opinions and their status of life and work and make choices according to ethnic norms and sometimes they could not fully express their ideas due to their limited vision.

16.3 Research Results

16.3.1 Value Orientation: Emphasis on Intellectual Property Rights and Global Application

The 4G network standard for the 2nd phase large-scale trial in Hangzhou is developed by a Chinese enterprise which has been incorporated by ITU, The development of TD-LTE can not only maximize the present technology of TD-SCDMA and its investment, but also gain more independent intellectual property rights in related areas, thus take the initiative and have a say over the standard.

In the promotion of 4G TD-LTE network, the Chinese government and enterprises attach importance to the global application of the standard and try actively to expand the international market, and the world witnessed the start of GTI, the Global TD-LTE Initiative, which aims to push the establishment of a top operating environment, provide service experiences for large customers, improve its operating efficiency, to promote the combination of TD-LTE and LTE FDD to the largest degree and promote multilateral cooperation. The establishment of GTI is a symbol of rapid progress in the commercial use of homegrown TD-LTE and a step into the international market. In an interview on the internationalization of TD-LTE, Miao Yu, Minister of China Industry and Information Ministry, says that, "Besides holding its leading position in China, the development of TD-LTE technology should conform to the international development so that the telecom operators and equipment manufacturers could share the international 4G market". Experts also claim that TD-TLE, as the evolution technology of TD-SCDMA, has the equivalent property to that of FDD-LTE and has gained worldwide acceptance. To grasp this historic opportunity, with the support from the government, China Mobile cooperates with all parties in the industrial chain and promotes the development and perfection of 4G TD-LTE network in the industrialization, internationalization, and innovation so as to create a good eco-environment.

At present, the mobile operators in America have introduced TD-LTE technology into the internet and mobile clients and Apple Company will apply it to Iphones [2]. In Japan, the mobile operators also put it into use in 2011 and an initial 400 billion Japanese dollars has been invested in establishing base stations for TD-LTE technology which is gradually becoming the mainstream standard for future wireless mobile communications in the world and has been accepted by large operators like China Mobile, Japan Softbank, German Telecom, and French Telecom. It is predicted that over 10 countries and areas will begin to deploy the commercial use of this technology, several of which have started with this program and brought nearly 100 billion US dollars for the use of the patent [3]. According to the latest report made by Infinities Research Company, it is estimated that the 4G facilities market will reach 16 billion dollars in 2015, which will provide an excellent opportunity in the international market for the homegrown 4G TD-LTE network. That is the reason why the Chinese government and enterprises go all out consistently to promote the global application of this technology.

16.3.2 Implementation Method: Rapid Deployment of Smooth Evolution Technology

To achieve this goal, China Mobile Zhejiang Branch co developed smooth evolution technology from 3G to 4G network with Huawei and promote the rapid implementation of 4G TD-LTE network. "With the start of second-phase large-scale trial of TD-LTE, how to evolve the present TD-SCDMA equipment smoothly and protect the existing investment to avoid the repetition of construction has become an important issue under consideration [4]".

Smooth evolution technology means inserting several boards into the original 3G TD-LTE and updating the software so as to allow two systems of 3G and 4G to operate in the same equipment and at the same time. "Compared with the newly built project, this technology will decrease the number of stations, shorten the cycle of the network construction, lower its cost and improve its quality [5]". At the same time it can protect and make full use of the original 3G investment.

The main difference between TD-LTE and FDD-LTE is eNodeB and the interface design of the clients. The smooth evolution of technology lowers the cost of 4G network deployment by 90 %, and shortens the time for building one base station from approximately 2 months to 3 days [6]. By the end of May 2012, 4G networks have covered the central area of Hangzhou and will cover the whole city by the end of 2012.

In response to the question 'Will 4G replace 3G that is still green?' with the rapid development of 4G TD-LTE in Hangzhou, the expert claimed during the interview that, 3G and 4G are not mutually exclusive. Many cell phones support various signal protocols, for example a 4G cell phone can both support 3G and 2G. The goal to develop 4G is to provide the network service as fast as possible. Also 4G technologies are compatible with most of the current technologies with the same core networks, transmission networks, and management platforms. With the help of seamless transition of technology, the majority of the current base stations can be upgraded seamlessly and only the minorities of outdated ones have to be upgraded with considerably more efforts.

16.3.3 Hangzhou: On the Threshold of the Era of Real Mobile Multimedia Telecommunication

Compared with 3G technology, the 4G TD-LTE in Hangzhou adopts a number of powerful and revolutionary technologies during the process of design and test. The system makes considerably more effective use of radio spectrum than 2G or 3G technologies, which not only allows more but also faster utilities in the same spectrum. It has been tested that the maximum bandwidth of TD-LET covering B1 Bus can be as high as 80 Mbit/s and 40–50 Mbit/s on average [7].

It has been revealed that, each 4G channel covers approximately 100 MHz of spectrum, as wide as 20 times of 3G networks, and Hangzhou's 4G TD-LTE can satisfy the demands that 3G technologies cannot meet, such as vast coverage, high communication quality, affordable high-speed data service and HD multimedia. The wireless multimedia telecommunication services provided by 4G TD-LTE include audio, video and data service; therefore the network system of Hangzhou's 4G TD-LTE can also be called 'Mobile Multimedia-Telecommunication' (Table 16.1)..

There is only 20 M of spectrum that has been appointed to 4G networks, and another 20 M will be given by the PHS channel that is to be retired soon. This 40 M spectrum could be barely enough for the experimental networks for some districts in Hangzhou, but not wide enough for the nationwide formal commercial utility. Being asked by the question 'Will the spectrum limits obstruct 4G networks development', Hu Honglin, a professor in the Shanghai Research Center for Wireless Communications Chinese Academy of Science, said, 'The spectrum will not limit the development of 4G networks, The number of channels appointed to 4G networks has been scientifically calculated according to relevant regulations and is enough for the need of network deployment and coverage'. Additionally, FDD-LTE, the competitor of TD-LET, has a higher demand of spectrum, which uses symmetrical channels to upload and download data. However, symmetrical channels are quite rare globally. Thanks to the asymmetrical channels used by TD-LTE, the disadvantage of FDD-LTE is offset and service efficiency of networks is improved.

4G TD-LTE network expressed during the interview that Hangzhou is at the threshold of the era of real mobile multimedia telecommunication and the life of smart 4G technology. For example, the citizens in Hangzhou can use various mobile devices such as cell phones or tablets to easily control household appliances even thousands miles away. If it is going to rain, the house owner will not worry but just switch his cell phone to Business Trip Mode so that the windows of his house will be closed as demand and reopen when the rain stops to prevent mildews. If there is traffic jam on the way home, citizens in Hangzhou can use cell phones or laptops to remotely open his coffee machine and rebuilder. When he arrives at home, he may have a cup of aromatic coffee that has been prepared, take a shower with the water that has been heated, lie into the bed to enjoy a fluent and exciting sports game on TV or iPad. Furthermore, the development of 4G facilitates remote medical care services, for example, some hospitals in Hangzhou are trying to use mobile devices worn by patients that will report patients' blood pressure and BGU 24/7 to the hospital. Also, with the help of 4G networks, experts in the hospital can observe the real-time status of patients on sports game site or in

Table 16.1 Telecommunication Technologies in China

No.	Generation	Link Speed
1	1G Analog Mobile Telecommunication	Phone call only
2	2G Digital Mobile Telecommunication	9.6 Kbps (32 Kbps max)
3	3G-TD-SCDMA Mobile Telecommunication	2 Mbps (3.6 Mbps max)
4	4G-TD-LTE Mobile Telecommunication	10 Mbps (100 Mbps max)

an ambulance, and give professional advices and evaluation. Hence, clear and rapid remote medical advice could be realized for the first aid and the 'Golden 30 min' will not be missed. Finally, 4G TD-LTE networks could be helpful to wireless HD CCTV. Nowadays, all CCTV cameras are fixed (cannot be installed on some mobile platforms like cars), expensive, and, more importantly, restricted by many environmental limitations. The mobile and wireless CCTV camera based on 4G TD-LTE can easily transmit video back and also act as an unmanned observatory for oilfields, dams, forests, and coasts.

16.3.4 Hot Issues in the Promotion of 4G TD-LTE Network in Hangzhou, China

In the interviews, several experts point out quite a few problems in the promotion of 4G TD-LTE network in Hangzhou. First of all, due to different communication standards, some technologies are difficult to achieve. So far, various mobile communication systems are not compatible, so it is the primary task to unify the telecom standards over which large telecom enterprises disagree with each other in the global promotion of the 4G TD-LTE system. Although the 4G TD-LTE system brings people much expectation for a better future, it needs to be improved, "Besides the support of core technologies like OFDM and intelligent antenna, it needs the enhancement of the interactive interference of suppression technology and recognition of multi-users so as to improve the anti-jamming capabilities among the neighboring users and channel-sharing users and cut the investment in network infrastructures [8]".

The next problem is the limit of transforming speed and the market shows a slow absorption of the 4G TD LTE technology.

Second, the limit of link speed may obstruct the market absorption of 4G technologies. Hangzhou's 4G LTE is mostly known for its huge link speed advantage over 3G networks; however, the speed may be greatly limited if by the network overall capacity, i.e., the more cell phones, the lower speed. It has been argued that 4G cell phone could hardly enjoy its maximum transfer rate of 100 Mb/s, which would greatly affect the experience of 4G networks users. It has been predicted by some researchers that, in a foreseeable future, the multimedia service of 3G telecommunication networks will go to the third stage, in which the globally 3G networks have been installed, over 25 % of global population is using 3G system, and the market absorption of 3G technologies is still slow. Concerning the utility of 4G TD-LTE systems in Hangzhou, a transitional period is still needed, during which the benefit outlook of 4G may be extremely undermined and threatened by the so-called 5G technologies if the 4G technologies are postponed no matter for the reason of networks or clients.

Third, the device upgrade may be challenged by the shortage of qualified engineers or experts. Before the deployment of 4G mobile systems, the most of the radio infrastructure all over the world are installed based on 3G technologies. If the

transition from 3G to 4G is inevitable, a great number of radio infrastructures will have to be upgraded, which will inevitably lower the pace of 4G entering into the market. At that time, 3G mobile devices may not be required to upgrade to 4G technologies. Concerning the deployment of 4G TD-LTE in Hangzhou, when being ask the question "Will 4G be postponed by the shortcomings of 4G mobile devices?", the industry expressed during the interview that, "There is no need for the cell phone in the future to support from the phone call services at KB level to the data service of hundreds of MBs—Just like there is no need for a cell phone to work from −80 degrees to 80 degrees." In other words, from the perspective of the network users, it is not necessary for client manufacturers to produce cell phones that cover all signal bands, but just few specific bands to satisfy users' needs. It has been revealed that, some companies are like Huawei, ZTE and Samsung are testing and manufacturing such cell phones that both support 2G phone calls and 4G data services. Meanwhile, some companies a number of manufactures are designing MiFi devices transferring 4G signals to Wi-Fi signals which is being widely used and considered as the main application of 4G technologies by Softbank in Japan. The chip manufacturer Innofidei CEO Zhang Hui believes the design of clients and the deployment of 4D networks could be mutually benefiting and supportive.

Fourthly, after the deployment of 4G is truly started, the industry lacks the professional and skillful engineers and experts who are familiar with 4G technologies, which will also postpone the speed of market absorption.

16.4 Summary

Through the survey of the second phase large-scale trial of the 4G TD-LTE networks in Hangzhou before its commercial trial, it has been revealed that, during the process of 4G TD-LTE networks deployment, the Chinese government and enterprises, in the concept of value, emphasize the intellectual property rights and global large-scale utility, contend strong for discourse power and leadership in the global business use of 4G., and work actively to promote the next stage of use and trial domestically. Where there is a standard, there is a way. "Being independent from foreign technical convention, TD-LTE found a new way for the industrial upgrade and independent innovation and laid a solid foundation for the industrialization and large-scale commercial use in the future. From following to leading, China has made a breakthrough for the future mobile telecommunication technologies [9]". Thanks to the seamless transition of technology, 4G TD-LTE makes full use of the current TD-SCDMA by lowering the cost, shortening the construction period and taking the advantages of the previous 3D resources.

However, some technical and practical issues still exist, primarily the location of base stations. Network service providers have to use some special methods to solve this problem, like separating antenna and base station, antenna masks, etc. Second, the TD-LTE industrial chain is trying to solve the issue of large-scale deployment.

The 2.6 GHz channel works well in densely populated districts, but in some remote areas service providers have to increase the amount of base stations, which will increase the running cost or the coverage will be flawed. Also there is no radio spectrum officially allocated to TD-LTE. But with the time passing, all technical issues will be solved [10]. "Finally TD-LTE will unite GSM/TD-SCDMA of China Mobile, GSM/WCDMA of China Unicom and CDM/EV-DO of China Telecom [11]". It has been proposed by the 6th LET TDD/FDD International Summit, TD-LTE GTI that in the next 3 years, TD-LTE by the year 2014 TD-LTE will have enjoyed more than 500 thousand base stations, more than 100 clients and more than 2 billion people coverage [12].

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Chapter 17
A Routing Algorithm Based on High Energy Efficiency in Cooperation WSN

Jianbin Xue, Ting Zhang and Wenhua Wang

Abstract To solve the weakness of small energy reserves of wireless sensor network, an ant colony algorithm based on the minimum energy consumption was proposed. The new algorithm chooses the path from the energy consumption of the current node to the next hop node, the path which chosen has the big pheromone to balance the energy consumption of whole network by the rules of intra-cluster communication and inter-clustering communication, and choosing the better link to realize the data transmission. The simulation results show that the path chosen by the algorithm is better than the simple ant colony algorithm, and the algorithm can save the network energy consumption better and can prolong the life cycle of the network.

Keywords WSN · Ant colony algorithm · Energy efficiency · Life cycle

17.1 Introduction

Wireless sensor network (WSN) as one of the key technologies of the Internet of things is listed as one of the ten major technologies in the future. Wireless sensor network, compared with the common mobile communication network, wireless LAN, Bluetooth network, the Ad hoc network wireless network, has obvious advantages. It is a data-centric application-oriented networking, such as: strong ability to self-organization, dynamic topology, the system of dynamic reconfigurable, and the number of nodes, the distribution of high density etc. But WSN has some problems which largely restrict the development of wireless sensor networks. For example, WSN energy efficiency is large; the hardware resource is limited.

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At present, many studies have focused on wireless sensor network power energy. In particular, in [1], an ant colony algorithm is applied to the routing protocol of wireless sensor in order to solve the problem of the limited energy of nodes in wireless sensor network, and in [2] a WSN model based on MIMO was introduced, and the energy consumption in this case was analyzed, compared with SISO, the inductive of the MIMO could reduce more energy consumption of the network. Wang et al. [3] proposed a network of wireless sensor networks clustering algorithm based on ant colony. The algorithm effectively balanced network energy consumption, and prolonged the network lifetime. Li and Zheng proposed a variety of group ant colony optimization routing algorithm in [4], it could obtain multiroutes, balance the energy consuming in the WSN, prolong the lifetime, and reduce the network congestion. In accordance with the problem of shortest path, a fallback ant colony algorithm based on altitude information and ant withdrawal was proposed in literature [5]. In [6], the node energy level and transmit range were introduced to ACO pheromone increment formula, to make ACO better adapted to routing protocols of WSN. However, the study points and length of the paper were limited; the above algorithm did not consider the energy balance of the whole network.

An ant colony algorithm based on the minimum energy was proposed by this paper, with the low-energy adaptive clustering routing (of LEACH) algorithm being analyzed for the shortage of dynamic clustering protocol [7], using ant colony algorithm to improve the routing mechanism, electing better link to transmit data, in order to save more energy, reduce the burden of power, and prolong the life cycle.

This paper is organized as follows. In Sect. 17.2, the related extension-rule based on TP methods is given. In Sect. 17.3, the parallel TP method based on the Semi-extension rule is presented. The experimental results of comparing the algorithm proposed in this paper with other algorithms are also presented in Sect. 17.4. Finally, our work of this paper is summarized in the last section.

17.2 The Ant Colony Algorithm

Inspired by a real ant colony in the nature of collective behavior, an ant colony algorithm based on ant colony evolutionary algorithm belongs to stochastic search algorithm. It was pioneered by the Italian scholar Dorigo [8]. The basic idea of the ant colony algorithm was [9]: if there was a given point, and there are many paths from the point to the destination node, the ants at the point need to choose from the different paths. The ants left some substance on the path and also perceived the presence of the substance and its strength in the course of the campaign to guide their direction of motion. In this scheme there is a very important variable–pheromone, after the ant colony go through a path every time, they will update the pheromone of the path. The more pheromone the path has, the more ants will go through the path. After a period of positive feedback there will have more ants after this path, and this path was the shortest path which was required finally.

This paper applied the algorithm to the wireless sensor network routing protocol, finding an optimal transmission path by the ant colony algorithm. The whole process of the ant colony algorithm is divided into three steps: the distribution and mobility of the ant colony, the updating and volatilizing of local pheromone, and the updating of the whole pheromone.

17.3 Algorithm Described

Energy consumption of wireless sensor networks [10] is essentially the superposition of all nodes' energy consumption in the sensor network; the network energy consumption was divided into two parts: intra-cluster communication and inter-clustering communication. The study found when the transmission distance was more than 30 m the multiple-input multiple-output (MIMO) system could save more energy than SISO system. So the multiple-input multiple-output (MIMO) system was used to transmit data for inter-clustering communication; but for less than 30 m distance of intra-cluster communication, SISO communication system was adopted, reducing the energy consumption of the whole network. And compared with inter-clustering communication the energy consumption of intra-cluster communication was smaller. This paper mainly studied the energy consumption of the inter-clustering communication.

The inter-clustering communication transmission channel can be modeled as a k order Rayleigh flat fading channel, according to the free space link transmission model [11]. In the above model the energy consumption of the inter cluster communication can be got, total energy consumption of transmit L bit data packet [12] can be shown as follow:

$$E = \frac{2}{3}(1 + \phi)\left(\frac{\overline{P_b}}{4}\right)^{-\frac{1}{M_t}} \frac{2^b - 1}{b^{\frac{1}{M_t}+1}} M_t N_0 L \frac{(4\pi)^k}{G_t G_r \lambda^2} M_l N_f + \frac{P_c L}{bR_s} \tag{17.1}$$

Where, ϕ expresses the efficiency of the power amplifier, N_0 single sideband noise spectrum density, R_b bits transmission rate, among them, ϕ, $\overline{P_b}$, b, N_0, L, G_t, G_r, M_l, N_f, P_c, R_s etc., can be regarded as constant, Pc the power energy consumption of sender and the receiver communication component circuit, in the case of fixed circuit, the value was certain. In type (17.1) the values of the b and k were certain for a specific link. The size of the E was decided by the value of M_t and d. And in MIMO communication system the number of cooperation node $M_t - 1$ was solved base on the value of d, so the size of energy consumption E can be determined by the value of d. Based on the type the relationship between the M_t and d for partial derivative of E can be got, and made the equal to zero, $\frac{\partial^2 E}{\partial M_t \partial d} = 0$. The relationship between the M_t and d can be obtained:

$$a = M_t = \frac{k}{d} - \ln\frac{\overline{P_b} b}{4} \tag{17.2}$$

Among them $a = \frac{1}{M_t}$, $B = \frac{P_c L}{bR_s}$, $A = \frac{2}{3}(1+\phi)\left(2^b - 1\right)N_0 L \frac{(4\pi)^k}{G_t G_r \lambda^2} M_l N_f$.

Put type (17.2) into the type (17.1), then can get:

$$E = A\left(\frac{\overline{P_b}b}{4}\right)^{-a}\frac{1}{b}\left(\frac{k}{d} - \ln\frac{\overline{P_b}b}{4}\right)d^k + B \tag{17.3}$$

Type (17.2) was the relationship between the energy and the path, in the case that the path between the node and destination node was determined. It was considered that digital modulation constellation several b (bits/symbol) and the value of channel fading coefficient k were known. The ant colony algorithm was based on the length of the path to choose the path; the one-to-one energy consumption of E value and the distance d value can be found by type (17.3). So the energy problem can be solved by converting into the problem of path length.

In the moving of the ant, the rule and probability of the ant jump from node i to node j was shown as follows:

$$p_{ij}^k(t) = \begin{cases} \dfrac{[\tau_{ij}(t)]^\alpha [\eta_{ik}(t)]^\beta}{\sum\limits_{U \in allowed_k} [\tau_{iu}(t)]^\alpha [\eta_{iu}(t)]^\beta}, j \in \text{allowed}_k \\ 0, \text{ other} \end{cases} \tag{17.4}$$

In type (17.4), the allowed_k expresses the city that ant k allowed to choose at the next step, α the importance parameters of pheromone concentration, β the importance parameters of heuristic information. τ_{ij} is the pheromone concentration of the path from node i to node j.

For the simple ant colony algorithm:

$$\eta_{iu} = \frac{1}{d_{ij}} \tag{17.5}$$

d_{ij} expresses the distance between two nodes. For ant k, the smaller the d_{ij}, the bigger the η_{iu}, the bigger p_{ij} also. So, the η_{iu} expresses the expectations of ant from node i to node j.

For the improved ant colony algorithm:

$$\eta_{iu} = \frac{1}{E} = \frac{1}{A\left(\frac{\overline{P_b}b}{4}\right)^{-\frac{1}{\frac{k}{d} - \ln\frac{\overline{P_b}b}{4}}} \bullet \frac{1}{b}\left(\frac{k}{d} - \ln\frac{\overline{P_b}b}{4}\right) + B} \tag{17.6}$$

For the improved ant algorithm, the smaller the E, the bigger the η_{iu}, the bigger the p_{ij} also.

In order to avoid residual information submerged heuristic information caused by excessive pheromone residue, after every ant walk finished, update the residue information and global pheromone.

To sum up, this paper calculated the state transition probability based on the energy, that is according to energy consumption to choose the next hop node, then get an ant colony algorithm based on minimal energy consumption.

17.4 Simulation

Hypothesis simulation environment was in 100 m * 100 m observation area where 48 sensor nodes were randomly thrown, and the nodes were randomly distributed in the 100 m * 100 m area, all nodes having the same transmission range. One of them was sink node, and the radius of all nodes was 14 m, simulation environment by Matlab7.0. Figures 17.1 and 17.2 were the simulation for the link respectively found by simple ant colony and improved ant colony algorithm.

The link in Fig. 17.1 was found by the simple colony algorithm; the link shape was irregular; the path was more complex and the distance of some neighbor nodes was relatively great, which make these nodes premature dead, and cause the entire network energy consumption uneven, because the simple ant colony algorithm was proposed to solve TSP problem, and the algorithm was based on the shortest path. In the network which was combined with the multiple-input multiple-output (MIMO) system and wireless sensor network, the path length and the energy consumption was not directly proportional relationship, which led to the individual nodes premature dead, the network energy consumption uneven.

The link in Fig. 17.2 was found by the improved ant colony algorithm. Simply seen from the link, it was more uniform and had more rules than the simple ant colony algorithm found. Analyzing the relationship between energy consumption

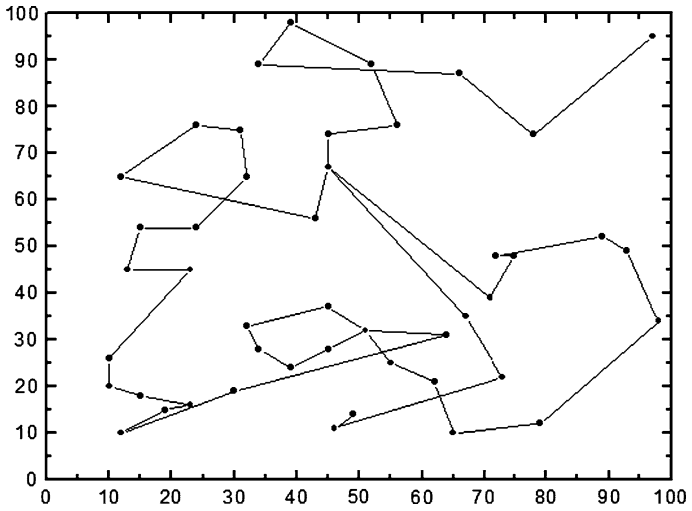

Fig. 17.1 Link found by simple ant colony algorithm

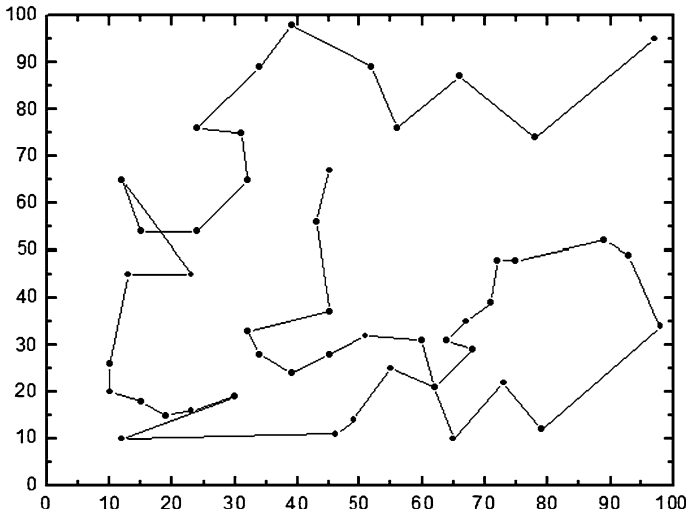

Fig. 17.2 Link found by the improved ant colony algorithm

and path of MIMO wireless sensor network, the ant colony of this algorithm updated the pheromone according to d_k, that is, based on the size of the energy to update the pheromone. So the selection of neighbor node was based on the minimum energy consumption, so the local optimal solution gotten was the node which has minimum transmission energy consumption. The link gotten by global update was the minimum transmission energy consumption of the whole network, so as to extend the survival cycle of whole network.

The paper analyzed the link found by these two algorithms, simulated the two algorithm's energy consumption, then compared the whole network energy consumption and life cycle of these algorithms. Hypothesis $k = 3$, the optimal constellation several $b = 5$. Wireless channel parameter resetting for: $\phi = 0.5, G_t G_r = 15dB, N_f = 10dB, \frac{N_0}{2} = -120dBm/Hz, P_b = 10^{-2}, R = 300bits/s, f_c = 2GHz, L = 2bit$. Ant colony algorithm parameter setting for: $\alpha = 1, \beta = 2, \rho = 0.3, Q = 50$.

From Fig. 17.3, in the same round case the node average energy consumption of the simple ant colony algorithm was more than the improved ant colony algorithm. And for the same node energy consumption value, in the improved ant colony algorithm the round number of transmit data was more 400 rounds or so than simple ant colony algorithm. It was also suggested that the improved algorithm proposed in this paper can save more energy consumption of the network than simple ant colony algorithm and can prolong the network life cycle. The main reason was that the simple ant colony algorithm was based on the shortest path, by finding the nearest neighbors to select the next hop node, and did not consider the problem of energy consumption. This article used the ant colony algorithm, different from the simple ant colony algorithm, which was based on the energy consumption of the current node to the next hop node to choose the least energy consumption path and improved the energy efficiency of the whole network.

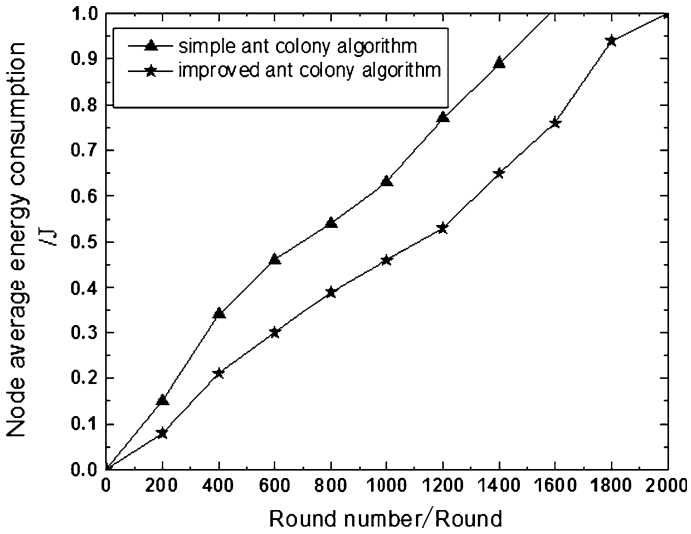

Fig. 17.3 Average energy consumption comparison chart

17.5 Conclusion

This article aimed at the limited energy weakness of wireless sensor network node, with collaborative MIMO wireless sensor network for model. Transforming the problem of energy consumption into the problem of distance, an ant colony algorithm based on the minimum energy consumption for routing distribution was put forward. The simulation results show that the link found by the improved ant colony algorithm was simple than simple ant colony algorithm and more suitable for network transmission. After comparing the two algorithm's average energy consumption, it was found that the improved ant colony algorithm can improve the energy consumption of network and prolong the network life cycle.

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Chapter 18
Communication Protocol for Greenhouse Monitoring System Based on Wireless Sensor Network

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Abstract At present, wireless sensor network (WSN) is mainly used in some applications with a few sensor nodes and poor expansibility, which make it difficult to change the number of nodes in the WSN and the number of sensors in the node flexibly. In this paper, a new communication protocol for greenhouse monitoring system with multifunctional nodes is designed based on zigbee WSN technology to overcome the shortages above. The protocol establishes and maintains the routing table dynamically. And the bit mask method is used to mark devices and sensors which can access multiple devices in one packet. Through the elaborately designed protocol, different nodes can join the system automatically. Users can scan the data, capture images, and control the devices through browser on the Internet. The experiment results show that this greenhouse monitoring system based on WSN has perfect transportability and expansibility.

Keywords Wireless sensor network · Communication protocol · Greenhouse monitoring system · Zigbee · Bit mask method

18.1 Introduction

In recent years, greenhouse agriculture has increasingly become an important direction of modern agriculture development [1]. And the design of an effective and accurate greenhouse monitoring system is prerequisite for improving the

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monitoring function service of greenhouse. wireless sensor network (WSN) has these advantages of low cost, low power consumption, flexible network organization [2, 3]. At present, the WSN has been applied in cabbage farm [4] and feed storage [5] successfully in foreign countries. Different applications of zigbee based on wireless sensor network in agriculture are developing rapidly [6]. Rajesh Singh has developed a pressure monitoring system using a RF module coupled to AVR MCU. Steven Silva has developed a website for monitoring water pollution based on Zigbee and WiMax technologies and realized the remote monitoring via browser. Liu Hui has used WSN to detect the environment parameters such as temperature, humidity, illumination, and harmful gas. These parameters can be summarized and managed at the server [7, 8]. These systems use some wireless communication technologies such as GPRS, WCDMA. And WSN has been applied in aquaculture, information collection of tea plantation and the cold chain environment of fruit respectively by Shi [9], Wang [10] and Guo [11, 12]. These developers have made great achievements in the zigbee protocol stack, packet loss rate and system stability. Zhang has designed a two-way communication, which can enable users to control these parameters in real-time way [13, 14]. But in the above applications, detecting data mainly depends on only one sensor. And the remote system is not mature enough to expand easily.

In this paper, a new communication protocol for greenhouse monitoring system with multifunctional nodes is designed based on zigbee WSN to overcome the poor expansibility of existing monitoring system. The protocol establishes and maintains the routing table dynamically. And the bit mask method is used to mark devices and sensors which can access multiple devices in one packet. Through the elaborately designed protocol, a distributed monitoring system is designed to realize scanning the data, capturing images and controlling the devices through browser on the Internet. And this greenhouse monitoring system designed in the paper has perfect transportability and expansibility.

18.2 General Architecture of Monitoring System

As Fig. 18.1 shows that the monitoring system includes three layers, which are relatively perception layer, network layer and application layer. The perception layer is made up of the greenhouse equipment. The network layer consists of zigbee nodes and embedded gateway. And the application layer program is located at the center server.

The gateway takes the S3C6410 provided by Samsung as the core processor (533 MHZ main frequency). It has a peripherals interface and built-in hardware image encoder. Gateway has IP network interface, DM9000 network adapter, WM-GMR-09 wifi module, WSN interface, and zigbee coordinator. At the same time the gateway is connected with some equipments, such as camera, wind speed sensor, wind direction sensor, and so on.

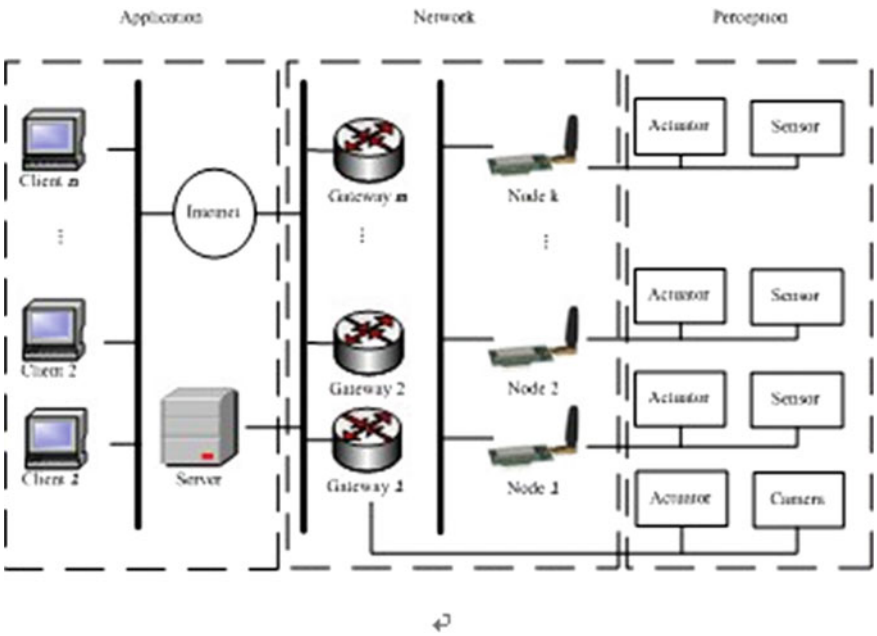

Fig. 18.1 Structure of the system

The MCU CC2530 with low power consumption and cost provided by TI is used to build zigbee wireless network. The MCU K60 using ARM Cortex-M4 for the kernel and produced by Freescale is the core control unit of the node. There are many actuators in the node including humidifier, heater, incandescent, and devices which are charge of communication with automatic equipment, such as pick-up robot, patrol robot, irrigation equipment, and so on.

The server is responsible for summarizing and storing the data of all sensors. The web server program provides service for clients to browse the data and operate the local equipment in the greenhouse through the Internet.

In Fig. 18.2, the single-arrows represent the calls and returns, and the double-arrows represent data communication.W2S represents web server and communication data packages for daemon, which are realized by the structure WEB2-SERVER below, similar to S2G, G2N, and so on.

Different nodes are just different in device driver and user interface, but the communication, acknowledge and data management of system follow the same method. Like this, compatibility of different nodes is realized, thus it is only necessary to add related user interface and device driver when new types of node are added which can make system suitable in different situations.

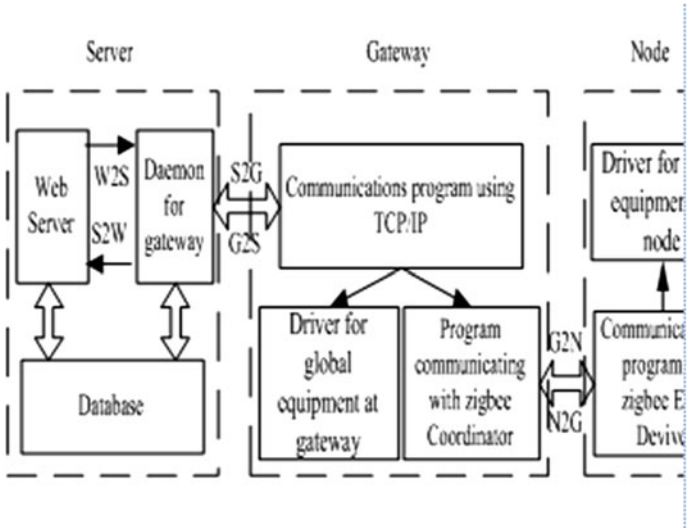

Fig. 18.2 Data flow of the system

Table 18.1 Each segment of packet

Segment	Meaning	Size
GWID	The serial number of gateway	4 bytes
NODEID	The serial number of each node in zigbee network	4 bytes
DEVID	The serial number of each device at one node	4 bytes
LoD	The length of field DATA in bytes	4 bytes
DATA	Data for transmitting, different CMD has a specific meaning	Alterable
PACKETID	Unique identification of packet between gateway and server	4 bytes
CRC	Cyclic redundancy check	4 bytes
CMD	The type of user's request	4 bytes

18.3 Design of Communication Protocol and Data Structure

From the Fig. 18.2, there are six data structures of the packet used in each layer. And the meaning of each segment is shown in Table 18.1. The six data structures are designed as follows:

WEB2SERVER: GWID, NODEID, DEVID, LoD, DATA, PACKETID, CMD
SERVER2GW: NODEID, DEVID, CMD, LoD, DATA, PACKETID, CRC
GW2NODE: NODEID, DEVID, CMD, LoD, DATA, PACKETID
NODE2GW: NODEID, DEVID, CMD, LoD, DATA, PACKETID
GW2SERVER: GWID, NODEID, DEVID, CMD, LoD, DATA, PACKETID, CRC
SERVER2WEB: GWID, NODEID, DEVID, CMD, LoD, DATA, PACKETID

CMD, DEVID and DATA fields are responsible for semantic representations. The values of CMD and DEVID fields are shown in the Tables 18.2 and 18.3, and DEVID represents the devices which are available in the way of bit mask. Each bit represents one device. The command has an operation to the devices whose corresponsive bits are set, or has an operation of uploading frequency to node when all the bits of DEVID are 0.

For example, if there is a packet whose GWID = 4, NODEID = 7, DEVID = 0 × 00001800 (bit11 and bit12, that are humidifier and temperature controller), CMD = 0 × 0002, DATA = 0 × 0046001c(70,28), it will present a request to adjust the humidity and temperature to 70 % and 28 °C around node No.7 in greenhouse No.4, using humidifier and temperature controller.

If the users need to obtain the current temperature and humidity of Node 7 in Gateway 3 by client browser, these steps of responding to the above request are shown as follow:

Step 1. The client web program generates the original WEB2SERVER data package as follow: GWID = 3, NODEID = 7, DEVID = 0 × 0003, CMD = 0 × 0003, LoD = 0, DATA is empty; PACKETID consists of timestamp and random number.

Step 2. The client web program transmits this package to a daemon designed to communicate with gateway. The daemon adds CRC field to start transmission using TCP protocol and waits for ack (acknowledgment character) signal from gateway. It will transmit again if time is out.

Step 3. Gateway will transmit an ack signal of GW2SERVER with CMD = 0 × 0006.

If the check is successful, find the short address of node No.7, delete NODEID to form GW2NODE and send it to the node.

Step 4. The node checks the DEVID bit by bit. When it comes to the bit of temperature (bit 0), node will sample the data of temperature once, and add 4 to LoD to fill this 4 bytes. When it comes to humidity bit, it will do the similar thing. After all bits are finished, the data NODE2GW is formed. Then the node will send it to the gateway.

Table 18.2 Downlink command

CMD	Describe	Meaning of the field DATA
0 × 0001	Control the device with switch value	On or off
0 × 0002	Control the device with numerical value	The expected value of controlled variable
0 × 0003	Request the data of sensors	Empty
0 × 0004	Alter the upload frequency	The expected value of upload frequency
0 × 0005	Reply the request for time hack	Current time
0 × 0006	ACK for network communications	Empty

Table 18.3 Uplink command

CMD	Describe	Meaning of the field DATA
0 × 8001	Apply for controlling device	Success or fail
0 × 8002	Apply for requesting data	The requiring data
0 × 8003	Add a record in routing table	Gateway, node or device
0 × 8004	Remove a record in routing table	Gateway, node or device
0 × 8005	Request for time hack	Empty
0 × 8006	ACK for network communications	Empty

Step 5. The gateway will send data in packet GW2SERVER to the daemon in server and then wait for ack signal. And the daemon will return the data to the client web program if check is successful. And these data are added to the database after it finishes analyzing these data.

As for the operations whose actuators are directly connected to the gateway, such as image capturing, the process of request is similar but simpler. Their NODEID is 0, which is the ID of gateway in zigbee network. Then these requests and devices will be analyzed on gateway like nodes. After image is acquired, the gateway will compress it to format jpeg and send it to the server. The client web browser shows the image as shown in Figs. 18.3, 18.4. In addition, the users can adjust the angle of cameras by up, down, right, and left buttons.

The users can configure the nodes and gateways by their GUI supplied by LCD or touch screen. And the device list will be established once the node is powered up. The routing table is established when the gateways and nodes join the system by transmitting the corresponding commands.

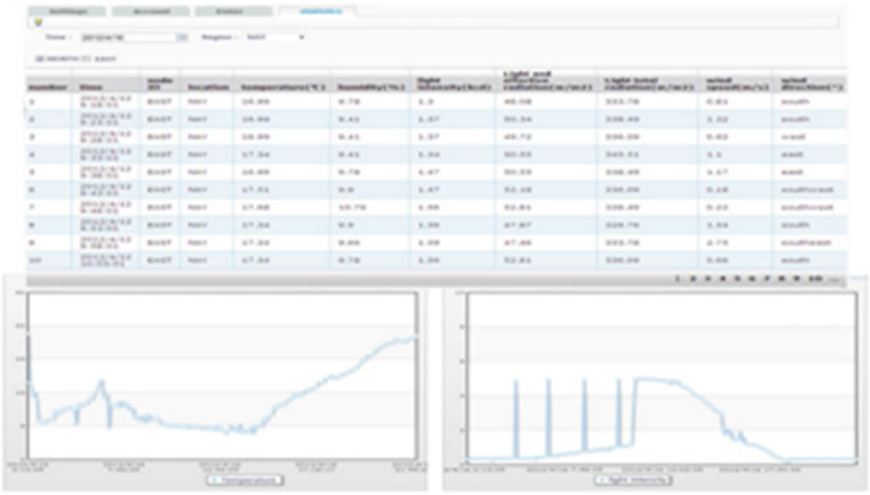

Fig. 18.3 The upload and display of sensor data

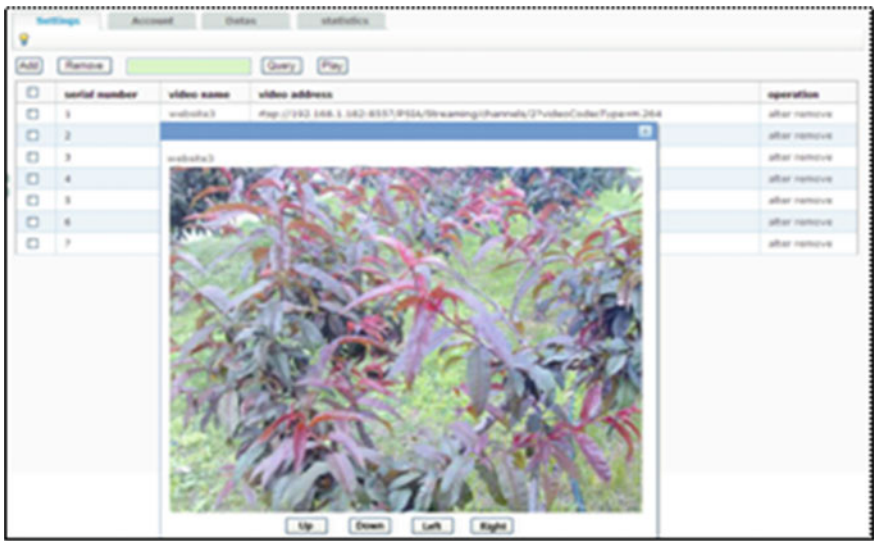

Fig. 18.4 The capture and display of image

18.4 Experiment Results

The WSN based on the above new communication protocol is established in laboratory. And the numbers of nodes are eight. In order to verify the transportability and expansibility of the monitoring system, there are three types of nodes in laboratory. The first type is only connected to temperature and humidity sensors. The second type is connected to one sensor and four devices including fan, irrigation valve, light, and stepper motor. And the third type is connected to automatic picking machine. Experiment results show that all the nodes can work well, upload data correctly, and control remotely. That's to say the stability and suitability of system are good.

18.5 Summary

In summary, the communication protocol designed in this paper improves the expansibility of monitoring system in three aspects. First, the design of dynamic routing can meet the variable number of nodes. Second, the design of software layer in the node improves the portability and the communication protocols need not be changed when the system is updated. Finally, the gateway and node are both configurable, which make the device in a certain node changeable and expansible.

When the short delay and real-time characters of the system are achieved, different types of nodes have good compatibility and flexible configuration. And the sensor nodes can be adjusted to avoid chaos automatically according to the configuration when the system is expanded. The new communication protocol makes up the deficiencies of existing greenhouse monitoring system. In the future, the system can be promoted. These applications of data and image processing will have more enhanced functionality.

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Chapter 19
Research on Single-Carrier System with Frequency-Domain Equalization in HF Communication

Boyuan Xu, Fei Xu and Weizhang Xu

Abstract The application of frequency domain equalization technique makes single carrier modulation a valuable alternative resisting multiple-path and time-varying channel in the broadband RF communication. This paper does a research on the principle and characteristics of Single-Carrier systems with Frequency-Domain Equalization (SC-FDE), and gives the performance of SC-FDE based on the 2 UW frame structure under RDM channel.

Keywords Single carrier · FDE · HF channel · MATLAB

19.1 Introduction

As we all know, the RF channel is the time-varying and disperse channel, and it has the selective fading of time frequency and space. The occupied bandwidth in the communication of shortwave is mainly limited to the 3 kHz till now. It is difficult to raise the bandwidth and data rate because of the high complexity of time-domain equalizer. The technology of frequency domain equalization is proposed to resolve this problem owing to its low calculation of the SC system in a large degree [1]. SC-FDE has a advantage of reduced peak-to-average ratio requirements (PARR) and low sensitive to the freq offset compared to OFDM. The paper does a research on the SC-FDE based on the MATLAB simulator [2].

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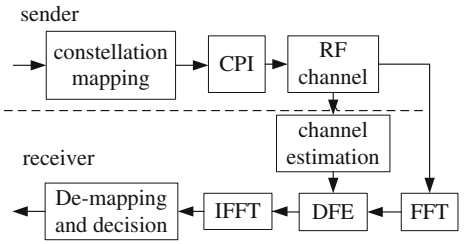

Fig. 19.1 The flow of the SC-FDE

19.2 Sc-Fde

19.2.1 The Principle and Structure

SC-FDE and OFDM are closed in the system structure, and both have the similar means of signal processing that in each of these frequency domain systems. Figure 19.1 gives the system flow of SC-FDE, and the concrete digital signal processing is described as follows: the sending part first adopts technology of bit-to-symbol mapping of QPSK, then adding unique words (UW) to data framing, at last data frames are sent through the channel to transmit after shaped filtering. At the receiving part, the UW in each data block is used to estimate the characteristics of the channel and get the equalizing coefficients. To the data received, processing of FFT is used to get the frequency characteristics. The equalizing coefficients are multiplied by the corresponding data in the sub channels, then the data is converted to time domain by the IFFT module and UW is removed. At last the demapping and decision module realize the function of demapping and decision.

At last the output symbols of the demapping and decision module in time domain become:

$$z_n = \frac{1}{N}\sum_{k=0}^{N-1} W_k Y_k H e^{j\frac{2\pi}{N}kn} + \frac{1}{N}\sum_{k=0}^{N} W_k V_k e^{j\frac{2\pi}{N}kn} \tag{19.1}$$

19.2.2 Frequency Domain

The precondition of adopting the FDE is the data block transmission by adding UW to realize the conversion from linear convolution to cycle convolution. Meanwhile the Channel characteristic is known. The process is that the equalizer produces the inverse characteristics to offset the function of the channel, so it can resist the ISI caused by RF channel. Also we can consider it that the equalizer is used to convergent the extended energy of symbol transmitting to its own time slot. It is equal to invert a filter to make it with the sub-channel to have characteristics of banner and liner phase [3]. Figure 19.2 shows the flow of FDE, in

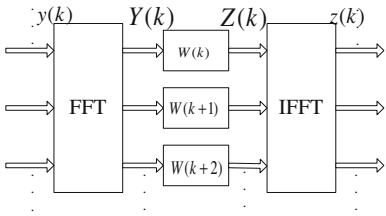

Fig. 19.2 The flow of FDE

which y(k) are symbols received and Y(k) are the in the frequency domain. Z(k) are the multiplication of Y(k) and W(k), and Z(k) are z(k) by FFT.

The technology of FDE contains liner equalization and nonlinear equalization, and it is divided by the structure of equalizer, that is whether the output is used for feedback. Liner equalization includes zero forcing ZF and MMSE, while nonlinear equalization is mainly the decision feedback equalization with the shortcoming of error propagation. This paper simulates the SC-FDE adopting the liner equalization including ZF and MMSE. The equalizing coefficients with ZF are:

$$W(z) = \frac{1}{H(z)}, (k = 0, 1 \ldots n-1) \tag{19.2}$$

And using MMSE is:

$$W(k) = \frac{H^*(k)\sigma_S^2}{|H(k)|^2\sigma_S^2 + \sigma_N^2} = \frac{H^*(k)}{|H(k)|^2 + \frac{\sigma_N^2}{\sigma_S^2}} \tag{19.3}$$

We can conclude that from the formula, MMSE method considers the influence of noise and channel at the same time has better performance than ZF method especially in the condition of low SNR, while the ZF method has a less calculation [4].

19.3 Simulation of SC-FDE

19.3.1 Design of the Data Frame Structure

In this simulation, adopts the 2UW frame structure, shown as in the Fig. 19.3. UW at the head of data block is used as guard interval similar to the CP inverted in OFDM data blocks [5], while UW has its own feature that UW is fixed and known to the receiver so it can be conveniently used to channel estimation as the training sequences [6]. So in the 2 UW in the continuous data blocks the first one is used as guard interval and the second is used to channel estimation, so it has a better property of channel estimation. Now this frame structure is widely used in the SC-FDE and has good performance.

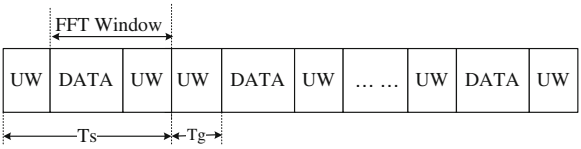

Fig. 19.3 The data frame structures of SC-FDE

On the ideal condition UW should have the feature of constant-amplitude in the frequency domain because of its function of channel estimation, so that it can produce relative stable frequency response to test the channel characteristics at frequency points. This paper adopts the Zadoff-Chu sequences [7–9] which have a outstanding of the const amplitude in time and frequency domain. This simulation uses the Zadoff-Chu sequences which are defined as follow:

$$C(k) = \exp\left[j2\pi\frac{M}{N}\left(\frac{k(k+1)}{2} + qk\right)\right], k = 0, 1, \ldots N-1 \text{ (N is odd)} \quad (19.4)$$

$$C(k) = \exp\left[j2\pi\frac{M}{N}\left(\frac{k^2}{2} + qk\right)\right], k = 0, 1, \ldots N-1 \text{ (N is even)} \quad (19.5)$$

19.3.2 Simulation Results

This simulation adopts the data frame of 2UW under the third channel model of DRM standard. Table 19.1 gives the parameters of simulation system and Table 19.2 shows the parameters of DRM channel 2. Figure 19.4 shows the simulation results under the parameters in Table 19.1. We can see the system displays a better performance after equalization, and adopting MMSE method is also better than ZF method with the SNR increasing.

Table 19.3 shows three series of parameters of SC system, in which length of UW is fixed, while length of data block is different. Figures 19.5 and 19.6 show the error rate curves under different parameters adopting ZF method (Fig. 19.5) and MMSE method (Fig. 19.6). We can see that whether MMSE or ZF is used the performance under the first parameters is best, under parameters 3 is better and the parameters 2 the last. So it can be concluded that the shorter the data block is,

Table 19.1 The simulation parameters of SC-FDE

Band-width (KHz)	Mapping mode	Aggregate data rate(Kbps)	Data block length Ts (ms)	UW length Tg (ms)	Frame head (ms)	Valid data rate (Kbps)
10	QPSK	20	32	4	16	14.88

Table 19.2 The parameters of DRM channel 2

Parameters path	Path1	Path2	Path3	Path4
Delay Δ_K(ms)	0	0.7	1.5	2.2
Path gain ρ_K	1	0.7	0.5	0.25
Doppler shift D_{sh} (Hz)	0.1	0.2	0.5	1.0
Doppler spread D_{sp} (Hz)	0.1	0.5	1.0	2.0

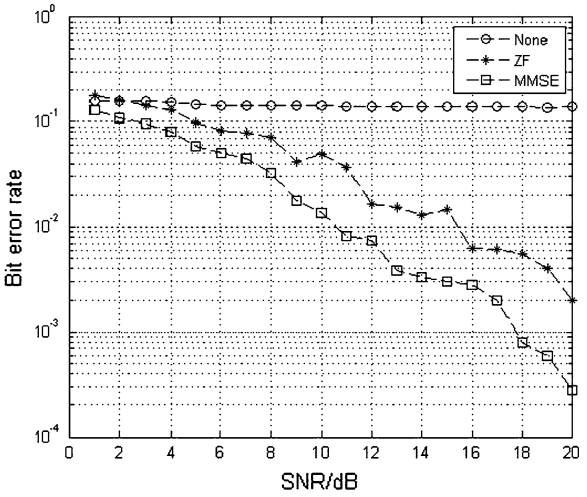

Fig. 19.4 The simulation result of SC-FDE

Table 19.3 Three kinds of simulation parameters

Parameters	Ts (ms)	Tg (ms)	FFT points	Effective data rate (%)
Parameter 1	16	4	96	50
Parameter 2	32	4	224	75
Parameter 3	24	4	160	66.7

the performance of system is better, and the ability to resist the time-varying feature is stronger, however the effective data rate is reduced.

19.4 Summaries

This paper describes the principle of SC-FDE and gives the methods of channel estimation and equalization. Also this paper has a study on the frame structure and displays the performance of SC system based on the 2UW frame structure under the DRM channel by MATLAB simulation tool. We can see that in the broadband

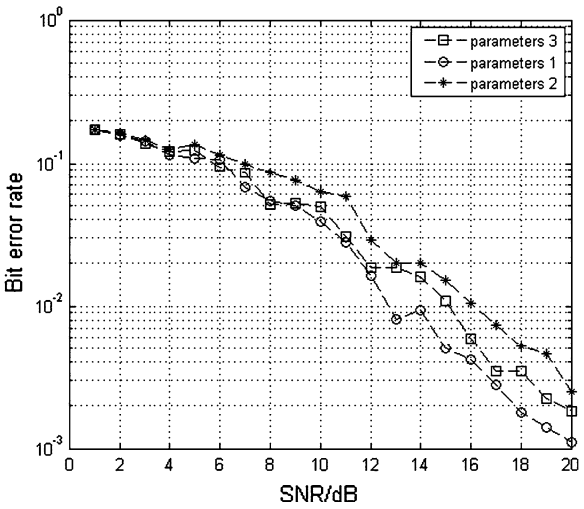

Fig. 19.5 Simulation results with ZF method

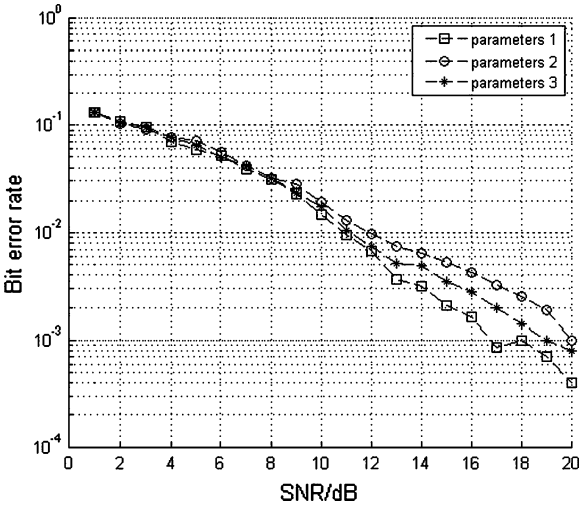

Fig. 19.6 Simulation results with MMSE method

RF communication, SC-FDE has a good performance to resist multiple-path effect and is paid more and more attention to by the people owing to its advantage compared to the TDE and OFDM. It can be said that SC-FDE has a broad application prospect in the broadband RF communication.

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Chapter 20
LEACH Clustering Routing Protocol for WSN

Dongfeng Guo and Lijun Xu

Abstract The node energy, storage space, and computation ability are limited, so energy saving is the primary goal in the design of wireless routing. The traditional wireless routing cannot be directly applied to the WSN, so WSN routing protocol research has important practical significance. The improved LEACH protocol means to make each nodes energy utilization more equalized to extend the total amount of data and network survival time. To improve the performance of the whole network is a crucial principle for the research of WSN according to a specific application in the future.

Keywords WSN · LEACH · NS2 · Simulation

20.1 Introduction

Wireless sensor network consists of a large number of nodes, which exchange data through wireless communication technology. Wireless sensor network collects information from plenty of nodes in sensors and has a data processing and integration to convey the final information to the observer. Routing protocol is so critical for network that it has a direct impact on network performance, efficiency, and safety [1]. Wireless sensor network has its own characteristics and is different from the traditional network, and its routing protocol presents difference from the letter. The routing protocol of traditional network cannot be directly applied to

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wireless sensor network [2]. As long as the differences between wireless sensor network and IP routing protocols as following: when designing routing protocols, node energy of wireless sensor network is limited and on the important position. In the transmission process, node energy is far away from the network center, while many-routing protocols mainly face much to one of the data current and one to much of the control current rather than point to point communication in the traditional network. During the data transmission, first, it is to do an integration of data processing. Mobility of wireless sensor network is poorer than the Ad Hoc networks [3].

20.2 A Wireless Sensor

20.2.1 Architecture of Wireless Sensor Network

Wireless sensor network is generally composed of the sensor nodes, cluster nodes, and management nodes, and sometimes it contains Internet, satellite links, and console. Aggregation has a received data processing and integration to convey the handled information to the management node through the Internet or satellite links. Furthermore, aggregation node has the function of data processing and transmission and designs enhanced sensor nodes in order to have much capacity and processing space [4]. While management nodes examine and manage the whole network, receive the information transmitted by aggregation nodes, and send the relevant control information.

20.2.2 Node Structure of Sensor

Node consists of the power service module, the radio traffic module, the processor module, and the sensor module. The node is the object in the wireless sensor network deployed studies fields to collect and the repeater information and complete cooperation assigns, each node is marked with different ID.

20.2.3 Layered Structure

According to the characteristics of the wireless sensor network design network system has two-dimensional structure, namely the lateral communication protocol layer and longitudinal management surface. Communication protocol layer is divided into five layers, respectively is physical layer, data link layer and network layer, the transport layer, the application layer. Network management surface is divided into mobility management, energy consumption management, and task management [5, 6].

20.2.4 Common Wireless Sensor Network Routing Protocol

Wireless sensor network routing protocol is divided into plane routing protocol and level of routing protocol in terms of the topological structure of viewpoint in routing protocol. Plane routing protocols include the flood agreement and chatting agreement, Sensor Protocols for Information via Negotiation (SPIN) agreement and directional diffusion, while level routing protocols include LEACH, TTDD agreement, SPEED agreement, and GEAR agreement.

20.3 Analyses and Improvement of LEACH Routing Protocol

20.3.1 LEACH Routing Protocol

The LEACH protocol is the first based on clustering hierarchical routing protocol. Compared with the plane routing protocol, LEACH has characteristics of low consumption and long survival of network. Selecting LEACH protocol as the research object and improvement can be understood more in-depth of the working process of hierarchical routing. The LEACH protocol makes use of self-organizing clustering, clustering with its strategy to select a node as the cluster head node, in the data transmission, all cluster member nodes first sending the data to the cluster and cluster head receiving all cluster members data, and then having the data fusion and sending to the remote base station.

(1) Selection in Cluster Head

The basic idea of LEACH protocol is that energy consumes a balance to each node so as to prolong the lifetime of network. The cluster head nodes receive other information within the cluster nodes, process the information, and sending to the base station. The LEACH protocol uses periodic selection cluster head nodes to solve the excessive consumption in cluster head node energy. In the LEACH algorithm, the node independently determines whether a cluster head or not. Periodic selection cluster head node is called round, each round consists of a cluster of the establishment stage and stable data transfer stage.

In each round of clusters process, the goal is to form K clusters. Algorithm starts with a random value from 0 to 1 and gives it to each node, function in formula 20.1 showed as follows to select the cluster head node.

$$\begin{aligned} T(n) &= \frac{p}{1 - p[r \bmod (1/p)]} \cdots n \in G \\ T(n) &= 0 \cdots n \in other \end{aligned} \tag{20.1}$$

For an arbitrary node N, the node N generates a random number range 0–1, if this number is less than a given threshold value *T(n)*, the node N will become the

cluster head node, at the same time, the node N broadcasts itself as a cluster head information. P is cluster head node ratio, its value is generally 4–5 %, and the value will be changed with applications. R is currently circulating round number, such as the current is carried on the tenth round, $r = 10$; G is a set in recently 1/P wheel has not elected a cluster head node. In a cycle, a node can only become a cluster head. When $r = 0$, $T(n) = P$, whereby probability of each node as the cluster head node is the same, value of P, R will be larger. The $T(n)$ value is larger, the probability of cluster head nodes becoming cluster head is the greater.

(2) Phase in Cluster Building

The "wheel" (round) is defined as the unit circle in the LEACH protocol. Each round consists of two stages, namely the establishment phase and stable phase. Node uses the formula (1) to calculate. By setting a threshold $T(n)$ to judge whether itself becomes a cluster head node. Once a node becomes the cluster head node, we need to broadcast the news of being a cluster head in remaining nodes network.

When a node is a cluster head node, it will send broadcast message to other surrounding nodes to show that is the cluster node, during this period it has been waiting for other nodes respond and waiting for other nodes to join. A noncluster head node may receive information from a plurality of cluster head node; finally, it selects to join the cluster according to the energy which is determined by the size of.

(3) Stabilized Stage in Clusters

After completing cluster building stages into the stable stage, this stage is mainly to complete data transfer. If the sensor node always has data to send, when the time for their turn to transmit data, member node will send data to the cluster head node. In the transmission phase, each member node has been shut off its own wireless communication module until its own time slot come open module to save energy. But the cluster head nodes to accept other node information within the cluster, so the cluster head node transceiver needs opening, hence, the cluster head node energy consumes more quickly than others.

20.3.2 Shortcomings of LEACH Protocol

The LEACH protocol has many advantages, but it also has some shortcomings, mainly in the following aspects:

(1) Selection of cluster head is not ideal

The LEACH protocol uses random manner to become cluster head, which is lack of binding and does not use the residual energy of nodes as a reference coefficient to select the cluster head.

(2) Cluster head distribution is not balanced

The LEACH protocol uses completely random manner to produce cluster head nodes, so the distribution of the geographical position is not optimal and is more likely to produce the unreasonable distribution.

(3) Signal hop communication is not reasonable

LEACH protocol uses a single jump communication in the process of communication, which greatly limits the size of the network.

20.3.3 LEACH-Improved Protocol

Wireless sensor network node energy is so limited that routing protocols are designed to save energy in important position in order to prolong the survival time of the entire network. The LEACH protocol in the selection of cluster head nodes do not take the residual energy of nodes into consideration, it may choose the residual energy of less node as the cluster head node, where the cluster head nodes distribution is uneven and some regional cluster head distribution is much too small to reduce the network survival time. The way of single jump is used in communication, by the model of energy consumption; the distance from the base station node energy consumption is increasing dramatically. As for LEACH protocol existing problems, this paper puts forward an improvement of the LEACH protocol LEACH-improved.

The LEACH-improved protocol focus on problems of LEACH protocol, from the following two aspects of the LEACH protocol was improved:

(1) Selection of Head Cluster Node

The LEACH-improved protocol selects cluster heads to increase the residual energy of the nodes in the cluster detection, or selects those nodes with more energy as the cluster head node in order to prolong the network life time. Current node is current energy and origin is the initial energy of nodes. The LEACH-improved protocol increases the probability of higher energy node a cluster head to prolong the network lifetime. The improved formula for cluster head selection as shown in a formula 20.2.

$$\begin{aligned} T(n) &= \frac{p * Ecurrent}{1 - p * (r \bmod (1/p)) * Eorigin} \cdots n \in G \\ T(n) &= 0 \cdots n \in other \end{aligned} \tag{20.2}$$

(2) The Multi-hop Path Transmission

The LEACH-improved protocol joins intercluster routing strategy. Cluster head is responsible for the data collection of cluster member cluster head node, data fusion calculation, and sends the fusion data through the multihop routing to the

base station. This chapter assumes that the data redundancy is limited and data from different clusters can not further data fusion, so it relays cluster head node simply forwarded from other formal cluster header data. In the network a cluster head node is denoted as Ci, Ci and the distance between the base stations recorded as D (Ci, BS), jump process is as follows: the cluster head nodes with radius d to broadcast their own news around, message contains the node ID Ei, energy, distance between cluster heads and base station (Ci D, BS). This cluster head node Ci is adjacent to the cluster head node set to SCi = {Cj, Ck},…, where the cluster head relays cluster head set for SCv = {Cv|Cv in SCi&d (Cv, BS) = D (Ci, Bs)}, if SCv is empty, then the cluster head transmits data directly to the base station, or selects the largest cluster head node of energy value in the collection SCv. If the maximum residual energy node is the only, then the node as the next hop routing node or in a plurality of energy values in the largest cluster head node selects the distance from the base station to recent cluster head node as the next hop routing node.

20.4 Simulations

20.4.1 Comparison of Protocol Stimulation

The comparison of LEACH-improved protocol and LEACH protocol is mainly from two aspects contrast analysis-the node data transmission amount and node of the survival time.

(1) Data transmission quantity simulation analysis

Data transmission quantity is node of the total amount of data that is transmitted to the base station. Figure 20.1 shows the improved LEACH-improved protocol and the original agreement in the test of energy consumption and the base station receives the total data quantity of the curve. From the chart shown, protocol LEACH-improved in consuming the same energy, the base station receives the great total amount of data. This shows the LEACH-improved has a promotion space than the original protocol, as you can see from Fig. 20.1, when consumed the same energy 80, LEACH-improved protocol accepts 6,000 of the amount of data, when consumption is 100, LEACH-improved protocol accepts the amount of data 7,000 than the LEACH protocol, which describes that the LEACH-improved protocol improves the total data receiving volume, this is mainly because the improved protocol in energy consumption is compared to the average, so the lifetime of the whole network is improved and the data transmission is more efficient.

(2) Simulation Analysis of Node Survival Time

Node of the survival time of wireless sensor network is one of the important parameters, survival time directly determine the performance of networks and the life time of the whole network. Figure 20.2 shows the number of nodes in the

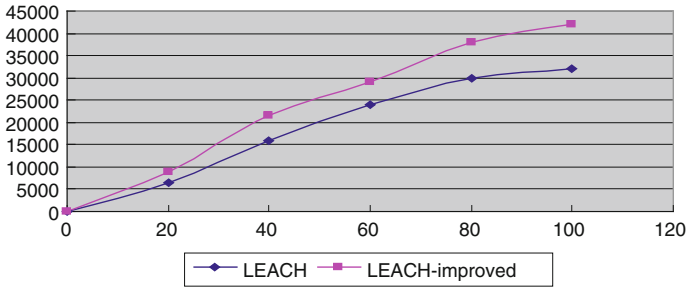

Fig. 20.1 The amount of data sent

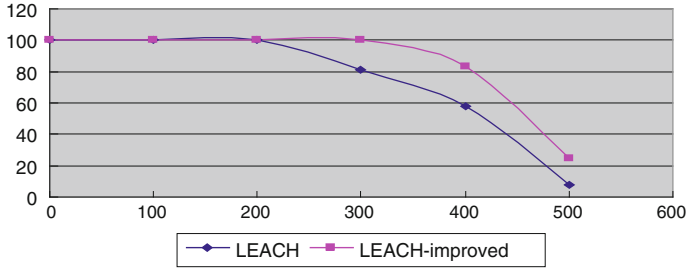

Fig. 20.2 Node survival time

network survival curves varying with time. The coordinates stand the time, and the ordinates stand node survival number. As can be seen from the graph, LEACH protocol has node death in 215 s, while LEACH-improve emergences the phenomenon of death node until in 275 s, and node death time postpones too much. This description of the LEACH-improve Protocol extends node survival time, at the same time, the energy consumption of the node is lower and the LEACH-improved protocol indeed reduces the energy consumption of the node, making the node energy consumption is more balanced to prolong the survival time of a single node, so that the performance of the whole network is in promotion.

20.5 Summary

After the detailed analysis of the first choice of LEACH agreement and the stability of the family of transmission stage, and the instructions of LEACH agreement during operation of the energy consumption model, it points out the shortcomings of LEACH agreement: in the process of selection of cluster head without considering the residual node energy, in the process of transferring, the way of communication is the single jump and proposed the improved protocol LEACH-improved agreement in this foundation. Through the simulation

experiments, it can be concluded that the improved LEACH-improved agreement can increase the overall data transmission and extend the node of survival time, which improves the network environment and makes the network performance improved.

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Chapter 21
Security Model Based on Cluster Formation in Ad Hoc Network

Shuyu Hu

Abstract We apply the idea of systems analysis and integration to constructing the AD hoc network security model based on cluster formation in this paper. In this security model for ad hoc networks, the initial nodes are authorized by the user, or validated by the cluster headers in other clusters when the cluster is created. The cluster header is elected by all nodes in the cluster, and there is a temporary cluster header in charge of the cluster header elections.

Keywords Ad hoc networks · Cluster formation · Security

21.1 Introduction

Mobile Ad Hoc networks are dynamic self-organizing networks, which are built by some mobile nodes. Those mobile nodes are capable of wireless communication. Mobile Ad Hoc networks have the arbitrary and temporary topology [1]. In the networks, each node can be used as a host or router. Mobile terminal has a routing function, and can make up arbitrary topology by wireless network connection [2, 3, 4]. This kind of network can not only work independently but also connect with the Internet or a cellular wireless network [5, 6, 7]. Compared with the usual networks, the mobile Ad Hoc network has some special features: self-organization, dynamic network topology, multi-hop communication route, limited wireless communication bandwidth, limited host energy, distributed network, and so on [8, 9, 10].

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The security of mobile ad hoc network has been the hotspot of current research. Compared with the fixed wired networks, mobile Ad Hoc networks face more security threats [11, 12, 13]. In the fixed network, the enemy needs to lap cable to wiretap, and to find loopholes of the firewall or gateway to access internal resources. But for mobile Ad Hoc networks, wireless channel make wiretap become probable anywhere, with the mobility of nodes making the networks without border and the firewall unable to play a role [14, 15]. Mobile Ad Hoc networks face more threats than fixed networks, such as wiretap, falsification of identity, replay, message tampering and refuse services, and so on, and therefore need security protection [16, 17].

At present, researches on cluster technology of mobile Ad Hoc network are still at the initial stages. There are still many unresolved issues in modeling of mobile Ad Hoc Networks, such as what is the appropriate architecture? What is the best framework model? How to authorize nodes to create networks? How to validate the security of mobile Ad Hoc network? And so on.

21.2 A Wireless a Hoc Network Ids Model Based on the Cluster

21.2.1 Assumptions

We proposed a mobile IDS model based on the cluster. As its structure shows in Fig. 21.1, the assumptions are as follows:

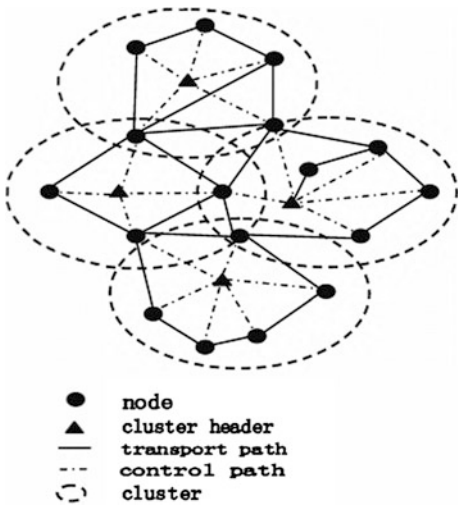

Fig. 21.1 Cluster formation

(1) Each node is inserted a GPS positioning system. And by doing so, the cluster header can get each node's moving speed, direction and orientation in the cluster.
(2) Wireless signal propagations are in accordace with fee space propagation model [2], and use the prediction method proposed in literature [3]. This method assumed that the strength of the received signal of the model are mainly decided by the distance between receiver and the sender.
(3) Each node's effective radiate distance are equal: specifically, if one node is in the other node's radiate rage, then they are adjacent nodes and have a line between them.

21.2.2 Cluster Formation

There are many conditions of formatting a cluster, as shown in Fig. 21.1.

The initial nodes must be authorized by the user or validated by the cluster headers in other clusters if they what create a cluster.

(1) Each discrete node indicates itself by sending a HLLO message and authentication handshake.
(2) There is only one hop distance between each the node in a cluster.
(3) The number of nodes in a cluster is limited. If there are too many nodes in one hop distance, some nodes will create a new cluster.
(4) The created new cluster must be able to maintain the channel with the cluster header validating it. If the channel is brea, the initial node needs to be re-authorized or re-validated and cluster re-created.

The process of Initial nodes' cluster formation:

If the initial node X is authorized by the user, then the user input the initial key to generate the key pair for the initial node.

If the initial node X is authorized by the cluster head of other cluster, firstly, this node will generate the key parr $M_x\{SK_x, PK_x\}$ by assembling the public key of the cluster head and the random number generated by itself. Secondly, PK_x will be encrypted by SK_x and distributed to the cluster head for certification.

SK_x is the secret key of this. There is no node in the network knows its contents. PK_x is the initial node's public key and known by all nodes in the network. Set the number of cluster nodes is m, the initial node broadcast it's PK_x to m neighbors node in its one hop.

The nodes which receive packets will generate the key pair $M_x\{SK_x, PK_x\}$ by assembling its public key of the cluster head and the random number generated by itself. PK_x will be encrypted by PK_x and distributed to the initial node X.

While X receive this package, it will decrypt it will decrypt it SK_x, and obtain public keys of each nodes.

X issue Certificate $CT < V_i, PK_i, N_i, t, T >$ for each node, it meas that: in the time interval $[t,t + T]$, persona public key is PK_t elective.

21.2.3 Election of the Cluster Header

Cluster headers are elected by nodes in the cluster; the following factors need to be considered in election:

(1) The security of nodes: whether the initial nodes are authorized by users or validated by the cluster headers in other clusters.
(2) The residual energy: Mobile Ad Hoc network nodes' battery power is limited, the residual energy is very important.
(3) The configuration parameters of the performance: to choose good performance, high efficiency, high hardware parameters as the cluster header as much as possible.
(4) Dynamic parameter: the node's mobility speed, moving direction, and the distance between nodes are the most important data; we can calculate the dynamic parameter of the node by using them.
(5) The cluster header control and manage the entire cluster and it does not participate in the cluster Routing Forwarding when the cluster header is not as sender or receiver in the cluster.

The election procedures of the Cluster header are as follows:

If the initial node was not validated by the cluster header in other clusters, then the initial node works as a temporary cluster header, and it also can be elected as the official cluster header in the following creation process. If the initial node has been validated by the cluster header in other clusters, then the cluster header in other clusters works as a temporary cluster header, and it cannot be elected as the official cluster header in the following creation process.

At first, each node sends its vote to the temporary cluster header, then the temporary cluster header calculates and compares the votes, and then select the official cluster header.

Assuming the nodes amount in a cluster as m, the nodes respectively are decrypted as: $X_1, X_2, X_3, \ldots\ldots X_m$ the remaining energy of the node X, is A_i, the configuration parameter of the performance is B_i; the dynamic parameter is C_i, the cluster header election function is:

$$W(X_i) = eA_i + fB_i + gC_i \tag{21.1}$$

where e, *f*, *g* are weights;

Node X_i sends its parameters of speed, coordinates, id, and direction of movement to its adjacent X_k.

X_k receive the information of X_i, then calculate the predicted connection time using the method proposed in the literature [4]:

Assuming the speed of node X_i is V_i, the adjacent nodes X_k's speed is V_k, node X_i's position coordinates is (x_i, y_i), the adjacent nodes X_k's position coordinates is (x_k, y_k), the node X_i's mobile direction is θ_i $(0 < \theta_i < 2\pi)$, the adjacent nodes X_k's mobile direction is θ_k $(0 < \theta_k < 2\pi)$, the distance between two nodes is S:.

$$C_i = \frac{(a(x_i - x_k) + c(y_i - y_k)) + \sqrt{(a^2 + c^2)s^2 - (a(y_i - y_k) - (x_i - x_k)c)^2}}{a^2 + c^2} \tag{21.2}$$

in the formula:

$$a = v_i \cos\theta_i - v_k \cos\theta_k \tag{21.3}$$

$$c = v_i \sin\theta_i - v_k \sin\theta_k \tag{21.4}$$

$$S = \sqrt{(x_i - x_k)^2 + (y_i - y_k)^2} \tag{21.5}$$

Assuming the shortest maintain time of the links (x_i to x_k) is $T_{\min}$, compared $C_i < T_{\min}$, if $C_i < T_{\min}$, then calculate the following associated values:

Which E_i is the node's residual energy, $E_{\max}$ is maximum energy capacity of the node;

$$Bi = kM_i + fN_i + hP_i \tag{21.6}$$

Where, k, f, h as the wrights, M_i is the parameter of the CPU's operation rate, N_i is the memory parameter, P_i is parameter of the network throughput;

$$F(X_i) = eA_i + fB_i \tag{21.7}$$

Where, e, f is the wright?

Then, send the value of $F(X_i)$, C_i to the cluster header;

Compare the values of $W(X_1)$, $W(X_2) \cdots\cdots W(X_m)$, the largest one is the cluster header;

21.2.4 To Add and Remove Nodes in Cluster

Each node in cluster can be added or removed from the cluster, as shown in Fig. 21.2:

Each node can change their places in AD HOC network. So when a node X moves outside the scope of the cluster W, the cluster header Wm will send transfer messages including authentication information to the cluster header Mm of the cluster M base on the mobile path of the node X. While node X is nearing Mm, X will send a join request including its authentication information to m. M receives

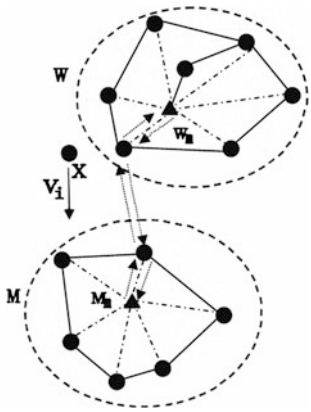

Fig. 21.2 Nodes in cluster to join and remove

the request and checks it with messages. If consistent, Mm will agree X to become the member of cluster M, and W will send a conf message to Wm.

Wm will record the event into log when it receive message from Mm, then update the cluster information, and delete the relevant information of node X in the W.

If the node X moves outside the cluster W, and not near any cluster (it is judged by the direction of node X's movement). The cluster header Wm will send transfer packets to all the cluster headers in the Ad Hoc network until receiving the message that this node had been attended any cluster. Then, it records this event into its log, updates the cluster's information, and deletes the relevant information of node X in the W.

21.3 Conclusion

If the cluster heads do not play any role as a sender or receiver, they also need not participate in the route exchanging and data forwarding. They are in charge of resource scheduling and intrusion detection control of this cluster. Although a cluster model of the Ad Hoc network is given in this article, its algorithm still needs more in-depth study, and also intrusion detection of cluster.

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Chapter 22
An Enhanced BitTorrent Protocol Supporting Multiple Network Accesses

Xue Yifei

Abstract We present our architecture which uses an enhanced BitTorrent protocol, supports multiple network accesses simultaneously, and localizes information retrieval. Our results showed that, for the scenario considered, the median download duration is reduced by more than 33 % compared to standard BitTorrent. The load on the inter-domain backbone was also significantly reduced. Since the information is localized, one would expect that it puts a high load on the gateway routers inside a network domain. However, the number of packets received by gateway routers was reduced by 62 %. The nodes could also send data at higher rates, recording a 63 % increase. The results display similar behavior to the prototype experiments.

Keywords BitTorrent · Peer-to-peer · Wireless local area networks · Multiple network accesses

22.1 Introduction

In today's Internet there are multiple users and servers located around the world. Internet applications have advanced from simple end-to-end communication applications to online-games, peer-to-peer file sharing applications, and video streaming services among others. The Internet was built on the host-centric

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paradigm, which states that end-to-end connectivity between hosts is a prerequisite for effective communication. However, most of the traffic in today's Internet is related to content distribution applications [1, 2], which include file sharing; audio/video streaming; groupware instant messaging (akin to Twitter) and status notification; and collaboration applications. For handling content traffic, new kinds of technologies have been developed. Peer-to-peer networks have proven to be efficient in file sharing by making the information available to a large number of users. Content distribution networks (CDNs) are useful in pulling the load away from a central server by distributing information to servers located close to the users. However, these technologies are still based on end-to-end connectivity, tying the content to specific hosts. The inability of the current Internet architecture calls for a transition to information-centric networking. Network of Information (NetInf) is an information-centric approach taken within the EU-funded FP7 4WARD project [3]. NetInf proposes a uniform mechanism for locating and retrieving content, which is more suitable to the usage of the current Internet. Currently, relationships between different copies of the same content are not represented. NetInf aims at employing access patterns similar to anycasting to obtain the closest replica of the content in a networking sense. It has been considered as a viable architecture for mobile networking, since it may reduce energy consumption of mobile devices and provide ubiquitous Internet access [4]. Research on information-centric networking is active, and in addition NetInf there are other proposals, such as PSIRP [5] and Content Centric Networking [2].

Information-centric networking allows users to focus on the information objects they need, rather than pointing to a specific, physical location of the data. Instead of connecting nodes and their processes, information-centric networking aims at connecting information consumers with information producers and distributors. The networking paradigm called NetInf [6] adopts this approach. Currently, the IP address is both an identifier and a locator. It expresses where the content is located and the name of the location. Thus, when content is moved to a different location its name also changes. The dual role of an identifier and locator should be excluded by using a flat namespace for persistent identification of content [7]. The content should be retrievable by a common known name even if it moves to another location. Flat namespace means that there is no hierarchy in the naming of content.

The NetInf information model has two objects: the bit-level object (BO) and the information object (IO) [7]. BO is a digital representation of the information: a specific sequence of bits located in a file, on the wire, in the air, or any other possible location. BOs can be divided into smaller pieces, to support features such as swarming in BitTorrent. An IO is a general term for a piece of content or information [6, 8]. By using IOs it is possible to locate content, regardless of irrelevant characteristics, such as, encoding of a certain song. In an information-centric network the same IO can reside in multiple copies at different locations [7]. The principle of object resolution in NetInf is that objects are retrieved based on their unique identifiers. To find an object in the network, users query a NetInf name resolution system. Routing forwards the object retrieval query to the storage location of the object, where it can be forwarded to the requesting client.

This paper describes an information-centric multiaccess supported NetInf simulation model with the OMNeT++ discrete event network simulator [9] and analyzes the simulation results. This paper builds upon, and extends our previous work on a proof-of-concept prototype for multiaccess NetInf [10]. In particular, this paper centers on feasibility on a larger scale and quantifies in this context the individual NetInf node performance improvement. In earlier work we showed that with an information-centric approach, it is possible to make significant gains in performance [11]. The scenario involved multiaccess content distribution for the case of video streaming in a large wireless metropolitan area network (WMAN). It was also shown that an information-centric approach may be instrumental in reducing the energy use of WMANs and information and communication technology (ICT) in general [12].

This paper presents the first simulation study on a multiaccess supported information-centric approach in a wireless peer-to-peer network. Reducing inter-domain traffic and improving download speeds of end users in peer-to-peer networks has been studied before. BitTorrent Ono [13] uses biased neighbour selection to find peers that are close in a networking sense. An ISP-supported oracle has been suggested in [14, 15]. However, these solutions are still based on end-to-end connectivity, i.e., the content is located at specific hosts in the network. In addition to peer-to-peer file sharing, information-centric networking is naturally suitable for content distribution scenarios such as A/V streaming. Downloading the closest possible replica can minimize the amount of inter-domain traffic and speed up streaming video.

This paper is structured as follows. Section 2 describes our methodology and details the simulation environment. Section 3 presents evaluation results and Sect. 4 concludes the paper and lists items for future work.

22.2 Simulation Scenario

The performance gains of a multiaccess supported information-centric approach are evaluated with a simulation model, which was implemented in the OMNeT++ discrete event simulator v.3.3p1, INET Framework [16] v.20061020, and OverSim [17] v.20080919. We enhance the BitTorrent module described in [18] to support our information-centric approach. The net-work topology includes several network domains or subnets. Each domain contains a seeder, a tracker, and a certain number of wireless access points. Figure 22.1 shows the simulation scenario, illustrating only a fragment of the network topology due to space constraints. The tracker inside the domain is called a subtracker (a normal BitTorrent tracker). A separate subnet called the Core Network holds a core NetInf tracker. As an approximation, the core NetInf tracker acts as a global NetInf name resolution point and the subtrackers are local NetInf name resolution points.

The simulation area is a residential area of 0.675 km^2 (900 $\times$ 750 m), consisting of 30 wireless access points, an access router, three backbone routers, ten

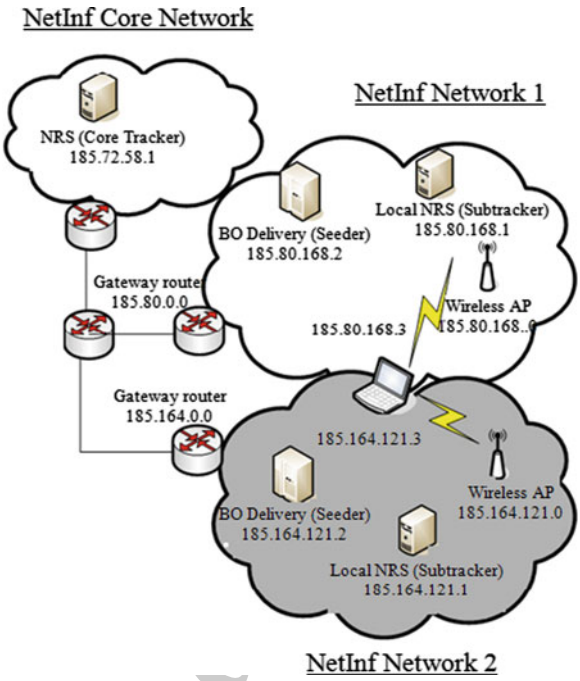

Fig. 22.1 Simulation scenarios: topology (fragment)

gateway routers, ten sub trackers, a core tracker, a fixed number of downloaders and ten seeders. The network consists of ten domains and each domain has three wireless access points. A gateway router is located at the edge of a domain and it is used for connecting the domain to a backbone router. Multiaccess nodes are placed in two adjacent wireless access points located in different domains. The simulation experiments also include single access nodes, which are placed in a random wireless access point. In Fig. 22.1 a multiaccess node is connected to two networks and holds two IP addresses. To support information exchange between the trackers, a signaling protocol was developed and evaluated with a proof-of-concept prototype [10]. The protocol was implemented in a testbed as an extension of the signaling protocol used in standard BitTorrent communication. In this paper, we focus on the most relevant elements as shown in Fig. 22.2. In a crude approximation, IOs can be mapped to the equivalent of the torrent file and the tracker's response in BitTorrent and BOs correspond to the content distributed by the swarm.

Once a NetInf node joins the network, it tries to get associated to a WLAN access point and establish a TCP connection with the core tracker. Multiaccess nodes form a connection with the core tracker via both interfaces. The core tracker implements part of the functionalities of an IO resolution server, which is used to map IOs to a BO or to other IOs. Upon connection establishment, the tracker request message is sent. The core tracker responds with a tracker response containing a corresponding IO. This IO points to the respective IO resolution server in

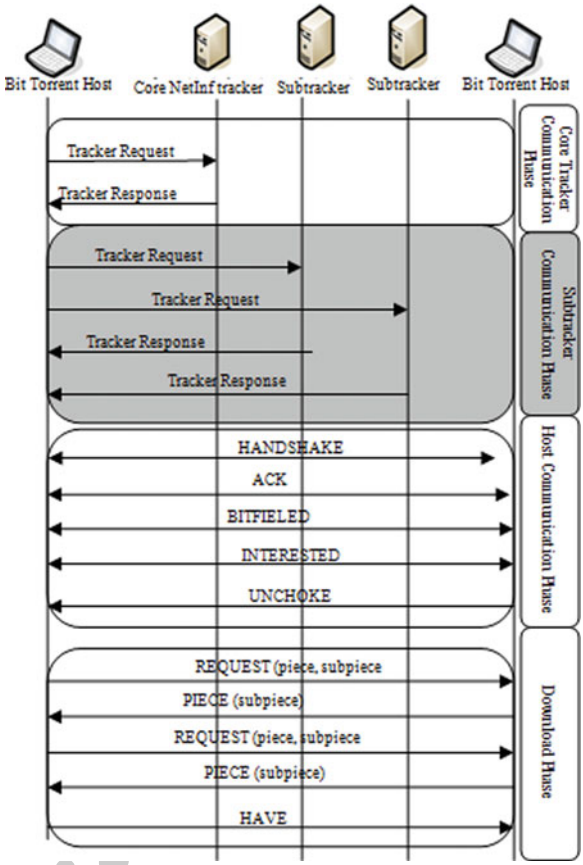

Fig. 22.2 Signaling and information exchange schema

the network domain of the NetInf node. For a multiaccess NetInf node, the resolution can occur simultaneously in two different domains. A BO is the actual sequence of bits of a file and for the BO resolution the node can contact either of the local resolution servers. For a BitTorrent-like NetInf operation, the BO resolution corresponds to pointing to the seeders (and leechers when appropriate) of the swarm. In the last step, the NetInf node establishes connections with the NetInf nodes and uses the standard BitTorrent protocol to obtain the BO. This approach aims at retrieving the content from the closest peer possible, making sure of using local resources first and avoiding cross-domain traffic.

The metrics of interest for our evaluation are the download duration of a file, the amount of packets received by the routers and the average download and upload throughputs. The amount of received packets in routers is used for quantifying the traffic flows in the network: how much traffic is maintained inside the network domains and how much traffic travels out-side. Our simulation parameters are given in Table 22.1.

Table 22.1 Simulation parameters

Parameter	Value
Area (rectangular)	900 m × 750 m
Simulation runs	10
Number of seeders	10
Number of active downloaders	40
Number of domains	11
Number of backbone routers	3
Number of gateway routers	11
Number of subtrackers	10
Number of wireless APs	30
Access link bit rate (b/s)	1×10^{10}
Access link delay (s)	0.001
WLAN radio bit rate (b/s)	11×10^{6}
File size (MB)	50
Piece size (kB)	256
Block size (kB)	16

22.3 Results

The simulation experiments include conducting ten independent runs with an active user population of 40 and the following three configurations: single access (SA) NetInf, multiaccess (MA) NetInf, and standard BitTorrent. With single access NetInf all nodes have one WLAN interface and with multiaccess NetInf two WLAN interfaces. The last configuration includes the normal topology-unaware overlay BitTorrent net-work. In this scenario, there are no subtrackers; the peers con-tact a single tracker in the network for finding other peers.

Table 22.2 shows the average number of received packets by all backbone routers for ten simulation runs. It shows that both multiaccess and single access NetInf can drastically reduce the traffic load on the backbone routers. With standard BitTorrent the amount of packets received by the backbone routers rises up to over 8 million, while with multiaccess and single access NetInf the amount is approximately 160 000, which indicates a 98 % reduction. The reason for this is that NetInf maintains the traffic inside the network domains and only sends packets to the core network domain to reach the core tracker. Standard BitTorrent is a network topology unaware overlay protocol. Connections are formed with all peers available and packets are sent to multiple different domains in the network. Table 22.2 shows that an information-centric approach can also reduce the packets received by the gateway routers. With standard BitTorrent the received packets rise up to nearly ten million and with NetInf the amount is well below four million. The total reduction in received packets is 62 % for multiaccess NetInf and 66 % for single access NetInf. The reason is the topology unawareness of BitTorrent. Once a BitTorrent node completes the download of a piece, it sends HAVE

Table 22.2 Average number of received packets

Configuration	Backbone routers	Gateway routers
Standard BitTorrent	8 256 866	9 827 848
Single access NetInf	158 672	3 351 568
Multiaccess NetInf	161 858	3 745 938

messages to all connected peers, which increases the number of received packets at the gateway routers. In an information-centric approach the HAVE messages are sent only to nodes inside the domain.

22.4 Conclusion and Future Work

To sum up, the information-centric approach is an efficient solution for content distribution applications and the results have created incentives for future work in this area. Further work must be done to explore larger network configurations, support mobility, and evaluate energy efficiency aspects.

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Chapter 23
An Improved QoS Routing Algorithm in Internet

Hongbo Huang and Yongzhi Wang

Abstract An efficient routing algorithm for Improving the QoS in Internet has been proposed and presented in this paper. The algorithm is a kind of multi constrained path algorithm. The routing takesplace based on more than one link weight components. To avoid the NP complete problem and to increase the computational efficiency some advancements are added. These include the definition of nonlinear path length, where the subpaths may not be the shortest path, having 'k' number of shortest paths in a node instead of having only the shortest path, and then removing the path dominancy for state space reduction. Finally, the concept of look ahead is also included through which a predicted path to destination is mapped. This work only implements the removal of path dominancy where the queue is updated by removing the dominated paths from the queue. The simulation also shows the better performance of the system.

Keywords Qos · Routing algorithm · Internet

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23.1 Introduction

The network has two things for transferring data packets, the routing protocol and the routing algorithm. Routing protocol manages the transfer of topological information to nodes and changes in the networks, whereas routing algorithm finds out the path to destination using these topological information given by the routing protocol. To have good quality of service we should have both these to be well fit for the given network and the traffic loads. When talking about the protocol, currently there is no protocol that mainly concerns QoS requirement of user. The term QoS refers to some measures namely loss, jitter, delay, and bandwidth. When we say that a service achieved its QoS, then the path through which the packets flow take place must have the required bandwidth, less loss and jitter, low traffic. Usually QoS is divided into two levels, application level and physical level.

Qos routing algorithm. The QoS is currently an emerging field in networks, since the evolution of fast and reliable networks. In the future every service may require an algorithm like this for its service. The QoS routing algorithm can be applicable for any kind of network services that require satisfaction QoS requirement of the customer who avails the service. Future networks might possibly make use of QoS routing algorithm since the hardware and software evolution of high speed networks is of less cost. In such circumstances we need a QoS routing algorithm to reduce resource wastage and to effectively utilize the resources. When the multimedia embedded data communication is taking place in a wide network like the World Wide Web, then there must be a lot of QoS requirements. The ordinary shortest path algorithm cannot be applicable any more since they only depend on single constraints. So in these criteria we can apply the QoS routing algorithm.

Due to the force that service providers are responsible for the QoS maintenance of the services that they are providing they mainly concentrate on the physical level QoS. For this situation this algorithm is a good remedy. Although proposals exist for Internet related to QoS issues, currently nothing exists. There is also no QoS routing protocol on the Internet.

Related work. Many papers have targeted the QoS routing problem, but only a few dealt with the general MCP problem. Jaffe proposed a shortest pat algorithm using linear combination of link weights [1, 2]. Iwata et al. proposed a polynomial-time algorithm to solve the MCP problem. The algorithm first computes one (or more) shortest path based on one QoS measure and then checks if all constraints are met. If this is not the case, the procedure is repeated with another measure until a feasible path is found or all QoS measures are examined.

Chen and Nahrstedt proposed two approximate algorithms for the MCP problem [3]. The algorithms return a path that minimizes the first weight provided that the other $m - 1$ (scaled down integer) weight are within the constraints. Korkmaz and Kurnz have proposed a randomized heuristic for MCP problem. Under the same network conditions, multiple executions of the randomized algorithm may

return different paths between the same source and the destination pair. This heuristic tries to find a path within the constraints by using the nonlinear path length function [4, 5].

23.2 Proposed Routing Algorithm

This paper focussed on removing dominated paths from the queue where we have our limited requirements and other sources for simulating the modules. For the full implementation of the QOS routing algorithm we need a lot of resources and some real networks like structures for simulating and measuring the performance. Though the work targets on network side the implementation of path dominance does not require any network structure and it is enough to have minimum system requirements in which a simple module testing can be possible [6].

When we talk about the exact requirement of the path dominancy we need a queue and some values that have been already loaded into the queue since the previous modules of main algorithm. Then our aim on this queue is to modify so we have to access that queue and it has to be returned as modified form.

The data flow diagram (DFD) of the proposed work explains the state changes of modules when data flow take place. The DFD of the proposed system is shown in Fig. 23.1.

The DFD has totally five states where each state represents the modules. Whenever a module is called control flows to that module. In the five modules of the proposed system include the update queue as theme of whole work. This module implements the path dominancy. Intern it calls the other aiding modules that simplifies its task [7]. The sub modules are private to update queue and only update queue module must make use of these.

The main module makes a call to update queue module. The queue, which is not modified, is passed as argument to the called module. There will also be another parameter that reflects the number of differences that are allowed between the components of subpaths. After that the update queue rearranges the queue based on the weight vector of the link. At this time we have the shortest path at the top of queue [8].

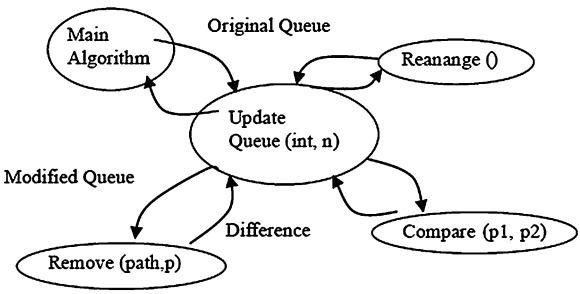

Fig. 23.1 The data flow diagram of the system

23.2.1 Modules Design

This system that implements process of removing path dominancy has mainly one module that then makes use of the three sub modules. The modules are update queue, rearrange, compare and remove.

23.2.1.1 Update Queue

The main module that is called by the main module after populating the queue has the following syntax. Public void update Queue (int n).

The main aim of this module is to get the original queue and then doing some kind of process that removes the dominated paths from the queue and then returns back the modified queue to the main algorithm. When designing this method instead of passing and getting back the queue to this module, this module is included as a member function for the Queue class, which is of user-defined type. This module and the queue are bound together since this module is only going to use the queue, nothing else. The original queue is rebuilt after removing the dominated path. This is then set as the queue for the rest of main algorithm. This method is declared as public so that the main module can make a call for this module. This module is also allowed to take one integer parameter that gives the number of difference that can be allowed between the link weight components.

23.2.1.2 Rearrange

As a sub module this arranges the queue in an order based on the path length specified in the path type. The syntax is private void rearrange ().

Since this is a sub module and the other modules out side of queue type should not use it, it is declared as private to queue type. Only the update queue module has the access to this module. It simply attacks the queue of which it is member for sorting the queue so that the further operation will be an easy one.

23.2.1.3 Compare

For comparing the sub links present in the queue and returning the difference as result this module is designed. Syntax of this module is private int compare (Path p1, Path p2).

The declaration of private is vital since the queue cannot be misused. The result of this module is an integer number that reveals the number of difference between the paths weight components. The arguments of this module are two subpaths from the queue that have to be compared. Path is of user-defined type that holds the subpath details. Actually this module does not affect the queue since its only

compares the arguments given to this module. There is no use of this module at outside of update queue module.

23.2.1.4 Remove

For altering the queue we need to remove the paths that are identified as dominated paths. For this purpose another private module is designed and named as remove as implication of its purpose. The syntax of this module is private void remove (Path p).

Complete protection is necessary for this module since it has capability to entirely erase the queue to which it depends. It does not return anything since the queue is only modified in direct manner. For identifying which subpath to be removed from the containing queue it requires a parameter that gives the path to be eliminated. Design must make sure that this module is only available to the update queue module only.

23.2.2 Class Design

The java is used as programming language so we need to pack these modules into user defined classes. This gives us a proper abstraction of modules from its operation details.

Path. It would be better to have a separate type for referring the subpath that will be placed into the queue. For this a type Path is designed that holds details for the subpath. Usually we can have some identification for that path that tends to place a name for that sub link. Then it is required to store the link weight components. They may be of fractional factors. We need also the path length so for calculated as separate item. These thinks are enough to dictate that it is a dominated path. So after these design considerations we can have the Path class with name, components and the length as members. For proper handling of these attributes we need the member functions to read and write data over these attributes. Only through these public methods all attributes can be accessed.

Queue. This is another class that is used in our design that implies the queue. The queue at each node is the collection of paths. Then according to this we have the queue type, which is going to have the collection of objects of Path type. The collection is then manipulated by the member functions present inside the queue type. These methods are advertised to the main module so that it can call these methods for updating the queue. At first we need a method to upload any paths to the queue. This is a simple method that only adds the given path to the collection maintained inside of the queue. Our main purpose is to get the dominated path out. So it would be very purposeful if the update queue module were placed inside this type. If we place the important module inside this type then the sub modules will be placed inside this type. For getting any path from the queue based on the index

another method is also added that returns the subpath at specified index. This method may be applicable for the main module so it is made as public. But mostly this method is used to get the paths for comparison inside the update Queue method.

Test. This is the class that holds the main method for the simulation of this system. It has only the main method and then creates the queue and loads it with path then simulates the actual process of removing the dominated paths from the queue. The design of this is straight forward that a class is declared and it has only main method.

23.2.3 Rearrange

The goal of this module is to rearrange the queue for easy access and comparison purpose. There is sorting take place inside this module. The length of the subpath up to this node where actually the queue is present is the criteria used for the sorting. At the end of sorting the subpath having the shortest measure is placed first.

The general process of the module can be defined as: look for population, get the length of each path and use any sorting, rebuild the queue after sorting

The first process of the module is to get the queue. Since the queue is present as member variable inside the abstract type the method can easily get access the queue. Before starting the process we have to look for the population of the queue. If queue is not having element if suppose the queue is damaged, and if queue is having only one element then it is not required for further processing of this queue since it is waste to spend time without any useful reason.

When we confirm that queue is having more than one element then we precede our further operation on the queue. We have to get the array of paths stored in the queue so that it would be very easy for sorting. Since our queue is type of collection we need to convert it first to array then we can do the arranging process. Proper care must be required for conversion process. Java has inbuilt facility for conversion we can make use of those conversion utilities.

After the conversion the elements are get sorted using the bucket sort where each element is placed at the position where it can be perfectly fit. Each element is compared with the other element based on the path length stored as member of the path type. Sorting takes time based on the size of the queue and how fast the path length can be accessed.

The original queue is again rebuilt using the sorted array at the end of this module so that it can be used for modification. Since this module converts the queue collection as array it is necessary to rebuild the queue again as collection from the sorted array.

The queue collection is actually a reference when we look at the point of member variable. So it is now important to make the reference to this new queue.

The abstract content of the queue of the module private void rearrange ()

```
{
//check for queue empty
//get the array of subpaths from the queue collection
//sort the elements of retrieved array
//rebuild the collection from the array
//make the change to member variable
}
```

This module can be used before modifying the queue and also after the modification of the queue inside update Queue method. One advantage of sorting the queue after modification even though it is not necessary is to fast the subpath selection process from the queue in main modules of the remainder part of the algorithm. This method, we can place it inside the queue collection in the private part so that the outside member of the update queue cannot access it.

23.2.4 Remove

Incase if it is necessary to remove any paths from the queue after it is marked as dominated path it will be better to have a separate procedure for such work. The aim of this module is to remove the path, which is specified as an argument, to this module. This module deletes the path from the queue collection. The rough idea of this module can be like.

Check for the queue empty
Check for the path
Remove it from the queue

We have to make sure that queue is not empty before we precede the process of removal. If the queue is empty then it is totally not make point for deleting any element from this queue. So for the correctness of this module the queue is checked first of its size. We can make use of the inbuilt collection property for this purpose.

The path to be removed is given as argument to this method. This is of path type. We can directly make use of this argument. The entire queue is searched for this path. If the path is found out then it can be deleted. After deletion the queue is automatically rearranged and it will now like ordinary queue with continuous elements. The collection of queue as inbuilt member for this function and only the given path is forwarded to this method.

If path given by the caller is not found in the queue the function simply returns back to caller without any deletion process. The body part of this module can be specified as private void remove (Path p)

```
{
//check for empty
//forward the argument to inbuilt function
//return back to caller
}
```

This method is placed inside the private part of the queue since it is sensitive to improper use due to its affect over the queue content directly.

23.2.5 Compare

For checking the path dominancy we require a method that checks for the difference between the link weight components. Compare module make this process efficient. This module gets the paths to be compared and it thoroughly goes through the link components and if any difference is found then it will be noted. The difference is counted at each time if the first path component is greater than the second path component. This difference may have value more than zero if it is so otherwise it may have the value of −1 that is there is no relation between given two paths.

The paths for this module are passed as arguments by the up date module. The arguments are of Path type, which is a user-defined type, that denotes the subpath and some attributes of these path. One of these attributes is the array of components for this link. This attribute aids to find the dominated path.

After getting the two paths the components count that is the number of components is retrieved. The reason for retrieving the number of components is to loop through the components and to get the difference. For this system the links have equal number of components. So it is enough to check the component count for any one link.

Now the job is to compare each component. It is assumed that the first path components must be compared to the other path component. If the first path component is greater than the second path component then the difference is incremented so that we can say that there is some way for path dominancy.

Before processing we have to make sure that the difference variable must be initialized. This could be very useful at the end of the module if no difference is found. Now we can directly return the result without worrying about the content. This also avoids the additional use of flags for denoting that there is no difference.

When comparison is over the result must be returned back to the caller. It may be the difference or the notion of no difference.

The abstract content of this module is private int compare (Path p1, Path p2)

```
{
//initialize the difference
//go through the components
//check the difference and increment the value
//continue for all components
//return the difference to caller
}
```

23.3 Experimental Results

The main theme of the system is this module and it is the only method that is called manually by the simulation part of this work. This module does the aim of our work. It finds the dominated paths from the queue and removes it from the queue for efficiency purpose. When the dominated paths are removed the search space of the algorithm is reduced so the execution speed is improved.

This module first sorts the queue then it identifies the paths that are dominated by other. This marked path is now ready for deletion. The next process of this module is to delete the dominated paths and rearrange the queue for final result.

The idea of this module is sort the queue, compare the paths to other paths, mark the dominated paths, delete the dominated paths, rearrange the queue, return the queue to main module.

The first process of this module is to call the rearrange module for sorting purpose. When the call returns to this module the sorted queue is placed in the collection. Then the first element of the queue is placed as reference and the next elements are compared to this path using the compare method. The first path and the next element of the queue are passed to the compare method. It returns the difference between the paths. The update Queue method has one argument that gives the threshold value for the difference between the components. If the difference is greater than this threshold value then the first path dominates the second path and keeping the second path is no longer required. This time the path, which returns the difference, is marked as dominated and this mark is implicit representation of deletion mark. This procedure continued until all the paths are checked against the reference path. Next step of operation is to delete the marked paths from the queue. For this each path from the queue is analyzed against the mark. If there is mark then that path is deleted from the queue with the help of remove module.

The abstract view of this module will be like, Public void update queue (int the diff)

```
{
//sort the queue for easy process
//place the first path as reference
//call the compare by passing the paths with the reference
//mark as dominated if difference is higher than threshold
//continue until all paths are analyzed
//remove the unwanted paths
//rearrange the queue
//send the report
}
```

The final stage of this module is process of sending the report in which a simple message is produced for the user.

23.4 Summary and Conclusion

The queue is packed as user-defined data in our work and all the modules are packed as members of user defined data types. We can improve this simple implementation so that we can add the other features such as look ahead and 'k' shortest path. The next enhancement is loading the nodes queue in both direction from destination to source and in the reverse. As a conclusion, even though this appears to be effective some loss of exactness in subpath calculation was there.

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Chapter 24
Synchronization Accuracy in Wireless Sensor Networks

Ying Zhang

Abstract This paper provides new methods to estimate the clock migration in wireless sensor networks. The synchronous benefits (IGMKPF) method improve the performance of the system, compared and applicability CRLB maximum likelihood estimation, any random delay mode, such as symmetric gaussian and exponential model. Generally speaking, in case of (unknown) the gaussian distribution analysis, closed-form solution may not exist-expression MSE benchmark, and difficult to get lower. However, this paper derived Cramer-after Rao bound (PCRB) and IGMKPF. An important element in the clock estimates is that the improvement of the performance of the prediction is an unknown observation noise density estimation which led to an improvement.

Keywords Wireless sensor networks · Synchronization · Maximum likelihood estimation

24.1 Introduction

In two network node clock synchronization complete information is usually through the exchange. Due to the existence of information and may be limitless stitch delay, information can be any delay, the synchronous hard to [1]. The most common distribution model is put forward and the index of the gaussian network latency probability density function (PDFS) [2]. Maximum likelihood estimation (MLEs) for clock estimate the symmetrical presence of gauss and index called

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MLEg network latency and MLEe, respectively. In [2], and the results show that, MLEg comparison sensitive, delay distribution network MLEe. At the same time, the cramer-rao lower bound (CRLB) with inverse is proportional to the number of observation [2]. It also seems to be, to improve performance, MLEg and MLEe need a large number of observation. However, because the network is a new type of system, such a solution is not appropriate.

24.2 Problem Formulation and Objectives

The two-way timing message exchange mechanism is a recently proposed clock synchronization scheme for wireless sensor networks [2]. In this mechanism, the synchronization of two nodes A and B is achieved through a number of N cycles. Each cycle assumes two message transmissions: one from node A to node B, followed by a reverse transmission from node B to node A. At the beginning of the kth cycle, the node A sends its time reading $T_{1,k}$ to node B, which records the arrival time of the message as $T_{2,k}$, according to its own time scale. Similarly, a time message exchange is performed from node B to node A. At time $T_{3,k}$, node B transmits the time information T_2 and T_3 back to node A. Denoting by $T_{4,k}$ the arrival time at node A of the message sent by node B, node A would then have access to the time information $T_{j,k}$, $j = 1,\ldots, 4$ at the end of the kth cycle, which provide sufficient information for estimating the clock phase offset θ_A of node A relative to node B clock [3,4].

Similarly to [2], the differences between the kth up and down-link delay observations corresponding to the kth timing message exchange are defined by $U_k := T_{2,k} - T_{1,k} = d + \theta_A + L_k$ and $V_k := T_{4,k} - T_{3,k} = d - \theta_A + M_k$, respectively. The fixed value d denotes the fixed (deterministic) propagation delay component (which in general is neglected ($d \approx 0$) in small range networks that assume RF transmissions). Parameters L and M stand for the variable portions of the network delays, and may assume any distribution such as Gaussian, exponential etc.

Given the observation samples $z_k = [U_k, V_k]^T$, our goal is to find the minimum mean-square error estimate of the unknown clock offset θ. For convenience, the notation $x_k = \theta_A$ will be used henceforth. Thus, it turns out that we need to determine the estimator $\hat{x}_k = E\{x_k|z^l\}$. Where z^l denotes the set of observed samples up to time l, $z^l = \{z_1, z_2, \ldots, z_l\}$. Since the clock offset value is assumed to be a constant, the clock offset can be modeled as following the Gauss-Markov model:

$$x_k = Fx_{k-1} + v_{k-1} \tag{24.1}$$

where F stands for the state transition matrix of the clock offset. The additive process noise component v can be modeled as Gaussian with zero mean and covariance $E[v_k v_k^T] = Q = \sigma_v^2$. The vector observation model is given by [5]:

$$z_k = [U_k, V_k]^T = Ad + Bx_k + n_k \tag{24.2}$$

where $A[1 \quad 1]^T$, $B = [1 \quad -1]^T$, and the observation noise vector $n_k = [L_k, M_k]^T$ has zero mean and covariance $R = \text{diag}\{\sigma_n^2, \sigma_n^2\}$, and it accounts for the random network delays.

24.3 Posterior Cramer-Rao Bound for Sequential Bayesian Estimation

We need a lower bound on the covariance of the estimator, $\hat{x}_k$ for the true state x, defined by (24.1) and (24.2). Assuming that regularity condition holds for the probability density functions; the posterior Cramer-Rao bound provides a lower bound on the mean-square error matrix for random parameters. Letting $\hat{x}(z)$ denote an estimate of x which is a function of the observations z, the PCRB provides a lower bound on the mean square error (MSE) matrix M, and it is expressed as the inverse of the Bayesian Fischer Information Matrix (BFIM) J [6]:

$$M = E_{z,x}\{[\hat{x}(z) - x][\hat{x}(z) - x]^T\} \geq J^{-1} \tag{24.3}$$

The BFIM for x is defined as $J = E_{z,x}\{-\triangle_x^x \ln p(x,z)\}$, where $\triangle_\phi^\theta$ is the $m \times n$ matrix of second-order partial derivatives with respect to the $m \times 1$ parameter vector ϕ and $n \times 1$ parameter vector θ. In [6], the BFIM is shown to follow the recursion:

$$J_{k+1} = D_k^{22} - \left(D_k^{21}\right)^T \left(J_k + D_k^{11}\right)^{-1} D_k^{12} \tag{24.4}$$

where the matrices D_k^{ij} are expressed in terms of expectation integrals, once we have a sample representation of the posterior density, these expectation integrals can be calculated through sample mean approximations. We can obtain the sample-based representation of the posterior pdf $p(x_{k+1}|z_{k+1})$ by exploiting the work done in particle filtering [7]. Therefore, we can generate weighted samples on a stochastic grid to represent the posterior density and estimate the Fisher component matrices with the empirical averages:

$$D_k^{11} \simeq 1/N \sum_{n=1}^{N} \Lambda^{11}\left(X_k^{(n)}, X_{k+1}^{(n)}\right) \tag{24.5}$$

$$D_k^{12} \simeq 1/N \sum_{n=1}^{N} \Lambda^{12}\left(X_k^{(n)}, X_{k+1}^{(n)}\right) \tag{24.6}$$

$$D_k^{22} \simeq 1/N \sum_{n=1}^{N} \Lambda^{22,a}\left(X_k^{(n)}, X_{k+1}^{(n)}\right) + \Lambda^{22,b}\left(X_k^{(n)}, X_{k+1}^{(n)}\right) \tag{24.7}$$

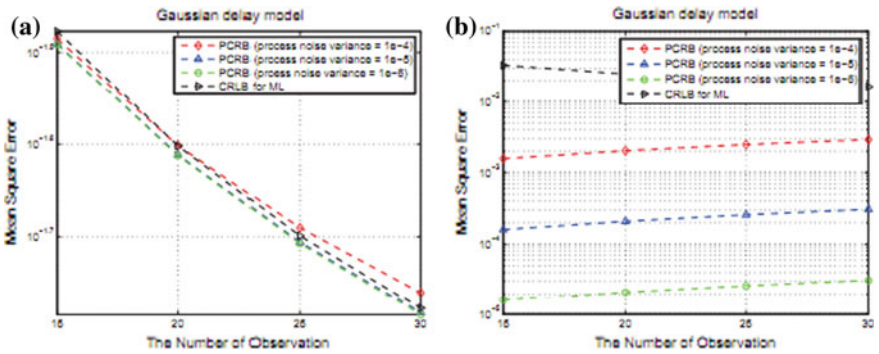

Fig. 24.1 PCRB and CRLB for symmetric Gaussian delays. **a** $\sigma_n^2 = 1$ and $J_0 = 1$. **b** $\sigma_n^2 = 1$ and $J_0 = 1/\sigma_v^2$

Figures 24.1 a, b shows CRLB and PCRB when the random delay model is Gaussian with zero mean and variance $\sigma_n^2 = 1$ for various initializations of the Fisher information matrix J_0 and different power levels for the process noise (σ_v^2).

24.4 An Iterative Gaussian Mixture Kalman Particle Filtering Approach

The proposed iterative gaussian mixture kalman particle filtering (IGMKPF) estimator combines the Gaussian mixture Kalman particle filter (GMKPF) with the observation noise density estimator [5]. The observation noise density estimator consists of the state model and a cost function in the form of an innovation equation expressed as the difference between the observation and estimated state posterior pdfs: $p_z - \hat{p}_z$. The innovation equation is produced by considering the estimate yielded by a standard Kalman filter as well as a GMKPF estimator using the prior, process, observation, state posterior, and noise density, which are propagated over time. Figure 24.2 provides a perspective on the proposed IGMKPF estimator.

IGMKPF algorithm

1. At time k, initialize the densities and set the initial state $\hat{x}_{k-1} = x_{ML}$.
2. GMKPF step (estimate the state posterior density).
   Calculate the state posterior density $p_g(x_k|z_k)$ using GMKPF.
   If k reaches the end of observations, go to "Infer the conditional mean and covariance step".
3. OND step (estimate the observation noise density).
   Calculate the observation noise density $p(\hat{n})$ given z_k and $p_g(x_k|z_k)$, and state model (Eqs. (24.1) and (24.2)).
   The observation noise density using GMM is approximated by: $p_g(n_k) = \sum_{j=1}^{J} \gamma_k^{(J)} N\left(n_k; \mu_{n_k}^{(j)}, R_k^{(j)}\right)$.

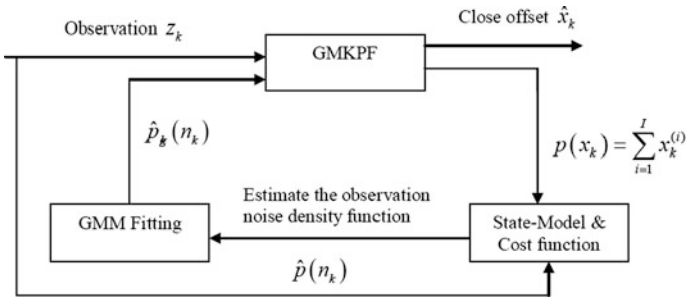

Fig. 24.2 Block diagram representation of IGMKPF estimator

4. $k = k + 1$, go to the GMKPF step.
5. Infer the conditional mean and covariance:

$$\bar{x}_k = \sum_{l=1}^{N} \omega_k^{(l)} \chi_k^{(l)} \text{ and } \bar{P}_k = \sum_{l=1}^{N} \omega_k^{(l)} (\chi_k^{(l)} - \bar{x}_k)(\chi_k^{(l)} - \bar{x}_k)^T$$

24.5 Simulation Results

In this section, computer simulations will be conducted to assess the performance of IGMKPF, PCRB-IGMKPF, MLEg [2], MLEe [2], and CRLB for estimating the clock offset in WSNs that are subject to two types of network delays: symmetric Gaussian and exponential. The process noise assumes the power $\sigma_v^2 = 10^{-6}$. Figure 24.3 a,b show the MSE of the estimators under the assumption that the random delay models are symmetric Gaussian and exponential, respectively.

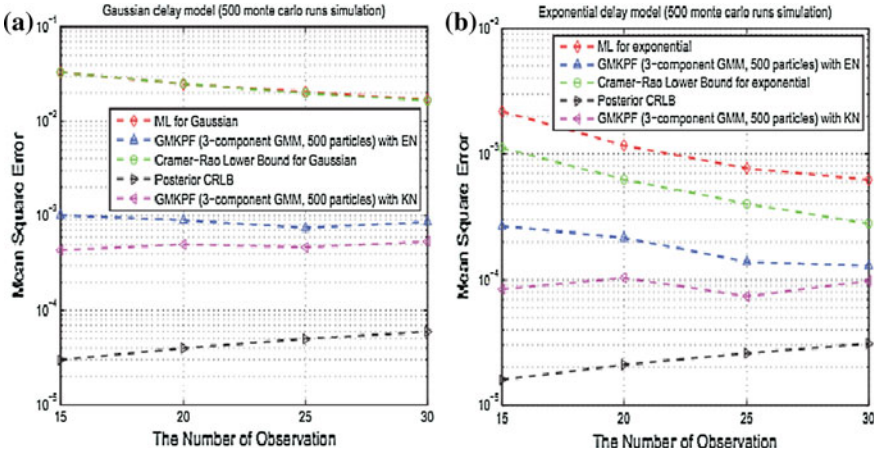

Fig. 24.3 MSEs of clock offset estimators. **a** Gaussian $\sigma_n^2 = 1$. **b** Exponential $\lambda = 1$

The notations KN and EN denote the set-ups with known observation noise density and estimated observation noise density, respectively. The MSEs are plotted against the number of observations ranging from 15 to 30. Note that IGMKPF ($G = 3$) performs much better (over 100 % reduction in MSE) than CRLB and MLEg in the presence of a Gaussian delay model.

24.6 Conclusions

Because the network delays may undertake any distribution and maximum likelihood estimation performance is quite sensitive distribution network delay, design clock synchronization algorithm robust network latency of unknown distribution appears as a very important problem. Bayesian framework, puts forward new clock synchronization algorithms, called the filter iterative particle gaussian mixture model (IGMKPF), and proves that the robust performance achieved the good and the existence of the unknown network latency distribution. Cramer-Rao after PCRB and bound MSE performance evaluation, the IGMKPF show improved performance and robustness relative maximum likelihood estimation.

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Chapter 25
Energy-Efficient Routing Algorithm in Wireless Sensor Networks

Hongmei Li

Abstract In this paper, we propose a congestion-aware energy-saving routing protocol (CER) network. Specifically, a source node degree get obstruction of the surplus energy and neighbor node determine destination for packet. Wrapped in a jump of routing with a minimum cost, light routing traffic, and high energy level, such congestion could be reduced and the network life increased. The experimental results show that there is a significant improvement in energy saving, network, and other energy output as-aware routing protocol.

Keywords Wireless sensor networks · Routing algorithm · Energy efficient

25.1 Introduction

Energy efficiency is a key aspect in wireless sensor networks sensor (network), in optimizing last months need or even years without charge [1, 2]. Most of the work in energy saving routing network only focus on before path finding method based on the minimum energy consumption, the biggest energy level or the minimal hop [3, 4]. These methods can reduce energy consumption. But in optimization and dense environment and high risk group jams, should consider the energy-aware routing. Because it will not only like a packet loss network performance and delay, but is also one of the most important factors, it leads to excessive energy consumption.

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25.2 CER Protocol

25.2.1 Network Model

The proposed network consists of a sink and a set of sensor nodes as show in Fig. 25.1. In this network, the sink node collects data from other nodes.

To avoid potential disconnected nodes, we define a lower threshold residual energy (LTR) which is the minimum acceptable residual energy of a node for routing. Each sensor node is distinguished by its residual energy level to classify into: EE-Node, R-Node, and FF-Node [5, 6].

To avoid the high congestion problem, we define an upper threshold congestion degree (UTC) which is the maximum acceptable congestion degree of a node for routing [7, 8]. The network is considered with different congestion areas as Fig. 25.2 which is an example obtained in a high congestion network case with UTC = 2. In this figure, Emergency congestion area (A1) includes the overloaded processing nodes with congestion degree high than UTC. Potential risk area (A2) includes light congestion nodes with congestion degree between 1 and UTC. Safe area (A3) includes light traffic nodes with congestion degree lower than 1. Based on the congestion areas, CER distributes the traffic fairly to decrease congested nodes and packet loss rate.

25.2.2 CER Protocol

In WSNs, energy efficiency is the main problem. So the least cost routing is considered in CER as an important factor. The energy cost is calculated as:

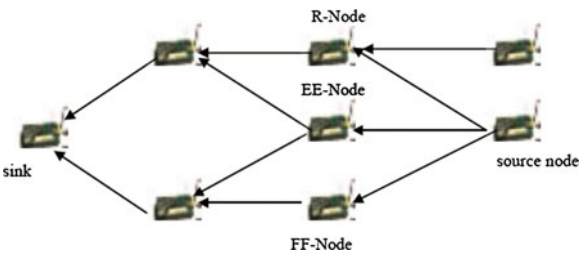

Fig. 25.1 Classification of node's function based on residual energy

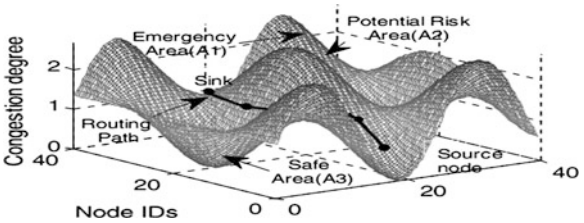

Fig. 25.2 Congestion area division

$$E_{ij} = c^* \text{dist}_{ij} \tag{25.1}$$

where E_{ij} is the energy cost to forward a packet from node i to node j, dist_{ij} is the distance from node i to node j, and c is a weighting constant which reflects the power cost of wireless transmission per unit distance [9]. We assume that the distance dist_{ij} can be easily obtained by several techniques, such as signal attenuation or estimation depending on RSSI [10]. Maximum of dist_{ij} equals the maximum range $R_{\max}$ of the used wireless. So we can get the maximum energy cost $E_{\max} = c^*R_{\max}$.

We use the following rule to map a value of the factor to a routing weight parameter. The rule shows that a parent node with higher routing weight is a better choice for routing. We call D_j as congestion degree at node j, $D_{\max} = \text{UTC}$ as maximum considerable congestion degree, RE_j as residual energy at node j, $RE_{\max}$ as maximum residual energy in a sensor node. In addition, W_c, W_r, W_e are defined as congestion weight, residual energy weight, and energy cost weight, which indicate the normalized values of congestion degree, residual energy, and energy cost in CER routing.

$$W_r = \frac{RE_j}{RE_{\max}} \tag{25.2}$$

$$W_c = 1 - \frac{D_j}{D_{\max}} \tag{25.3}$$

$$W_e = 1 - \frac{E_{ij}}{E_{\max}} \tag{25.4}$$

The final routing decision depends on W_c, W_r, and W_e. We linearly combine above three parameters to construct a routing weight RW_{ij} for the path from node i to j as:

$$RW_{ij} = (1 - \alpha - \beta)W_e + \alpha W_c + \beta W_r \tag{25.5}$$

Where: $0 \le \alpha \le 1$, $0 \le \beta \le 1$, and $0 \le \alpha + \beta \le 1$. The routing coefficients α and β determine how much impact of the congestion weight and residual energy weight on the routing decision. The positive effects of these routing coefficients drive the packets to move in light traffic and high energy level area. The value $(1-\alpha-\beta)$ reflects how much importance of energy cost on the routing decision. Adjustment of the routing coefficients brings different effects on the network performance. Our main goal is to route the packets toward the next hop which has the lowest energy routing cost, light traffic and high energy level. And it is difficult to find the perfect results for all situations of applications in WSNs. So in normal case, CER maintains equivalent values of three factors as discussing in the next section. Besides, CER also supports a flexible routing. In high network congestion case as Fig. 25.2, most of the neighboring nodes near the source node have high congestion degree, seem overloaded processing, and toward A1 area. They create "congestion mountain" obstacles on the paths from the source node to the sink

Fig. 25.3 CER routing algorithm

```
1. CER -Routing Algorithm (parents[]) {
2.    next-hop = null;
3.    for each p of parents[]
4.       if D_p < UTC and RE_p > LTR
5.          if p.RW >next-hop.RW== true
6.             next-hop = p
7.          End if
8.       End if
9.    End for
10.   Return next-hop;
11. }
```

node. Although they may have a short distance and the better energy level, they are not good paths for routing, because they lead to a high packet loss rate and increasing congestion level. Fortunately, CER offers a flexible routing by adjusting the routing coefficient α toward proximity of 1 to increase priority of forwarding the packet to sink through the light traffic area. So the packets are driven along the mount of "congestion mountain" obstacles as show in Fig. 25.2 to avoid high congestion area and reduce routing traffic to A2 area. Therefore the packet loss rate and congestion are reduced efficiently.

Figure 25.3 shows CER routing algorithm. First, CER rejects risky areas where include nodes with high congestion and low energy level as EE-Nodes and nodes in A1 area. Next, CER finds a parent with the best routing weight as the next hop. Then source node forwards the packets to the selected next hop. The next hop receives the packets and this process continues until the packets reach to sink node. In the worst case, if there is no returned next-hop, the packets are kept in nodes' buffer, and some packets will be dropped by buffer overflow.

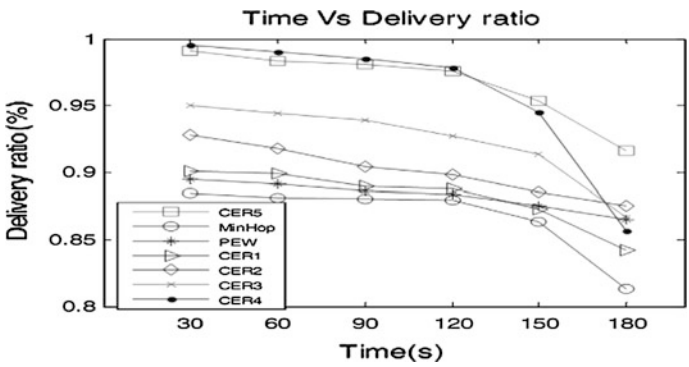

Fig. 25.4 Time vs delivery ratio

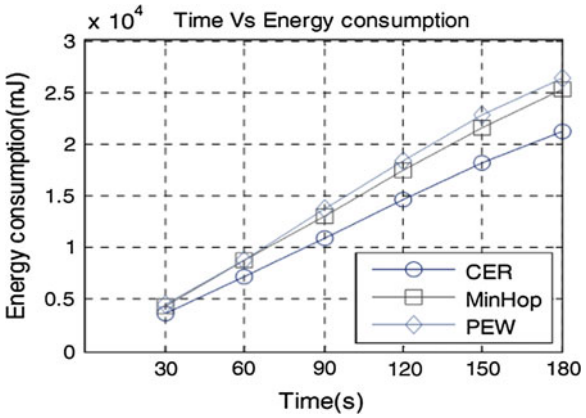

Fig. 25.5 Time vs energy consumption

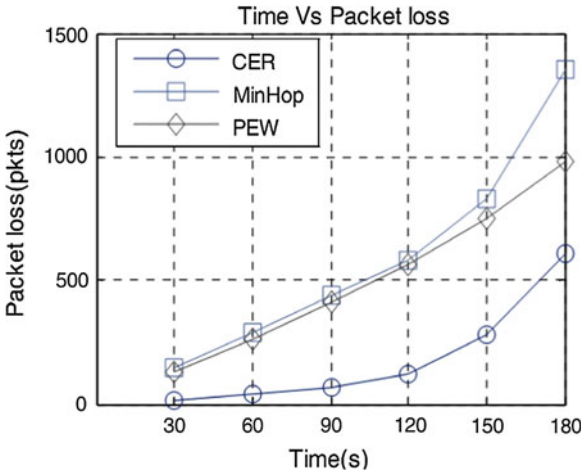

Fig. 25.6 Time vs packet loss

25.3 Performance Evaluation

Figure 25.4 presents the packet delivery ratio of the routing protocols. With Min--Hop routing, after 150 s of simulation, delivery ratio is decreased fast by some over utilized paths and exhausted energy nodes. In PEW, it can reduce exhausted energy nodes, but high congestion and more energy consumption is one of the existing problems of this protocol which increases packet loss rate. Under different values of routing coefficients, we obtain different results of packet delivery ratio. With configuration (0.0, 0.0), CER1 implies CER as the least energy cost routing. So its result is very close to Min-Hop routing because it has disadvantage of static routing in WSNs. At the first stage, the delivery ratio is very high because congestion is avoided. But a routing algorithm without considering the energy cost as an important factor leads to energy consumption of overall network highly.

Figure 25.5 presents energy consumption of the network with the corresponding routing protocols, which is the consumed energy of the network at the time. Energy consumption in CER is reduced significantly as compared with PEW and Min-Hop, because the high congestion and low energy problems are addressed. It demonstrates that considering congestion in energy-efficient routing as CER is more efficient for saving energy.

Figure 25.6 presents an improvement of our proposed routing protocol in reliability by reducing packet loss rate. Since CER rejects risky areas in routing and distributes the traffic fairly based on congestion and energy level, the packet loss rate is reduced efficiently. In Min-Hop and PEW, the existing high congestion and low energy problems are serious causes of packet loss.

25.4 Conclusion

We effectively solve high congestion and low energy problems. The simulation results show that to reach a better network performance CER through improving energy consumption, packet loss, the network life keeps network throughout.

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Chapter 26
Planar Inverted-F Antennas Structures for Mobile Communications

Ming Li and Juan Song

Abstract In answer to the increasing demand for portable terminal antenna, many of the works were all these years shorted-circuit quarter from the more commonly known PIFA wave antenna (planar inverted-F antenna). The main advantage of this antenna is their weak compactness and manufacturing cost, in addition to their important performance. In this chapter we put forward the new antenna-type geometry. Elements of coaxial probe feed. The design of the structure of advice from a simple PIFA antenna, based on software IE3D makes it possible to have Bi-bands, tri-bands, and quadribands antenna.

Keywords PIFA Antenna · HFSS and IE3D Software · Mobile Communications

26.1 Introduction

Different communication standards require more and more low radiation structures crowded in telecom equipments [1]. Again and again to answer these questions, it is wise to develop thick, low compact antenna for the good performance of storage in adapting to the conditions for radiation efficiency. In addition, the concept of multiband antenna is impossible, because it allows the party of many of the same features as the radiation structure to remain [2]. The work presented in this paper describe the study of a PIFA antenna (planar inverted-F antenna) which has length approximately equal to $\lambda/4$ [3, 4].

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26.2 PIFA Antenna

PIFA antenna is a ground plane, radiation unit, feed, and wire or wires of short-circuit article circuit, with connections between landlines and top plate. Figure 26.1 shows a typical PIFA configuration. Antenna is feeding in the location of the base line which connects the electric wire. This is a very attractive PIFA antenna; wireless system in space within the antenna, wireless system is quite limited. The addition of a shorting circuit strip allows giving good input impedance measurement to be achieved with a top plate that is typically less than $\lambda/4$ [5].

Feed circuit One and a half rigid coaxial has a central conductor extension at the end of the outer conductor which is used to form PIFA thread feeding. The conductor of the coaxial is the edge of the welding showing a small hole in the ground plane position. The common circuit board-type PIFA short selling is a better way to reduce the antenna size, but the results are narrow impedance bandwidth.

Our study is based on a simple PIFA antenna presented in Fig. 26.2

The PIFA is designed to operate at 2.4 GHz as [6]:

$$f_r = c[4(W + L)]^{-1} \tag{26.1}$$

where c is the velocity of light, W and L are, respectively, the antenna width and length.

In order to validate our results, we initially simulated PIFA antenna of Ref. [7] with software HFSS and IE3D. The antenna dimensions are $W = 11$ mm, $L = 27$ mm, $h = 7.5$ mm and $x = 7.2$ mm on a ground plane of 130 × 70 mm [7]. The respective geometries in each editor are given as in Fig. 26.3a, b.

In Fig. 26.4a–c, one respectively represents the return loss, the input impedance locus, and the polar radiation pattern in 2D.

The radiation pattern representation allows knowing the electromagnetic behavior of the antenna. According to the two graphs of Fig. 26.4c given for the plans E and H, the radiation is almost omnidirectional. The obtained results by HFSS and IE3D are in good agreement with those of Ref. [7].

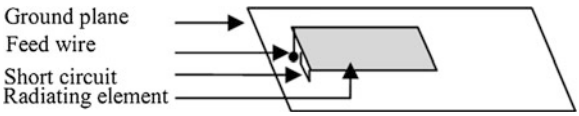

Fig. 26.1 PIFA antenna with shorting circuit strip

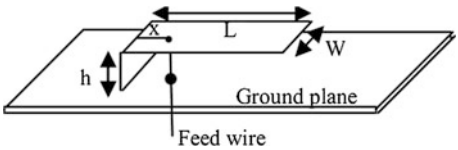

Fig. 26.2 The shape of PIFA structure

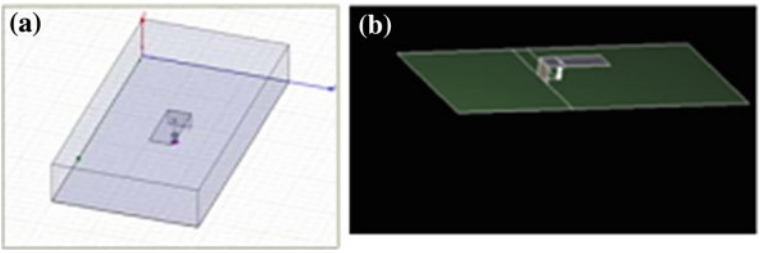

Fig. 26.3 **a** The PIFA antenna geometry on the HFSS editor. **b** The PIFA antenna geometry on the IE3D editor

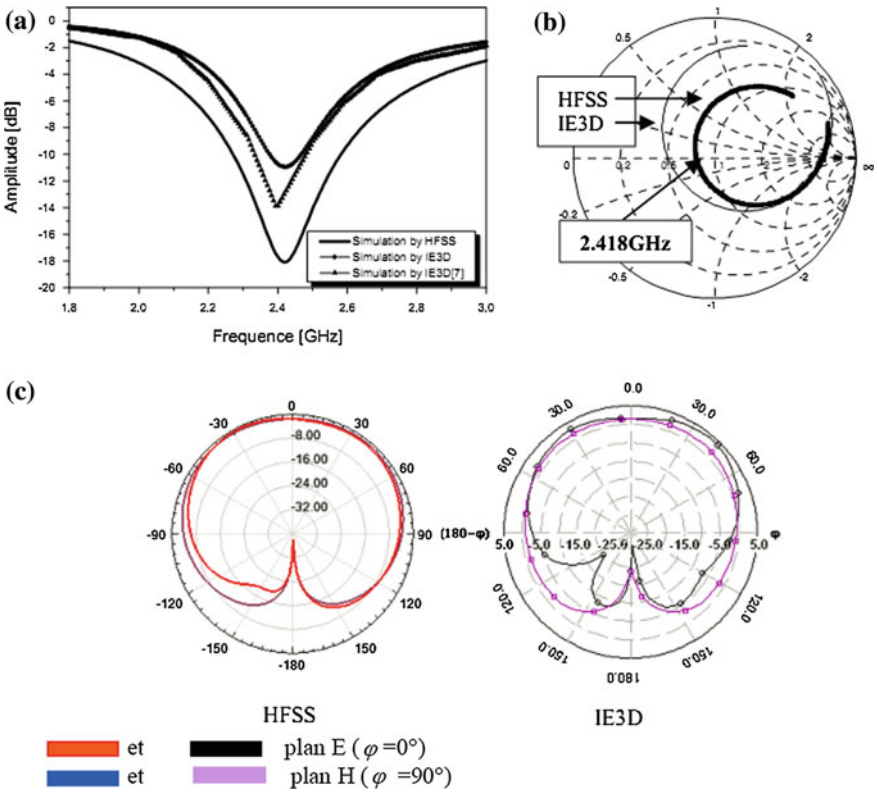

Fig. 26.4 **a** The return loss. **b** The input impedance locus. **c** The radiation pattern in 2D at f = 2.418 GHz

26.3 Proposed Antennas Structures

We applied to the initial antenna of the miniaturization techniques which give multibands antennas integrated in the handsets mobile [8].

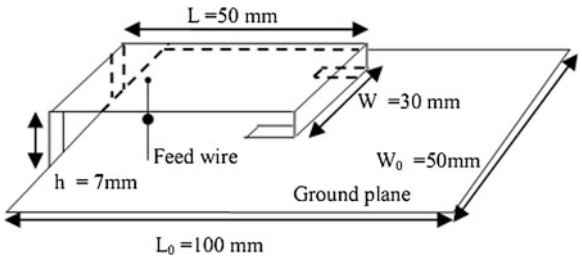

Fig. 26.5 The PIFA antenna geometry

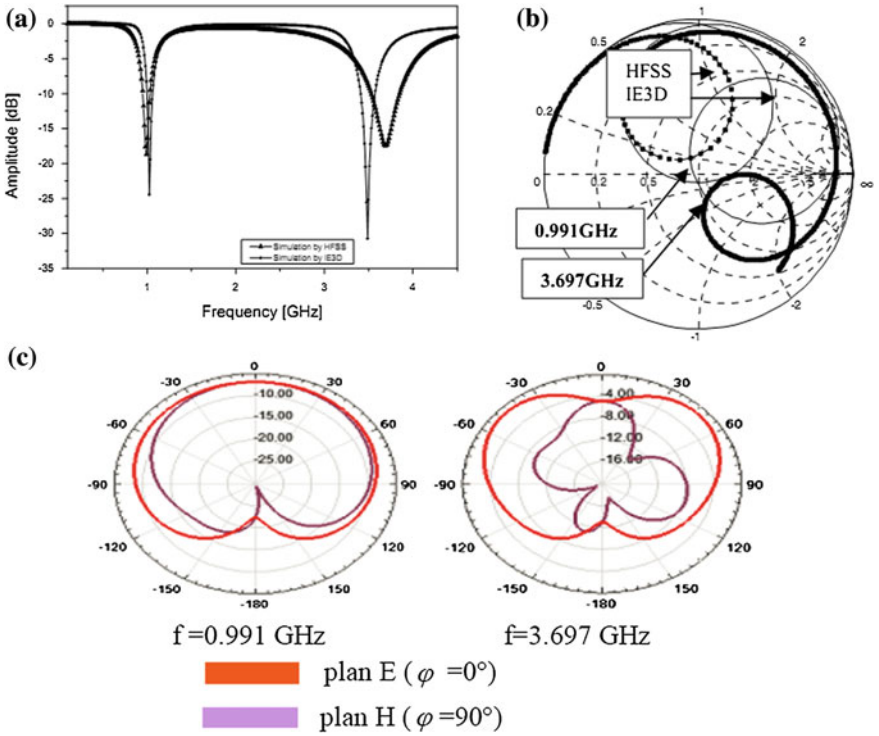

Fig. 26.6 **a** The return loss. **b** The input impedance locus. **c** The radiation pattern in 2D presented by HFSS

This goal of this paper is to propose new PIFA designs applicable to GSM and WiMAX systems. Figure 26.5 shows the PIFA antenna configuration proposed for a Bi-bands operation. The structure contains two short-circuit plans of height 7 × 5 mm, a radiating element folded towards low of 5 mm height, and two horizontal arms of 7 × 3 mm height.

In Fig. 26.6a–c one respectively represents the return loss, the input impedance locus, and the polar radiation pattern in 2D.

The PIFA structure simulation by HFSS gives a Bi-band antenna operating at two resonant frequencies, 0.991 and 3.697 GHz. The first return loss for the frequency 0.991 GHz has a peak lower at −18 dB and the second for the frequency 3.697 GHz goes down until −17 dB value. We found almost the same results by IE3D, with peaks of −22.5 and −30 dB appearing at frequencies 1.026 and 3.488 GHz respectively. These results translate a very good adaptation of the antenna.

In the same way, the representation on the Smith chart shows the input impedance locus positions at the two desired frequencies which are located at the chart center.

The radiation patterns in polar coordinates in the two plans *E* and *H* at the two resonant frequencies represented by the preceding figure show that the antenna radiation is globally almost omnidirectional, except for that of the plan *H* of the second frequency.

26.4 Conclusion

In this paper we proposed several antenna structures, operation of telecommunications standards for mobile and wireless communication applications. Some small antenna design PIFA types can accord the current standards of operation. Three PIFA antenna designs allow operation of each GSM/WiMAX standard, GSM/WiMAX/uwb, and GSM/WiMAX uwb wi-fi//. The antenna was simulation software based on IE3D in three-dimensional spaces. A good agreement between the various the results obtained. We can see that at the input to the antenna, these three suggestions reduce the crowded frequency structure.

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Part III
Internet of Things and Applications

Chapter 27
Study of Web-Based Independent Learning Environment in the Course of Programming Foundation

Yan Gou, Dongsheng Liu and Liping Zhang

Abstract This study focuses on the network teaching platform based on Tsinghua online education, and takes the tree structure of printed alphabet as the case in order to expound the process of construction of web-based independent learning environment in the course of programming foundation, in which the problems rising, circumstance creation, objectives definition, motivation arousing, initiative exploration, monitor, and regulation are included.

Keywords Independent learning environment · The platform of network teaching · Program design foundation

27.1 Introduction

At present the study of web-based independent learning environment is one of the most popular topics in the research of network assistant teaching [1]. The course, Program design foundation, suited perfectly for network teaching, which is also highly needed to assist teaching. After a long period of teaching, I found that it is hard for the students who are new to the course program design to complete this teaching task, due to the outstanding capacity of students, teaching hours are far from enough and teaching contents are in great amount. However, a wealth of teaching resources would be offered by means of the platform of network teaching to satisfy students' learning demands greatly. Meanwhile, this platform would help

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students widen their horizon, stimulate their learning interest, and further improve their information competence. The teachers also benefit a lot from the materials over the Internet, and they could choose corresponding contents to organize teaching practice according to their teaching requirements. While plenty of courseware, reference materials, and exercises make it possible for students to practice on this platform over which we provide a lot of teaching resources and create a lot of opportunities for students to communicate, cooperate, and go with self-teaching [2].

This paper aimed at constructing the independent learning environment on the Internet, which caters to both the teaching characteristics of program design foundation and facilitates students to master the contents of this course, combining the study of the network teaching platform based on Tsinghua online education (hereinafter referred to as THEOL Network Platform) [3] and the study features of students in our college. This paper is to provide theory basis for learning practice under the environment of Internet and promote the integration of theory and practical application by applying this autonomic learning environment to classroom teaching and analyzing the process of students self-teaching.

Taking the construction of autonomic learning environment as a guide, this paper applies the abstract theory to practice. A real autonomic learning environment is constructed through the applying of THEOL network platform, which improves learning interest, stimulates creativity, and promotes teaching.

27.2 The Construction Case and Study of Web-Based Independent Learning Environment in the Course of Programming Foundation

According to the construction mode and the implementation process of independent learning environment in the course of programming foundation, with a consideration of the characteristics in this course, we have designed an independent learning mode based on problems exploration. This mode focuses on the THEOL network platform, combining online evaluation system, and plagiarism detecting system. As shown in flow Fig. 27.1.

27.2.1 Asking Questions

Students who are new to the course of programming foundation would feel it boring, dreary, and difficult. Therefore, they have little interest in this course and have no idea about how to transform the problems into programming language [4]. Consequently, stimulating learners' interest during the learning process is always the first priority. We have chosen the tree structure of printed alphabet as a discussing topic, more interesting and direct, hopefully to arouse students' interest.

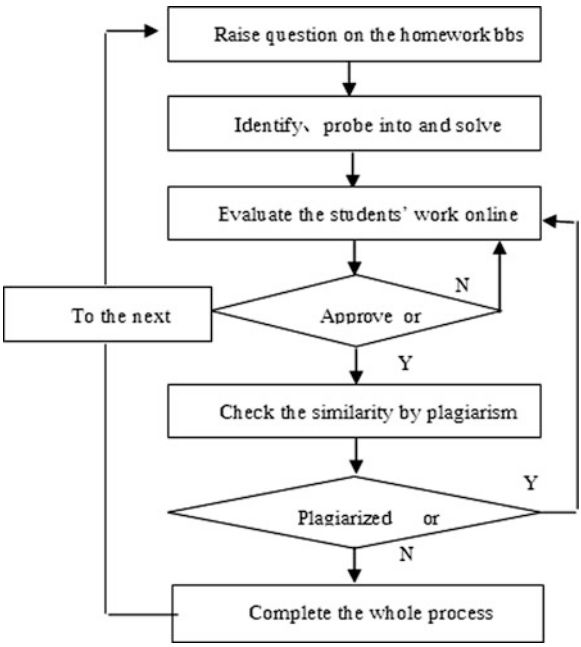

Fig. 27.1 The model of independent learning based on problem exploration

As a result there are the following questions appearing in the course forum on the THEOL platform. Let us discuss how to solve this problem.

Programming the following tree structure of printed alphabet.

27.2.2 Creating Situation

THEOL network platform provides a general learning environment including the course learning resources, additional materials, and hyperlink with various studying activities. THEOL platform at this stage works as a creation tool and creates rich learning situations.

This situation creation in autonomic learning activity focuses on the section of course forum. First, questions are brought up in the form of discussion, and then a discussion section named For Everyone to Discuss the Tree Structure of Printed Alphabet is created, which is mainly for learners to voice their views and discuss during the process of problem solving. Teachers could provide a great quantity of examples and cases of double cycles such as printed alphabet graph, statistic program of selected subjects of physical education, judgment of leap years, chicken and rabbits in the same cage, and so on. Students become aware of the similarities and disparities between the cases through these examples so that they can master well in double cycles. Meanwhile, it is helpful for the students to solve the problem of tree structure of printed alphabet and successfully complete this independent learning.

27.2.3 Setting Learning Goals and Enhancing Learning Motivation

Teachers present the basic grammatical part of branch and iteration statements in the statements of control flow in advance and they instruct students to discuss problems and finish the tasks by assigning exercises, arousing students' intrinsic exploring interest and motivation, and making them enhanced during the process of exploration. Then the learning goals would be displayed on the THEOL platform.

27.2.4 Learners' Autonomic Exploration on the Platform

27.2.4.1 Writing Source Program

The students being aware of problems and learning objectives could answer questions in detail with the help of course learning materials, additional resources, relevant Internet resources about program design, and contents in textbook on the THEOL platform. They can also discuss by means of various communication tools offered by the platform. Advice is given in the discussing section For Everyone to Discuss—tree structure of printed alphabet in order to avoid blindness and too much freedom of learners' exploration.

After this autonomic learning, the author discovered in the interview that some students use the search engine Baidu to find relevant information on websites by typing tree structure of printed alphabet as key words. They formed their own way of solving problems after referring to the other's methods of calculation. While some students got their own algorithm by consulting programming foundation textbook and relevant contents in other textbooks first and following the learning advice and tips. Next, students begin to write source program under the compiling environment on the local machine. When the compiling task is successfully finished, some test data would be input to judge the accuracy of source program preliminarily.

27.2.4.2 Online Judging

In the traditional teaching process, students would write source programs and submit them to the teacher for examination. Owing to the large number of students, these source programs would become a huge burden for the teachers for they have to examine with their manual work, and error caused by human element is unavoidable. Therefore, under the web-based independent learning environment of program design foundation, the writer adopts the online judging to test students' source program. If the source program passes the judgment it will go to the similarity test; or it needs alterations until it passes the judgment. Teachers do not have to correct students' work one by one any more. Instead, by looking into the

testing system they would know the number of students who have finished tasks and the results of the comparison in the similarity test, by which they could find out the students with plagiarism. Finally, teachers would give an assessment based on the experiment report. Thus, teachers' working load is greatly reduced and students' learning interest is highly improved, with the teaching quality rising as a result.

Students submit their source program over the Online Judge, which begins to run the compiler automatically. If there would be error in the compiling process, it will display Compile Error; otherwise the students' source program will be run by inputting files as the running data. Comparing the obtained result with the data in output files, if they are totally the same, the program is marked as "Accepted"; or it will be displayed as "Wrong Answer", and the "Presentation Error" with the wrong format. At last, students would finish their independent learning by submitting their experiment report with the use of the assignment section on the THEOL Internet platform.

During the process of independent learning, the adopted Online Judge is one of the most important features in the construction of web-based independent learning environment and is the characteristic of the course of program design foundation. On the one hand, it helps reduce teachers' burden; on the other hand it is conductive to the unified test criterion. From the perspective of students, they become very happy while seeing "Accepted" on the screen. This makes the students feel the joy of success and sense of accomplishment, which urge the students to do more exercises and stimulates them to face new challenges.

27.2.5 Monitor Adjustment

27.2.5.1 Monitored by THEOL Network Platform

At this stage, it is necessary to use THEOL network platform as monitoring and adjustment tools in students' learning. THEOL network platform provides powerful monitor function. Teachers could use this platform to get relevant data, such as the number of logging on and reading teaching material, handing in the assignments and publishing topic in the BBS, questioning to teachers and studying the notes, finishing questionnaires, and reading the test questions, etc. In this way, it is convenient for the teachers to be aware of circumstances of all the learners on the THEOL platform and understand the learning process of them in order to guide and adjust learners' learning perfectly.

27.2.5.2 Monitoring with the Online Evaluation System

During the independent learning process, teachers need to monitor and adjust students constantly and to urge the students with less consciousness to take an

Run ID	User	Problem	Result	Memory	Time	Language	Code Length	Submit Time
154892	lds200920081121103	1425	Output Limit Exceed			G++	0.5K	2009-04-25 20:12:45.0
154879	lds200920081121103	1425	Output Limit Exceed			G++	0.5K	2009-04-25 20:03:26.0
154778	lds200920081121038	1425	Accepted	312K	0MS	G++	0.45K	2009-04-25 17:54:50.0
154765	lds200920081121064	1425	Accepted	312K	0MS	G++	0.37K	2009-04-25 17:43:44.0
154759	lds200920081121064	1425	Accepted	312K	0MS	G++	0.37K	2009-04-25 17:38:54.0
154755	lds200920081121064	1425	Compile Error			G++	0.36K	2009-04-25 17:37:35.0
154743	lds200920081121064	1425	Accepted	312K	0MS	G++	0.37K	2009-04-25 17:29:20.0
154739	lds200920081121064	1425	Accepted	312K	0MS	G++	0.37K	2009-04-25 17:27:22.0
154736	lds200920081121064	1425	Output Limit Exceed			G++	0.38K	2009-04-25 17:25:53.0
154702	lds200920081121064	1425	Presentation Error			G++	0.38K	2009-04-25 17:03:01.0

Fig. 27.2 The function of monitor and regulation of online test system

active part in the problem exploration activity and finish the assigned task on time. With the help of statistic function of Internet teaching platform, teachers could check students' independent learning and examine the number of subjects finished or the advancement of subjects at present, which is assisted by the "online state" in the online evaluation system (as seen in Fig. 27.2).

27.2.5.3 Monitoring with the Plagiarism Detecting System

Students would discuss, explore, and solve the problems put forward by their teacher, who afterwards collect the source program when their students submit. The students' task is severely identical in the process of experiment; therefore, teachers need to test the similarity of students' source program with the Jplag testing system of German Karlsruhe. The testing system will present the comparative result of different source programs (as seen in Fig. 27.3) After analyzing the result, the teachers select those tasks with high similarity as the main suspicion of fraud, so they would be sure whether the students cheat or not by asking about the details of procedures and their train of thought in the process of solving problems. The students who cheat could be basically picked out through the test above and would receive punishment thus to reduce plagiarism in the future.

After the independent learning this time, the writer finds that teachers' monitoring, adjustment, and timely feedback to the students would stimulate their enthusiasm and interest during the learning process. Learner's self-monitoring also plays an important role in the learning effect under the independent learning environment of program design foundation.

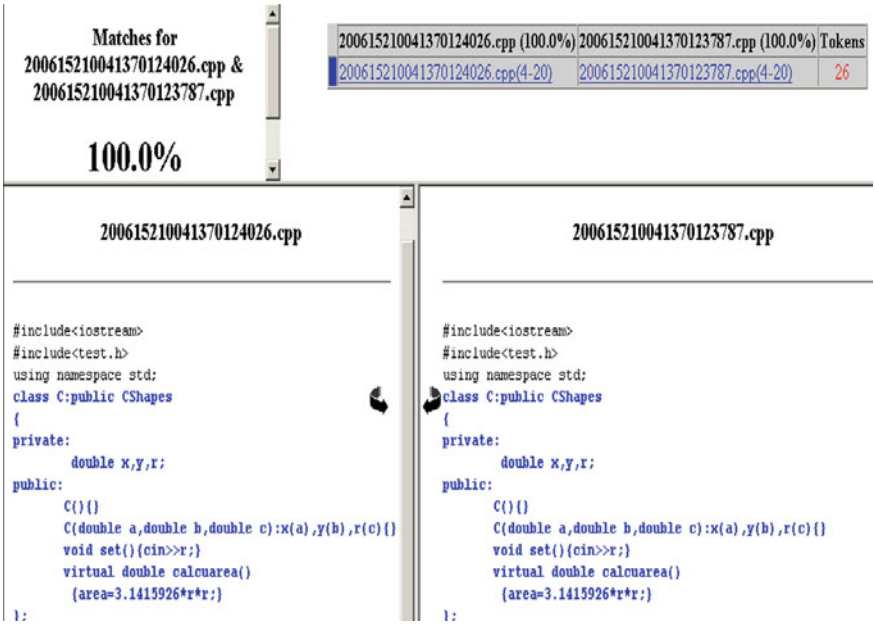

Fig. 27.3 The detail information of a program with higher degree of similarities

27.2.6 Learner's Summary and Reflection Through the Platform

Learners could collect, read, and analyze a lot of documents through various channels, and they eventually form their own opinions after discussing with others. Furthermore, the learners could voice their view, summarize, and reflect over the Internet post in the discussion section of the THEOL Internet platform.

27.3 Conclusion

The study of web-based independent learning environment is not a pure research on theory, while it focuses on contributing to the teaching practice effectively and solving the specific important problems [5]. This paper takes the double-circulation tree structure of printed alphabet in the course of the program design foundation as the case in order to describe the study process of web-based independent learning in detail.

After the application of the web-based independent learning environment for the whole semester, the learners take more interest in the course of the program

design foundation. At the same time, the accomplishment on information and the capability to use information technology have been dramatically improved, as well as the ability to independently explore the based network. Thus, it can be seen obviously that the application of the independent learning environment does promote learners to learn well the course of the program design foundation and improve various abilities of the students in order to contribute more to cultivating the innovation spirit and improving the practice capacity.

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Chapter 28
MPLS VPN Technology in Campus Network

Dong Wang

Abstract A variety of novel service systems have been created in the campus network access to cross-MAN, and college information workers are required to ensure that these systems are in real-time, efficient and safe operation in the same physical network. To address this issue, this paper proposes the solution by which the BGP/MPLS VPN technology is introduced in the campus network, where the virtual private network of service systems is deployed to give the key steps to implement the program, which is a proven reference.

Keywords Campus network · Service systems · MPLS VPN · BGP

28.1 Introduction

Multiprotocol label switch (MPLS) VPN technology involves the use of public backbone network for the transmission of the network information within the enterprise. It can meet the needs of the enterprise information in security, real-time, high bandwidth which greatly enhanced the flexibility in network operation and management. In recent years, domestic end-users of various fields come to gradually realize the advanced technology of MPLS, and the VPN business demand based on MPLS technology have increased significantly.

On the other hand, the majority of colleges and universities devoted significant resources to basically complete the work on renovation and expansion of the base platform of the campus network, leading to a significant increase in the campus

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network bandwidth, reliability, and the advanced feature of the network protocol. Different programs have come along aiming to establish the new variety of service systems in the campus network, such as all-in-one card private network, financial private network, and special video surveillance network, etc. How to fully ensure that these service systems work in a real-time, efficient, and safe manner in the campus network is an urgent issue facing the workers of the university information system.

According to the MPLS VPN technology and its features, this paper describes its application in the campus network of the Chongqing Institute of Technology as a useful exploration for the MPLS VPN technology to be used in the campus network.

28.2 Principle of the MPLS VPN Technology

In the traditional IP network, packet that arrives at a router is planned to find the route table to set the hop routing in accordance with the principle of "longest prefix match". When the network size is large, a route table lookup may take a long time. To make it worse, burst traffic often causes a buffer overflow, resulting in the packet loss and the increased transmission delay and the declined quality of service [1].

MPLS is defined by RFC3031 [2] as a tag-based IP routing selection method, which is focused on that the peripheral network is based on routing while the core network on label switching. Each IP packet enters the core network via the peripheral network; the support label switching router will "mark" a fixed length to the IP packet, which is then forwarded in hardware. This eliminates the need for the process in which the IP data packets to a router must rise to the third level of the router and use software to find the routing table, thus greatly improving the IP packet forwarding rate. Network administrators can also use the MPLS tags and marks to forward the forwarding equivalence class (FEC) to achieve quality of service (QOS) and the traffic engineering.

In the MPLS network, MPLS LSP in tunnel is responsible for sending the VPN data (two-layer frame and three-layer grouping). The service provider is the edge router PE, within the user VPN, determines whether the routing selection is made, by which the MPLS VPN is divided into two types: Layer 2 (VPLS and VLL) and Layer 3 (BGP/MPLS VPNs) [3]. The latter in the network is often used as it can greatly simplify the service, featured in scalability, flexibility, and convenience of large-scale deployment.

BGP/MPLS VPN follows the RFC2547 [4] standard, it uses the extended MP-BGP Community attribute to distribute user VPN routing information [5], and uses MPLS to forward VPN traffic from one site to another site. A typical BGP/MPLS VPN model is composed of three parts: customer edge (CE) device, the provider edge (PE) device, and provider (P) device.

CE device: the user edge router, which has direct access to the network operators. It can be a router or switch or host. It cannot "feel" the presence of the VPN, nor has the need to support MPLS.

PE device: the provider edge router, which is connected with the CE. In the MPLS network, all the processing on the VPN occurs on the PE.

P device: the operator's core router, which is mainly placed to complete the routing and fast forwarding.

In BGP/MPLS VPN, an ISP's network is available to support multiple IP VPNs. Each VPN is, to its users, a separate private network. Each VPN is associated with one or more VRFs (VPN routing or the forwarding instance). A VRF includes a routing table, a forwarding table and a set of interfaces that use this forwarding table. PE router maintains a separate routing table and the forwarding table for each VRF, thus to prevent the information sent to the other VPN. Additionally, each VPN is allowed to use the overlapping IP addresses.

28.3 Application of MPLS VPN Technology in the Campus Network of Chongqing Institute of Technology

This Institute is a young undergraduate institution, and it has established a cross-metropolitan area network for the use of its three campuses, which are scattered in the city to connect the Gigabit Ethernet network. In the process of building such a digital campus, the institute has established a university-wide smart all-in-one card system, which is composed by the backend server, and a number of POS machines, and transfer machines. These devices are spread over three campuses at different physical locations. In order to achieve the normal communication of these devices, each device is assigned an IP address. At the same time we have established card business systems, private network based on the existing campus network to ensure the safe operation of the service system in the campus network. This is a private network based on the BGP/MPLS VPN technology as a virtual private network. Please see Fig. 28.1 for its network topology.

The campus network supports 10 MPLS convergence devices, including core equipment. Exchange agreement with the label distribution protocol (LDP) is be used as MPLS, and OSPF as the IGP protocol. This paper takes already-built card virtual private network as an instance to introduce its key steps, where the device RONGYUAN1 is used to describe the device configuration.

1. In theory, the formation of BGP/MPLS VPN network requires the CE, PE, and P routers. In order to achieve simplicity, we did not include the P routers in the design of all-in-card private network. The convergence exchange devices and core devices were designed as PE, and CE was simplified into a POS machine or back-end server or a single layer switch.

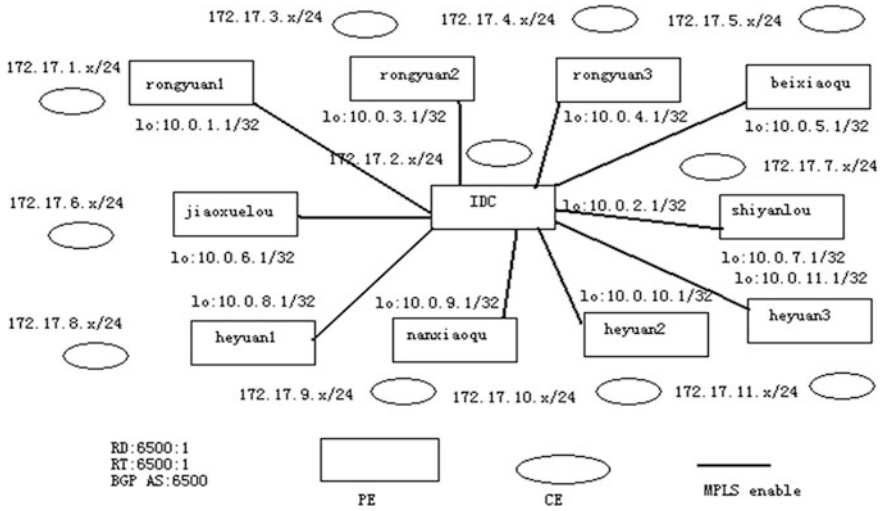

Fig. 28.1 Cross-MAN BGP/MPLS VPN

2. Each PE was divided with their areas of jurisdiction for use of the VLAN numbers in the card network, and the corresponding physical port was added in the VLANs.

```
VLAN 100 NAME YIKATONG_MPLS
PORT ACCESS VLAN 100
```

3. In each PE, the divided VLANs were given the definition of VPN VRF, such as the name as YIKATONG, and in the mean time, its RD, the export target, and the import target were all set to 6500:1.

```
IP CEF
IP VRF YIKATONG
RD 6500:1
ROUTE-TARGET EXPORT 6500:1
ROUTE-TARGET IMPORT 6500:1
```

4. Each VLAN interface connected to the CE was linked to the defined VRF, and the card network was added to the VPN routing.

```
INTERFACE VLAN 100
IP VRF FORWARDING YIKATONG
IP ADDRESS 172.17.1.1
```

5. To configure the MP-BGP to spread the VPN routing information required configuring the IBGP interconnection in each PE.

```
Router BGP 6500
No BGP default ipv4-unicast
```

```
Neighbor 10.0.2.1 remote-as 6500
Neighbor 10.0.2.1 update-source loopback0
……
Neighbor 10.0.11.1 remote-as 6500
Neighbor 10.0.11.1 update-source loopback0
```

6. Make the statement within the VPN and activate the neighbors as part of the BGP.

```
Address-family vpnv4 UNICAST
Neighbor 10.0.2.1 activate
Neighbor 10.0.2.1 send-community extended
……
Neighbor 10.0.11.1 activate
Neighbor 10.0.11.1 send-community extended
```

7. Each PE device had its YIKATONG subnet distributed to the VPN network, enabling other ten PE devices to learn its sub-network.

```
Address-family IPV4 UNICAST VRF YIKATONG
Redistribute connected
```

8. Enable the MPLS capabilities in each PE interface, which is used to connect to another PE.

```
Interface gi0/0
Tag-switching
```

Completion of the above steps means the end of building the all-in-one card special network transmission platform in the campus network, where each PE device may share the routing data on the card networks of other PE equipment. In this way, the CE devices that are located in scattered places can communicate with each other, except for nonauthorized users. This fully ensured the transmission security of the card's private network system. With the future increase of the card nodes, it is also allowed to use the dynamic routing protocols RIP/OSPF in each of the VPNs to greatly enhance the network scalability. If the campus network needs to build other private networks, such as a remote video monitoring private network, or a financial professional network, the idea of its design is basically the same with the achieved steps. Each new private network is required to create a VRF, and assign different identifiers of the RD, the export target, and the import target.

28.4 Conclusion

In building a variety of application platforms for service systems in the campus network, using MPLS VPN technology for the private networks may bring the following benefits:

1. Security and confidentiality: the various operational systems are completely isolated, and independentof each other, by which service data is not easy to get leaked.
2. Reduced construction and management costs: a variety of service systems that share one physical network are possible to save construction costs, without having to purchase the equipment and the laying of fiber optic systems for each system, plus saving administrative costs.
3. High scalability: with the increase of the various operational systems, it is flexible to achieve the expansion of the physical network and logical network.

Practice has proved that using MPLS VPN technology to build a private network of service systems in the campus network is quite impressive concerning stable operation and low failure rate, able to create a better network application environment for teaching, research, management, and service. Compared to its peers, this institute is one of the early few ones to use the technology in the construction of an all-in-one card network, truly worthy of being merited by other colleges and universities of the country.

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Chapter 29
Evolution Course and Analysis of Internet of Things

Peng Li, Qingzheng Xu and Na Wang

Abstract As the three industrial tide of information technology after computer, Internet, and mobile communication, Internet of Things may provide fresh impetus for communication technology in the future, and it is attached importance as nation's information strategy by more and more government. In this paper, the evolution course of Internet of Things is reviewed, and then the relationship between Internet of Things and related technologies, such as Internet, sensor network, ubiquitous network, M2M, cyber physical system, is analyzed to comprehensively understand the denotation and connotation of Internet of Things. Finally, we put forward some development direction of Internet of Things.

Keywords Internet of things · Internet · Sensor network · Ubiquitous network · M2M · Cyber physical system

29.1 Introduction

As a new industrial tide of information technology after computer, Internet, and mobile communication, Internet of Things plays an important role in promoting Internet development and pushing society forward, and it is becoming a new growth point of economy development in the near future. The ratio of Internet of

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Things service to Internet service is 30:1 according to predicting results by Forrester, unattached market research agency in USA. With the huge potential market, Internet of Things, a new trillion industry, is attached importance as nation's information strategy by more and more government. Therefore, many development plans and action programmes based on Internet of Things are formulated.

Jiabao Wen, Premier of the State Council of the People's Republic of China, said that "We will make substantive progress in developing motor vehicles powered by new energy sources and in integrating telecommunications networks, cable television networks, and the Internet, and accelerate R&D in and application of the Internet of Things. We will also increase investment in and policy support for emerging industries of strategic importance" on March 5, 2010. Internet of Things is first written in the report on the work of the government, which means that its development is becoming the national development strategy of China.

Until now, Internet of Things has been applied successfully in military, industry, agriculture, environmental monitoring, architecture, medical treatment, space, and oceans exploring. However, as an emerging technology, the connotation and denotation of Internet of Things is varied by different people, and it has not a distinct and uniform concept.

29.2 Definition and Evolution Course of Internet of Things

Internet of Things is not a new concept, but in fact a technology existing for over ten years. It is the development and commercialization of wireless communication technology, the core technology of Internet of Things, which produces the prosperity and development of Internet of Things nowadays.

The original idea of Internet of Things first appeared in The Road Ahead authored by Bill Gates published in 1995 [1]. He said that, "When the personal computer is popular, we can abolish the bottleneck road using identity card or note and waiting in line in airport, theater, etc. For example, when you entered the airport, your personal computer can verify you have brought the ticket through connecting with computer system at airport. Your computer can also verify your legal identity and open the door without the key or magcard". However, limited status of wireless network, hardware and sensors of that time, Internet of Things do not become the main aspect of information technology at that period.

Radio frequency identification (RFID) system is first proposed by Auto-ID Center of USA Massachusetts Institute of Technology in 1999 [2]. In this system, all items are connected with Internet through some information sensors, such as radio frequency and bar code, and then distinguished and supervised intelligently. The early Internet of Things is proposed based on the material flow system, in which the radio frequency is used as a substitute for the bar code to manage the material flow system intelligently.

The connotation of Internet of Things is clearly changing with the development of new technology and application. World Summit of Information Society was

held in Tunis, and ITU Internet Reports 2005: the Internet of Things was published by International Telecommunication Union on November 17, 2005 [3]. The report comprised of six fields: concept of Internet of things, related technologies, potential market, challenges, new opportunities for development, and life in the future. Unfortunately, ITU has not made a specific definition of Internet of things, but only described it as a whole new communication and computer network connected every items, every person, at every time, and every locations.

European Union constituted the route diagram of Internet of Things research in September, 2009, and described it further as following [4]. As a part of Internet in the future, Internet of Things is a dynamic network facilities in the world, with self-configuration ability based on standard and alternate communication protocol. Its physical and virtual items have identity and physical property, and they can seamlessly integrate into the information network using intelligent interface.

In the comment of the 2010 report on the work of Chinese government, the Internet of Things is explained as follows. Internet of Things is a network connected all items with Internet through appointed protocol, to share information and then distinguish position, track, and monitor and supervise them intelligently [5]. It is an extension and expansion based on Internet.

29.3 Related Concepts of Internet of Things

To understand the connotation of Internet of Things, it would be useful to clarify some related technologies, such as Internet, sensor network, ubiquitous network, and M2M and cyber physical system.

29.3.1 Relationship Between Internet of Things and Internet

Internet, the greatest invention of the twentieth century, has greatly promoted the great variety of international development structure and the profound transition of human society to information society. What is the relationship between Internet of Things and Internet? The relationship between them can be reduced to four types based on different application stage of Internet of Things [6]: (1) Internet of Things is the same as sensor network, not connect with Internet. That is to say, Internet of Things and Internet are two substantive networks. (2) Internet of Things is a part of Internet, and it is an extension and expansion naturally based on Internet. (3) Internet of Things is an extension and expansion based on Internet, and they are two equal networks. (4) Internet of Things is Internet in the future.

The foundation network of Internet of Things has some variation based on its applications, including public communication network, trade special network, and even new communication network especially for it. Usually, Internet is propitious to the foundation network of Internet of Things, especially when the scope of

connected items has gone beyond the local area network and when we need public communication network to send and receive the useful information. So, Internet of Things is seen as some extension and expansion of Internet application with the properties of trade application, Web 3.0, and cloud computing.

Internet is people oriented, in which the sharing information is produced, sent, and edited by some people. But Internet of Things is item oriented, in which the information is produced, sent, and edited by some items to acquire and understand. In the era of Internet of Things, each item can independently communicate, address and control, and the network can eventually understand the world.

From some point, Internet can be seen as a network connected the virtual world. At the same time, Internet of Things can be seen as a network connected the physical world. Then danger from information world is brought naturally into the physical world. So, the Internet of Things security is more serious than Internet. In case of security problem, the cost of lives and property is great and can not reduce the losses by redundancy and disaster backup. In addition, individual privacy is another problem in Internet of Things.

29.3.2 Relationship Between Internet of Things and Sensor Network, Ubiquitous Network

29.3.2.1 Relationship Between Internet of Things and Sensor Network

In ITU-T Y.2221 proposal, a sensor network is composed with some sensor nodes exchanging sensor data through wired or wireless communication [7]. Each sensor node is made up of sensor and optional power element testing data and linking them. Compared with other traditional network, sensor network has some outstanding features, such as resource-constrained, self-organized structure, good dynamic, application related, and data centered.

Sensing is the soul of both Internet of Things and sensor network. The core of sensor network is senor, reflecting a part of item. At the same time, the core of Internet of Things is item, reflecting the whole item. In a sense, sensor network is the main bearing network, excepting public communication network and trade special network, and the main information sources. The scope of Internet of Things, which can sense the items using sensor, bar code, and RFID, is larger than that of sensor network from this point of view.

29.3.2.2 Relationship Between Internet of Things and Ubiquitous Network

In ITU-T Y.2002 proposal, ubiquitous network is described as follows [7]. In the case of service ordered, person or facilities join the service freely with the least technology restriction no matter when, where and what method. Ubiquitous

network has beyond the scope of intrinsic telecommunication network and provides the communication between person and person, person and item, item and item.

From the view of the connotation of ubiquitous network, it is very much concerned with harmonious interaction between people and the environment, and sensing equipment and wireless network is only the tools. Ultimately, the ubiquitous network belongs to Internet, Internet of Things, and also intelligent system. Compared with the today's realizability of Internet of Things, perhaps we can say that, ubiquitous network is the perfect state and long-term vision of information network technology. That is to say, ubiquitous network includes all features of Internet, sensor network and Internet of Things. Internet of Things is yet an object of ubiquitous network, and the forerunner and the commanding height during its development.

29.3.2.3 Conclusion

Based on the concepts of Internet of Things, sensor network and ubiquitous network, and their features as mentioned earlier, we can simply summarize their relationship as follows. Ubiquitous network contains Internet of Things, and Internet of Things contains sensor network.

From the view of communication object and technology coverage, we can find that, (1) sensor network is the foundation for the extension and application of Internet of Things, and it is the end of network to collect data information. Except for some kind of sensor, the sensing equipment includes RFID, two-dimension code, and other terminal inserted with mobile communication unit. (2) Internet of Things is the primary and inevitable stage to ubiquitous network, the ultimate goal of information society. The ubiquitous network realizes the integrating of the heterogeneous networks and then achieves the communication goal between item and item, item and people, people and people.

29.3.3 Relationship Between Internet of Things and M2M, CPS

29.3.3.1 Relationship Between Internet of Things and M2M

M2M, an abbreviation of Machine-to-Machine, Man-to-Machine, or Machine-to-Man, is intended to send data and share information through intelligent and interactive seamless connection among people, machine, and background system [8].

The core idea of Internet of Things is identical to M2M, which is the most common and feasible method. The main difference between Internet of Things and M2M is application field. The application of M2M is restricted to wireless communication network, a principal field of Internet of Things.

29.3.3.2 Relationship Between Internet of Things and Cyber physical system

Cyber physical system (CPS) is a multidimensional complex system integrating environment sensing, embedded computing, network communication, and physical environment [8]. The object of CPS is to possess computing, communication, accuracy control, distance cooperation and autonomy property of physical system, and to perfectly coordinate between virtual society and realistic society through autonomous control system and information service system.

With the similar ability of Internet of Things, CPS more emphasizes the feedback loop. To be more specific, it realizes real-time and dynamic information interaction and information service through the feedback loop between computing process and physical process, and then extends some novel ability at last.

Compared speaking, industrial community pays close attention to M2M, the common application of Internet of Things at the present stage. However, CPS, an important technology pattern of Internet of Things in the future, is attracted the eye by academic world.

29.4 Development of Internet of Things

29.4.1 More Extensive and More Comprehensive Connecting

First, the connecting object will extend from people to item. On the technical side, the diversity of the end of the network will increase dramatically. Intelligent degree of the prior network equipment is high, such as mobile telephone, PDA, iPad, and even personal computer. However, intelligent degree of the network equipment in Internet of Things is relatively low. For example, the computing ability and memory space of a sensor node can not compared with other equipment mentioned above. In the future, more network equipment may have little intelligence but distinguishable. In the era of Internet of Things, active intelligence is to distinguish and control other objects, and passive intelligence is to be distinguished and controlled by other intelligent items.

Second, the network communication pattern will extend more and more widely. It is possible that, the node is connected into the network lasting 1 min or even 1 s in 1 day, such as delay tolerant network (DTN). It is also possible that the node is only connected into the network logically. For example, node *A*, not joining any network, will exchange the data every 1 hour with mobile node *B*, updating data to a base station every day. In this case, the nodes *A* and *B* are both considered as node in Internet of Things. These different cases may embody the universality of communication pattern of Internet of Things.

The other side of the more extensive and more comprehensive connecting of Internet of Things is the node number. Without Internet of Things, the greatest node number may be 10 billion or 100 billion, even if every people surf the net and each people has many network equipment. However, in the era of Internet of Things, every item can be connected into the network and controlled. The node number is surging into 100 billion or trillion, which will pose immense challenges in network technology and be adverse impact on our mind seriously.

29.4.2 More Thorough Sensing

With more extensive and more comprehensive connecting, Internet of Things will have more thorough sensing and more profound insight. As we all know, sensor is invented 100 years ago, but communication is a useful addition of sensor in recent 10 years. According to instructions and working alone, sensor operating will not have the properties of cocomputing and self-adapting.

For example, in the story of the blind man feels an elephant, each one made distinct description after feeling an elephant. It was clear that they can sense the elephant more thoroughly, if they exchange the position and observation angle with other partners after feeling a part of the elephant.

29.4.3 More Synthesized Intelligence

Naturally, the next step is deeper and more synthesized intelligence after more thorough sensing. Forest fire prevention is a classics application of sensor network and is proposed first. How can we find the potential fire hazard from the continuous and arid value measured by temperature sensors? The temperature beyond the threshold value can be regarded as a potential fire, which is the simplest incident detection algorithm. We can further cosense using many sensors to avoid false alarm and missed alarm for the error of single sensor system and to increase the reliability of fire detection, which is the intelligence of “Many hands make light work”. Further, using multidimensional sensing data, such as humidity, wind speed and wind direction, we can also provide the forest fire warning information to relevant departments and remove the risk in the bud, which is the intelligence of “To nip a thing in the bud”. We can also mine mode from long period data and mine relationship from seemed irrelevant event such as El Nino, which is the intelligence of “A straw shows which way the wind blows”. The intelligence is continuously deepened from the temperature data to potential fire, from short term and discrete event to long term and wide scale climatic phenomenon [9].

29.5 Conclusion

Internet of Things, merging the advanced technologies and the novel ideas, has crossed the huge chasm between electronics, automatics, communications, biotechnology, mechanics, and hylology. Its objective is to share information not only between people and people, but also between people and item, item and item.

Researches on Internet of Things have huge economic and society value to the next generation information technology. From academic research angle, the evolution course of Internet of Things is reviewed, and then the relationship between Internet of Things and related technologies is analyzed at closer range in this paper. Based on personal comprehension, Internet of Things will go ahead to more extensive and more comprehensive connecting, more thorough sensing, and more synthesized intelligence.

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Chapter 30
Study of the Hierarchy Management Model Based on Active Network Node

Wenshu Duan, Tianping Dong, Yan Ma and Lunpeng Liu

Abstract Active network can provide a programmable interface to the user where users dynamically inject services into the intermediate nodes. However, the traditional prototype of network management does not accommodate to the management of active networks, it cannot utilize the distributed copulation capabilities that active networks provides. This paper analyzes the structure and mechanism of the active network management system, introduces a pattern of active network management, and studies the structure, management mechanism, design outline, and each connection of the management system. The paper also studies the network topology discovery and traffic.

Keywords Active network · Network management · Active node

30.1 The Management of Active Networks

Due to traditional network management using the centralized management, we manage the network without using the computing power of the active network node. Therefore, the traditional networks neither effectively implement the active network management, nor reflect the advantages of active network. In order to

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DOI: 10.1007/978-1-4471-4853-1_30,

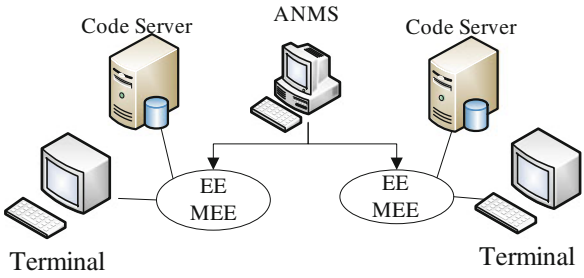

Fig. 30.1 The architecture of active network management system

adapt to the characteristics of the active network, the management model of active network should break through the asymmetric management model of traditional network. Necessarily, active network include the network control, management of workstations, and the active node perfectly, so as to solve the key issues of manager-side in the traditional network. It also loads the dynamic business and manages dynamic MIB. The structure of active network management (ANM) is shown in Fig. 30.1.

In the Fig. 30.1, it is known that active node is the main object of the active network management in the system of ANM [1]. It is an equivalence relation between active node and control management workstation, and instead of the relation between client and server in the simple network management protocol (SNMP). Intuitively, ANMS contains the following features, such as ANMS is an interface of the network managers for controlling and managing active network. Active node is the main management object of network management system that is responsible for handling the initiative letter bag. Execution Environment (EE) provides the environment which must operate and handle the active envelope. MEE represents the overall management functions of active node. Code server (CS) provides the logical method which is necessary for network element equipment to collect data. And the terminal system uses the service of active node to run the active application.

30.2 The Structure of the Active Network Management System

In this paper we propose an active network management model based on the management features and the structural characteristics of the active network. The management model based on the node is the core management, which make full use of the advantages about active network initiative, dynamic, and intelligent to achieve the active network distributed intelligent management.

The structure of this management mode is shown in Fig. 30.2 [2]. In this mode, the management system must complete the node management, configuration, analysis, and monitoring which consists of the network management node and the

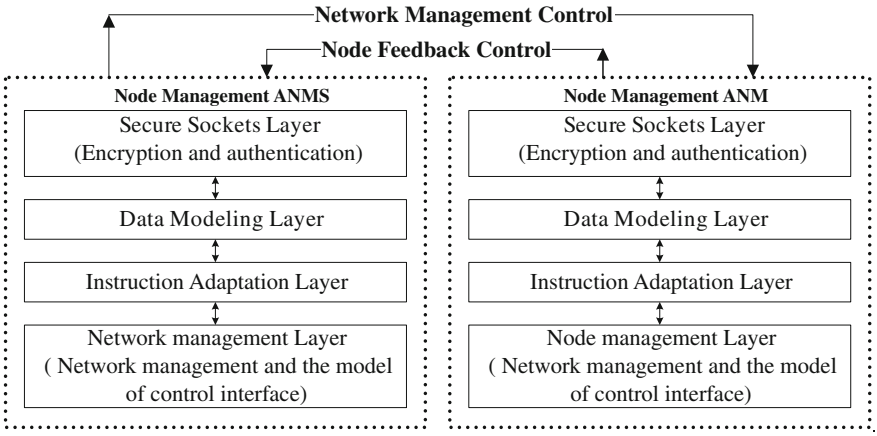

Fig. 30.2 Hierarchical model of network nodes and active nodes

active node, the node management (Local Mgrs SW), the modeling layer (Modeler) and the instructions of the adaptation layer (Instrumentation). Management system will achieve the following functions. For instance, to manage node configuration, failure and performance with the control EE of node, to visit and configurate node by the node OS API issue commands, to provide a set of API interface for EE in order to make active application (App) can adapt and configurate the network resources and monitor the performance of the network dynamically.

30.3 The Structure and Forwarding Mechanism of Management Message

30.3.1 The Structure of the Management Message

In the design of this system, the active packet is encapsulated into UDP and ANEP. The active message consists of the UDP header, ANEP header, active message subject and effective load, which is shown in Fig. 30.3. Next, we will introduce the usage and meaning of fields in the active message subject.

Active message subject follow the construction of ANTS encapsulation body form, and there are several domain in its head.

Capsule/protocol: This field is used to describe this text that belongs to the code segment, the code group, and the corresponding agreement.

Sharing head: It contains the source address, the destination address, a node address and version information, and so on, and it is the common domain of the different types of package body.

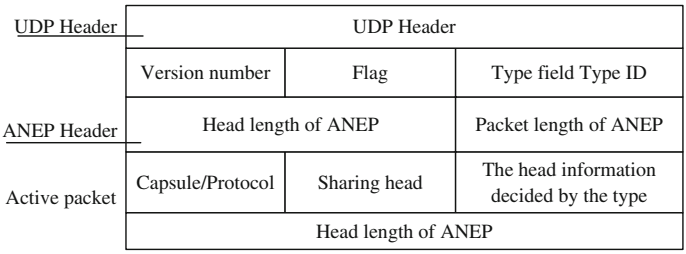

Fig. 30.3 The encapsulation format of management packet

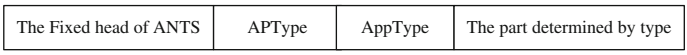

Fig. 30.4 The format of management packet

The head information decided by the type: Different types of active packet have a different field, and the number and size of the field are not the same.

In this system, we will divide the active messages into the direct implementation messages and active application messages according to the code distribution mechanism of a message. The transmission of the direct implementation messages is "package", that is to say the small program code is transmitted by the encapsulated messages directly. The active application message becomes complicated and it uses the code distribution mechanism known as on-demand to obtain. The active messages only carry code identification. Therefore, we join two fixed fields in the head information, then the unity format of active message as shown in Fig. 30.4.

APType field: it is used to indicate the type of active message. 0 means direct execution of the messages, and 1 means active application of massages.

AppType field: it indicates that the massage belongs to the application type. For example, 0 means getting ordinary network management message, 1 said common network management message; and 2 denotes patrol message. The purpose of the establishment of the field is to make the active packet which could complete the implementation of the traditional node.

30.3.2 The Forwarding Mechanism of the Management Message

(1) One–One mode forwarding

One–One forwarding mode is one of the simplest forwarding modes. It is divided into two structures according to the package in the section. One structure is similar to the current end-to-end communication mode, which is not to enforce middle node. This approach is mainly used to access to the specified node as shown in Fig. 30.5a. Another structure, as shown in Fig. 30.5b, is a forwarding

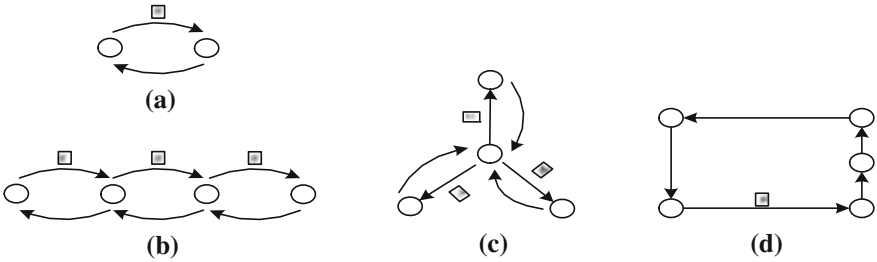

Fig. 30.5 The schematic of One–One mode forwarding, BFST forwarding mode and DFST forwarding mode

mode which is calculated along the transmission path. In this mode, package body packets are necessary to carry the program executed in the node in accordance with a specified intermediate node. Through the implementation methods, management node can put the concentrated tasks into practice along the entire transmission path.

(2) Breadth first search traversing (BFST) forwarding mode

This mode, as shown in Fig. 30.5c, is a kind of parallel control modes. When the message of the package reaches an active node, it is directly sent to the neighbor nodes which connected to the current node. The same implementation will be playback when the message reaches the adjacent nodes. Obviously, the network will come up a lot of the copies of the encapsulation body message after one transfer. When these copies to reach the next node, they are copied and forwarded to their neighbor node, then a copy of the message is in turn forwarded continue until the messages traverse the entire network.

(3) Depth first search traversing (DFST) forwarding mode

This mode, as shown in Fig. 30.5d, is a kind of serial control modes. In this mode, the package message is directly forwarded to a neighbor node which connected with the current node, when it reaches an active node. Then the message was forwarded to a neighbor of the neighbor in turn until the messages traverse the entire network.

30.4 The Analysis of Active Packet Path Forwarding Algorithm

The network is defined as the connectivity graph $G = (V, E)$ [3], where V represents a set of nodes, E represents the two-way connection between the nodes. Every active node consists of fast forwarding(FF) unit and EE, etc. All packets have delay in forwarding when they go through each hop, and the forwarding

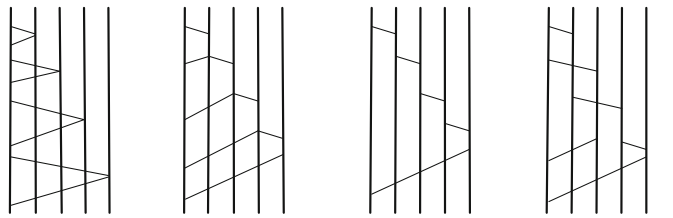

Fig. 30.6 The schematic of active packet forwarding mode

delay includes the propagation delay and queue delay. Some packet may be processed by EE, so this packet also includes processing delays. If a communications link treats the pack using FIFO order, the service program of EE also follows FIFO order. The head of a packet mainly contains the source, purpose, application identifier and other information. FF matches packet headers through a set of Filters, if there is a match then turn it over to EE processing, or directly forwarding to the destination address. However, delays of each package are limited on the node. Simply, we assume that FF delay is banded by constant C, and the executable code delay in EE is defined as function P (k). Then, C and C + P (k) represent the delay for forwarding packets on the node and the delay for executing in EE, respectively [4].

Here, we ignore the cost of the transfer of programs, and we could assume that most of the active network code can be obtained from the node cache [5]. Because of the node in the treatment could copy the package in order to send messages to the EE, the function P (k) mainly depends on the package in the EE calculation, so P (k) must be a linear function at least [6]. And we have the assumptions as following:

$$\mathrm{P}(k) = \mathrm{P_C} + k\mathrm{P} \tag{30.1}$$

In the above formula, k means the length of the packet and P represents a constant. Normally, we can ignore the $\mathrm{P_C}$, so the above equation could simply rewrites as:

$$\mathrm{P}(k) = k\mathrm{P} \tag{30.2}$$

In order to analyze the performance, we define the following concepts.

TC(n): time complexity. To measure the time of a task from beginning to end.
MC(n): message complexity. To measure the node number of the active packet in a task.

In the structure represented in Fig. 30.6, Link-A is seen as the nodes of a management center and the algorithm injected into the corresponding active packet.

Next, we will analyze several algorithms used in this paper.

(1) The Get-Response is similar to the Request-Respond in the SNMP.

In the Get-Response algorithm:

$$\mathrm{TC}(n) = n\mathrm{P} + \sum_{i=1}^{n-1} 2i\mathrm{C} \tag{30.3}$$

$$\mathrm{MC}(n) = \sum_{i}^{n-1} 2i \tag{30.4}$$

where nP is the action delay of n tasks executed in the EE, and $2i$ means the time delay for $i = 1, 2, 3, \ldots, n-1$ hop.

(2) The Report-En-Route is a forwarding request to the next node when the request which reached to the node sends the response to the source side.

In the Report-En-Route algorithm:

$$\mathrm{TC}(n) = 2n\mathrm{C} + n\mathrm{P} \tag{30.5}$$

$$\mathrm{MC}(n) = n + \sum_{i=1}^{n} i \tag{30.6}$$

where nP is the time delay in the implementation of all the nodes, and $2n$C means transmission delay that includes the time cost in sending to the destination and the returning to destination.

(3) The Collect-En-Route algorithm is that the request which arrived at node carries the response information to the next node, and the request will directly returns to the source when it reaches the destination node.

In the Collect-En-Route algorithm:

$$\mathrm{TC}(n) = 2n\mathrm{C} + \sum_{i=1}^{n} i\mathrm{P} = 2n\mathrm{C} + \frac{n(n+1)}{2}\mathrm{P} \tag{30.7}$$

$$\mathrm{MC}(n) = n \tag{30.8}$$

The iP is the time delay in the implementation of node. Because of the length of the package will add a unit after a hop, obviously, the biggest message complexity of the node n does not exceed $2n$.

(4) The Report-Every-l algorithm is a compromise definition of Collect-En-Route algorithm and Report-En-Route algorithm. The time complexity and message complexity of Report-every-l algorithm are appropriate.

The thought of Report-Every-l algorithm is described as that n will be divided into n/l section, each section length is 1, and we would send a fixed size massage which is initialized to collect-en-route algorithm to all the n/l section. So, the

section i started in Collect-En-Route until cost more than the $(i - 1)$ (C + P) time unit.

So in the Get-Response algorithm:

$$\mathrm{TC}(n) = (n - l)(\mathrm{C} + \mathrm{P}) + \sum_{i=1}^{l} (\mathrm{C} + i\mathrm{P}) = \mathrm{O}(n\mathrm{C} + (n + l^2)\mathrm{P}) \tag{30.9}$$

$$\mathrm{MC}(n) = O(n) + \sum_{i=1}^{n/l} (l + il) = O\left(\frac{n^2}{l}\right) \tag{30.10}$$

We assume $l = \sqrt{n}$, then the TC (n) is linear, and the message complexity is $O(n\sqrt{n})$.

In order to keep balance in the two complexities, we make $l^2 = {}^{n^2}/_{l}$, and then the two complexities are $O(n^{3/4})$.

30.5 Conclusion

This paper discussed the active network management model which has independent module and accurate task. And each layer can be dynamically updated to adapt to the volatility of the active node in the active network and the expansion of the active application. Ultimately, the stability and scalability of network management are improved obviously, and the active network management meets the needs of the modern network management commendably.

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Chapter 31
Fault Elimination in Campus Network

Hong Ye, Yuanyuan Liang, Mingyong Li and Wenshu Duan

Abstract The campus network of Chongqing Yuzhong vocational education center was the background for this paper, from campus network troubleshooting model, troubleshooting of tools, combined with the troubleshooting case to discuss common faults and eliminating methods of the campus network. The purpose is to help the personnel maintenance of the campus network to troubleshoot network problems quickly, Troubleshooting steps, which is proposed in this paper, is obtained by long-term practical experience of the author, it has practical value and operability.

Keywords Campus network · Troubleshooting · Troubleshooting tools

31.1 Introduction

The campus network is popular to understand as a LAN, which consists of the campus computers, connected to the Internet via a router and become a part. The campus network is mixture of protocols, technology, media and topologies, with the development of information technology, the use of campus network is becoming more wide [1]. In the application process, due to hardware and software, it fails more frequently, the school's teaching and dealing with daily work and affairs more

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and more dependent on network, Once a network failure cannot be immediately removed, Damage done to schools may be large, even catastrophic [2].

The network failure can be quickly and accurately locate the problem and troubleshooting, is a challenge for our network maintenance and management personnel [3], It not only requires a strong understanding of network protocols and technologies, It is more important is to establish a troubleshooting ideas of the system, and reasonably applied in practice, isolate, decomposed complex problem, or reduced troubleshooting range, in order to timely repair the network failure.

31.2 The Classification of Common Fault

Although the network failure phenomenon is manifold, network failure also have some relevance [4]. Network failures can generally be divided into two categories: connectivity issues and performance issues.

The connectivity problem is easy to notice. The main form of connectivity problems are the following:

Hardware, media, power failures—network infrastructure, hardwares such as routers, switches, hubs, servers, terminal equipment, transmission media, power equipment, as use time of Internet goes on, or vandalism, leading to equipment problems.

Software configuration error—software configuration error is a common network failure. As network protocols is too many, and configuration is complicated, if a parameter of a particular protocol is not configured properly, it is likely to cause network connectivity problems.

Compatibility issues—the establishment of computer network requires a lot of network devices, from the PC terminal to the network core routers and switches, is likely to be composed by network equipment of multiple vendors. At this time, the interoperability of the network equipment is very necessary. If the network device is not well compatible, it also can lead to network connectivity issues.

Computer network performance problems as follows:

Network congestion—the performance of any node in the computer network has problems can lead to network congestion.

To the destination is not the best route—The design issues of routing protocol will lead to the data reach the destination network by sub-optimal route.

Insufficient power supply—ensure that the power of the network equipment can achieve the required voltage level; otherwise it will result in equipment handling performance issues, which affect the entire network.

Routing loops—distance vector routing protocol may produce routing loops, cause broadcast storms and reduce network performance.

31.3 The Troubleshooting Steps

The paper uses systematic troubleshooting method. Troubleshooting systematic is reasonable,to find out the general principles of the cause of the malfunction and troubleshooting step by step, and its basic idea is systematically reduced by the large collection (or isolation)consist of the possible cause of the failure into several small subset, so that decline the complexity of the problem rapidly.

The ordered ideas can help resolve any difficulties encountered while troubleshooting. The following steps shows the general network troubleshooting processes.

Step one: the failure phenomenon observed—first of all, I have to complete and describe clearly the phenomenon of network failure, marked the failure location and failure consequences. For example, a PC in Office 201 at 10:30 on May 16 can not access, can not access all site.

Step two: the collection of failure information—first look for the situation of network topology, a variety of running protocols and configuration; then, according to description of the problem feedback user, ask users that affected by the failure about the details, while using network device to diagnostic information. Protocol analyzer tracks and records information collect useful information, understand the operation of the relevant network equipment.

Step three: the empirical judgment and theoretical analysis—based on experience and technical theory of network failure mastery, make preliminary analysis to rule out some obvious points of nonfailure.

Step four: list of all possible reasons—develop a troubleshooting plan according to the remaining potential sticking point, list every possible cause of the malfunction according to the order of the failure possibility's level, start with most likely fault cause, each time only one change.

Step five: implemented troubleshooting program for each plan—implementation debugging program for each possible cause gradually according to troubleshooting plan. In the troubleshooting process, if a possible causes proved invalid, be sure to return to the state before the troubleshooting, and then verify that the next possible reason. If the possible reasons you listed all is invalid, that means it has not collected enough failure information, did not find the failure point, return to the second step, and continue to collect the fault information, until you find the cause of the malfunction and troubleshoot network problems.

Step six: documentation of troubleshooting the process—when eventually ruled out after a network failure, do remember recording the work you have done. Document the process is not a trivial task for the following reasons:

Document is a summary of troubleshooting valuable experience, is the most important reference data of this process of judgment and theoretical analysis; document records the changes the network parameters have made in this troubleshooting;

This is relevant information the next network failure should collect.

Documented record including the following aspects:

The description of the fault phenomenon and the collection of relevant information;

Network topology mapping;

Equipment list and media list in the network;

Protocol list and inventory in the network;

Possible causes of failure;

Develop the program and the results for every possible reason;

The feelings and experiences in the troubleshooting;

The other, such as reference data use in the troubleshooting list and so on.

31.4 Troubleshooting

There are three common troubleshooting ways of campus network: stratification, block method, substitution method.

Layering idea: all the models follow the same basic premise, when the lower structure of the model is working properly, its high-level structure can work properly. Layered troubleshooting method according to the OSI reference model, from physical layer to application layer, troubleshooting layer by layer, and ultimately solve the troubleshoot problems. Specifically each time should be concerned about the following problem while using the layered troubleshooting.

Physical layer—cables, connectors, signal levels, coding, clock, and framing, these are all factors contributed to the link, state is down.

The data link layer—package inconsistency is the most common cause that leads to the failure of data link layer. When use the interface command to displays the ports and protocols, if the port up is agree with down, there is a fault on the data link layer. Data utilization is related to data link, port and protocol is good, but the link bandwidth may be excessive use, then causing intermittent connection failures or network performance degradation.

The network layer—the wrong address and subnet mask error is the most common causes of network layer failure; routing protocol is part of the network layer, and a very complex part is the important content of trouble shooting, while troubleshooting, along the path from source to destination to view the router's routing table, check the IP address of router interface. Typically, if the route does not appear in the routing table, you should check whether entered the appropriate statement, the default, or dynamic routing, and then manually configure the missing route or exclude the failure of the selection process of the dynamic routing protocol to update the routing table.

Senior—is likely to be terminal fault of the network, and then it should check the computers, servers and other network terminal ensure the normal work of the application and software and hardware of terminal equipment running well.

Block method divided network into blocks:

Block network is divided into blocks:

Management section—router consists of name, password, service, and logs.

Part of the port—address consists of packaging, cost, and certification.

Routing protocol consists of section—static routing, RIP, OSPF, BGP, and import-route.

The strategy part—routing policies consists of security configuration and so on.

Access part—the main console consists of Telnet, login or dumb terminal, etc.

Other part of the application—language configuration consists of VPN configuration, QoS configuration.

The substitution method is the most commonly method I will choose when I check the hardware. Replace a cable that is a good one to try when suspected cables problem; replace an interface module to try when suspected interface module's problem.

31.5 Troubleshooting Tools

Network products of H3C series provide a complete set of commands, can be used to monitor working conditions of network interconnection, and troubleshoot basic network failure. The following is diagnostic command:

Ping command—used to check the connection of IP network and host readability, in order to determine whether network connectivity is good.

Tracers command—used to test the gateway that the data packet via from the sending host to the destination, it is mainly used to check network connection, and analysis where the failure occurred in the network .

Display command—used to display the basic information, configuration information and parameters of the router's hardware and software.

Reset command—used to clear the current statistics and exclude the interference of the previously accumulated data.

Debugging command—used to obtain the details of the exchange of packets and frames in the router.

The H3C network management tools—Quid view, it is unified management and maintenance software for data communications equipment, such as routers, switches, there are the following fault management functions:

Alarm real-time monitoring, provide alarm sound and light tips, support external alarm box;

Support alarm switch to Email, SMS;

Support alarm filtering, allowing users to focus on important alarms, query results can generate reports;

Support redefines alarm base level, support alarm dump to ensure the efficiency and stability of the system operation;

Support alarm topology location, locate the focus to the topology objects;

Support alarm correlation analysis, including shielding the repeat alarm, shielding the flash alarm, shielding the root-cause alarm.

31.6 Troubleshooting Examples

Three LAN in school, including 192.11.56.0 network for a user segment, 192.11.56.118 server as a log server; 192.15.0.0 is a centralized application server segment. A day, the user reflects the log server 192.11.56.118/16 and backup server 192.15.254.153/16 encountered a backup problem (Fig. 31.1).

The survey collected the following information:

Recently, the 192.11.56.0 segment clients continue to increase;
FTP transfer speed between the machine and the backup server is 7 Mbps, FTP transfers speed between the machine and the log server is slow, only 0.6 Mbps.

Between the nonpeak of the log server and backup server, the FTP transmission speed is about 6 Mbps.

According to my own past troubleshooting experience, I am sure this is a problem of network performance degradation, so where is the problem? Between the machine of 129.9.0.0 segment and the backup server, FTP transfer speed is normal, so we can exclude 192.15.0.0 segment performance fault.

Based on the empirical judgment and theoretical analysis, summed up the possible reasons as follows:

The reason of the performance of the network segment 192.11.56.0 may be:

Log the server performance issues;
Performance issues of 192.11.56.0 segment gateway;
Performance issues of 192.11.56.0 segment.
Cloud performance issues, the route from the network segment 192.11.56.0 to the network segment 192.15.0.0 are not the best route.

Possible reasons 1: the route from network segment 192.11.56.0 to network segment 192.15.0.0 is not the best route.

Test program: use the "tracer 192.15.254.153" command on the gateway of the network segment 192.11.56.0, found that to returning length of probe packet is only 10 ms, indicating that the reason of the possible reasons is not failure cause. I entered the circulation troubleshooting process again.

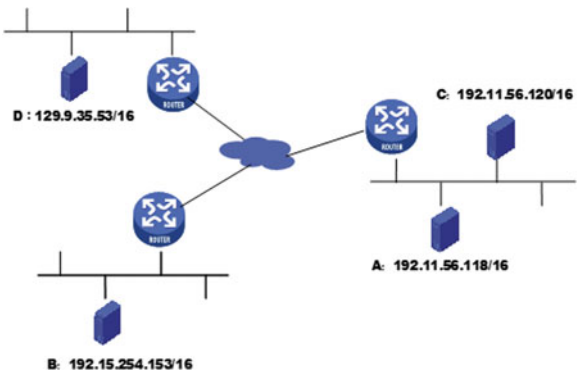

Fig. 31.1 The routing table of school LAN

Possible Reason 2: log server a performance problems.

Test program: test the FTP transfer speed between the host C and log server of the same segment is 6 Mbps, normal. It shows that the problem has nothing to do with the server A.

Possible reason 3:192.11.56.0 segment gateway performance issues.

Test program: test FTP transfer speed between host C and backup server B is 7 Mbps normal. Exclude the gateway factors, because B, C is in a different segment while and the speed is normal.

Possible reasons 4: the performance problems of 192.11.56.0 segment its own.

Test program: using the command "display Mac-address" on Ethernet switch of the network 192.11.56.0, the output is as follows:

Possible causes, I develop a testing program as follows:

Port	Rcv-Unicast	Rcv-Multicast	Rcv-Broadcast
6/32	10317812	0	8665

Port	Xmit-Unicast	Xmit-Multicast	Xmit-Broadcast
6/32	6667987	286652	2474038

Port	Rcv-Octet	Xmit-Octe
6/32	14094829358	1516443041

Using the command "the display Mac-address" on the Ethernet switch of Network 192.15.0.0, the output is as follows:

Port	Rcv-Unicast	Rcv-Multicast	Rcv-Broadcast
6/36	55780287	0	285

Port	Xmit-Unicast	Xmit-Multicast	Xmit-Broadcast
6/36	27879749	190257	119430

Port	Rcv-Octet	Xmit-Octe
6/36	67172587081	4998816809

Thus, the proportion of the broadcast packets and uncast packets on the network segment 192.11.56.0 is 1:3, indeed too big. Asked again what is the mainly business the user segment runs, and arrive the ultimate failure cause as follows: 192.11.56.0 network segment is a common user network segment, for business reasons, each user needs to send a large number of broadcast packets and multicast packets, with more and more users access the network recently, the network server in this segment need to spend more resources to deal with a growing number of broadcast packets and multicast packets, naturally slow down the transmission speed of its service.

Since this is a network layout inappropriate, then rearrange the location of the server, move the server to the 192.15.0.0 network segment, then troubleshooting.

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Chapter 32
Advices of Perfecting the Civil Law on Protection of Network Virtual Property

Yu-e Li and Zhi-jie Li

Abstract Based on the idea and thinking of perfection advice in the civil legal protection about the online virtual assets, this paper compares the character and value through the network virtual assets and take the advantage of the authority instrument to adjust data that compare with the real questions. Moreover, provide some advices, principals, and methods of the virtual assets that based on the civil legal protection. It divides the basic real right and the characteristic of virtual assets property, and provides the suggestion for the special virtual assets property. Their special legal establishment for the network virtual assets is the necessary result during the modern network development. Therefore, it is the basic requirement for perfecting the socialism law.

Keywords The concept of network virtual assets · Real right

32.1 Introduction

With the rapid development of the network game industry, network space brings the new question that was ever seen in the legal field. Network virtual assets are one of the questions. The network virtual assets are combined with electronic data. The loss of network virtual assets means the electronic data loss of the game player ID. This behavior belongs to the unlawful entry, and stealing of user's information. However, the "illegal invasion of computer information system" only protects the computer network information about national affairs, national defense, financial

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instrument, high technology, and other special fields [1]. The protection of personal network information belongs to the empty part of the legal adjustment. At present, there have been disadvantages in our civil system of the network virtual assets. Aiming at these disadvantages, here, we suggest the legal can base on the principle of autonomy of the will and the affair principle to modify and implement the present civil law. Moreover, determine the fault principle and doctrine of presumption for the virtual assets. The complicated questions of virtual assets need to legislate independently and standardize the quality and right of virtual assets [2].

32.2 Existence Point of Virtual Assets

Network game is the new entertainment mode that is under high development. From starting til now, the age arrangement is growing. It first started from the junior school student, high school student, and college students. Now, it is expanding to the old people [3]. This variety brings more consumer group. There is no lack of the high consumption of the middle age. Just as the report shown, 18.6 % players spend 500 Yuan in each month. That is 3.7 % higher than the last year. The expanding age arrangement promotes the game player to become larger, more mature that can greatly promote the game industrys development. Moreover, it can increase the consumption level and bring the better development of the online game industry [4].

Based on the research of the authority institution (Fig. 32.1), the major objective to play the online game is pure entertainment, making friends, and spare time. The proportion is 34.26 %, 28.88 %, and, 12.71 %. The game player who can obtain the benefit is nearly 3.26 %. The trade is not including the people for entertainment. At the same time, the growing game players and trade amount cannot be ignored. This means we need to perfect the regulation in order to standardize the virtual assets trade of the increasing online game [5].

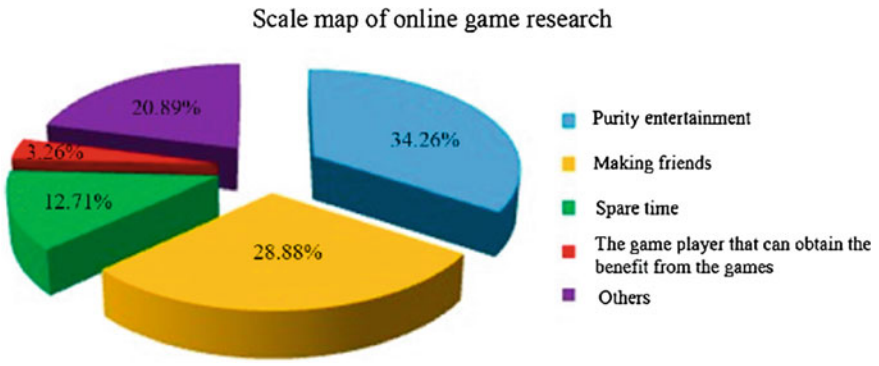

Fig. 32.1 Scale map of online game research

In personal view, people approve that the virtual assets value is the wave of the future. It is the best protection to build the regulation of the virtual assets by some institutions. This can increase the player consumption. With the hot development of the online game industry, the background disputes are growing. The various relationships harmonious in the competition among developers and operators, the contradiction of virtual assets protection between players and operators, and the benefit balance between online game economy and culture is the big background stable [6].

32.3 The Concept of Network Virtual Assets

Virtual assets are the nonphysical and chemical properties. With the internet development, the virtual assets expression is increasing. For example, QQ number, game account, game equipment, game currency, network integrates, and so on. The various types of virtual assets express the different benefit and obligation. The different characteristics are under legal classification. This is under the consideration of virtual assets in the general aspects and the individual difference [7].

The trade between virtual assets and real assets are very common at present. The popular online game increases this kind of trade. There exists the fighting for the game equipment or other virtual assets in the Internet bar. This expresses the urgent and important to build the virtual assets. The virtual assets dispute is mostly developed under the online game development. Therefore, from the angle of online game,it can express the process of question production and development. The operators lost the players' virtual assets can make up through the technology. The wild existing virtual assets stolen, and invasion, the technology will be helpless. The virtual assets stolen and fraud needs to determine the detailed value not only in the criminal help but also in the civil remedy. If we cannot ensure the detailed value, it is adverse to maintain the network security and player's benefit.

32.4 Protection Opinion of the Network Virtual Assets in the Civil Law

32.4.1 Legal Protection Arrangement of the Network Virtual Assets

The citizen property includes the visible and invisible assets. Network virtual assets belong to the invisible assets. We can buy the virtual assets from game developer or other game players or change with them. Then the virtual assets have the attribution of the common production. However, the present law is not perfect

that will lead the series loss cases. This will greatly decrease the network benefit and operator enthusiasm.

From the legal definition of the property, virtual assets can obtain the protection. Acquire the assets needs the holder's labor (leveling), real asset payment (buy the game card), market dealing (buy and sell the equipment). The network virtual assets have obtained the basic character of the real assets. The virtual assets have to prepare the following conditions that can obtain the legal protection.

The holder obtains the assets in legal. The player can sell the independent equipment. Property legal is the first element.

The legal obtain approach. No cheating, no defraud and obtain it in the legal arrangement.

The value needs to have the conformability. The transform production needs to have the independent value. The judgment depends on the labor strength, length as well as the virtual production.

Purchase ability is valuable. People will show the price only for the practical requirement. Food is used for filling the stomach. The virtual production is used for satisfying the spiritual pursuit. That is the value.

32.4.2 Property Protection of the Virtual Assets

Property protection means the law protects all the lawful rights and interests. That includes the right of occupation, usage, benefit, domination, and the punishment. Right has the inviolable character of the national protection. Protect the real rights is to protect the inviolable rights. In the real life, the violate rights are different. That means protecting the real rights is the common targets by the various legal departments. In the present network, the protection of QB is urgent. For the characteristics of the virtual assets, we can follow the civil law to express the following characteristics:

Property determination. Each virtual production has the own platform, we need to ensure the information, work with the player and operator, record the computer system to determine the ownership.

Request the turn-back. If the owner is violated, he has the right to apply for the send back. This is useful for the operator. The lost data from the system, the operator can return it can take the responsibility and obligation. It has great significance for the internet tenderization.

Request indemnify for the loss. Compensate for loss means the real right person has the right to request the compensation that caused by the illegal action. This is the method to protect the obligatory right.

Determine the property, request the compensation, and compensate the loss is the civil protection method. It can use in single or combine with other laws. This is worth to reference and improve on the virtual assets legislation.

32.4.3 Property Determination of the Virtual Assets

Property means in the legal arrangement, the owner has the occupation, benefit, and management right on the assets. Virtual asset is the special form with the basic characteristic.

Absolute right of the ownership. Different from the other property, the ownership do not need any right. The owner can enjoy the complete right without any intervention. The virtual assets production needs the hard work of the game player with time and basic labor cost. Therefore, the virtual assets are special. The ownership belongs to the real right with exclusiveness. The virtual assets need to have the exclusiveness. It is important to have the only owner. At the same time, the exclusiveness can avoid the assets dispute.

Different from the real right, here suggest the virtual assets have no elasticity. The owner can set the servitude and mortgage right while holding the basic real right. The occupation is apart from the usage. However, if there has been no real right loss, the owner still has the right to control. Based on the virtual and special storage of the virtual assets, the writer advises not to hold the elasticity character. The network trade is much more convenient than we think. It will bring great trouble while obtains evidence and identification. Therefore, the elasticity is not suited for the virtual assets.

Virtual assets do not need to have the permanence. In the modern network trade, loss of equipment needs to upgrade. Many accounts have the limitation no matter in time or the usage. Otherwise, in the virtual world, there exist many uncertainties. Therefore, here we suggest not determining the virtual assets permanence. However, the legislation can take the special arrangement to set the limitation. Just like the preferential card has time limitation in our real life. It is the empty part of the real legislation. The card sending institution has not legal limitation. Many customers cannot obtain the relative compensation after cheating.

32.4.4 Build the Convenient Litigation Channel

We know the civil dispute is the civil affairs as well as one kind of legal dispute and social dispute. Civil dispute is the dispute of civil rights and obligations and the civil property. The main regulation to solve the civil dispute has reconciliation, accommodation out of legal action, arbitration, and civil action. Each method has the definite limitation. The owner of virtual assets has the universality that separates far apart. The legislation needs to take fully consideration of the party regional lock. At the same time, the party might not travel for the small number compensation. Here we suggest adopting the regional determination. The method to obtain evidence will not limit in the traditional method and approach. Meanwhile, it needs to break the regional limitation and build the nongrade litigation institution. It is necessary to simplify and promote the civil dispute process.

We can combine the various powers that rapidly determine the property. In personal view, the network police are particularly important. In the meantime, pay attention to the various operators monitor and management that can provide better network security service to protect the virtual assets. We have to say the responsibility of network operators. As the network operators, they need to grasp the users' basic condition, registered company name, network record, the IP distribution. Moreover, the illegality information production and management have to record. This is beneficial for the network protection and monitoring in the large part.

32.5 Summary

In the rapid development period of the Internet, we can find that the legal of virtual assets is very important among the various network competitions. Legal protection of the asset starts from the detailed value with the relative evaluation methods. The Internet development is only 10 years in the society, and the network legislation is behind the times. At present, there has no detailed legal to maintain and determine the game player virtual assets. Moreover, it is inexistence to ensure the virtual assets value. In personal view, the best way to protect the network virtual assets is as well as the civil property to provide the rigid and special identity. The legal perfection can promote the network security, and develop the network profit. The modern society of socialism legal development, it is possible to think and practice the virtual assets protection and legislation for each network user.

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Chapter 33
Intelligent Learning System Based on Ontology for Network Learning

Xie Yong

Abstract In this paper, we used ontology and semantic annotation to construct the intelligent network learning behavior analysis system, based on network learning behavior model and concept relations in the network learning domain to build the ontology base, extract metadata, or semantic annotate data of the behavior information which we collected. Match the semantic parsed data with ontology base to deduce learners' learning effect, to evaluate learning process, and to give some advice for learners' learning. This system can help development of network learning platforms and educational resources also help teachers in designing and organizing the curriculum.

Keywords Ontology · Network learning · Intelligent learning system

33.1 Introduction

With the Internet and network technology developing, network learning became the primary instructional media in our life [1, 2]. Learners can study with network learning at any time. It provides personalized, virtualized cooperative studying environment for learners' learning [3, 4]. Learners' behavior reflect multistructural and multilevel properties in the network environment, so analyzing learners' behaviors are essential to develop the network learning platforms and educational resources, to help teachers designing and organizing the curriculum, to provide guide for learners' studying [5].

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Unfortunately, many analysis systems only carry out surface and manual, not in-depth, automatic analysis. In this paper, we will introduce ontology and semantic annotation into the network learning behavior analysis system, which is able to automatically analyze and make the analysis result more intelligent and reasonable. Outlines the basic idea of the system framework, describes the process of creating analysis system for network learning behavior, and explains the data flowing in the framework. Afterward we show an example, analysis of a learner' behavior who is learning through the network learning.

33.2 Related Works

33.2.1 Network Learning Behavior and its Model

It includes behavior subject, behavior object, behavior tools, behavior community, community organizations rules, and division of labor, and so on. Network learning behavior showed multidimensional and multilevel property compared with traditional learning behavior.

Commonly, the network learning behavior divides into three levels: low-level, mid-level, and high-level [1]. In general, it includes browsing page, information search, sending and receiving e-mail, real-time exchanging, BBS discussion, asking questions, answering questions, downloading, browsing lesson plans preservation, and so on. Table 33.1 is the detail description of network learning behavior model. We build ontology base and evaluate the network learning behavior based on the network learning behavior model.

33.2.2 Ontology

An ontology is defined as "a common vocabulary for researchers who need to share information in a domain. It includes machine-interpretable definitions of basic concepts in the domain and relations among them." The domain is the subject area and ontologism is, basically, systems of categories.

Ontology specifies a rich description of the:

- Terminology (vertices in a graph);
- Concepts (vertices in a graph);
- Relationships between the concepts (directed edges in a graph);
- Rules;
- A set of instances assigned to a particular concepts (data records assigned to concepts or relation).

Table 33.1 Use metadata description part of concepts in online learning behavior model

Network learning behavior	Properties
Browsing page	URL, title, keyword, time(into pages, exit pages),low-level network learning behavior
Browsing lesson plans	The theme of lesson plans, time (enter page, exit page, frequency), the lesson plans (read, unread),low-level network learning behavior
Information researching	Keywords, searching results, searching engine, low-level network learning behavior
Downloading	Sources, keywords, URL, description, low-level network learning behavior, form
Sending and receiving e-mail	Address, the theme, mid-level network learning behavior
BBS discussion	Subject; the number of reading time, frequency, posting number, whether was deleted, the number of articles, high-level network learning behavior
Asking questions	Theme, frequency, the number of back, mid-level network learning behavior
Answering questions	Theme, frequency, the number of correct, the number of wrong, high-level network learning behavior
Real-time exchanging	Tools, exchanging time, theme, content, high-level network learning behavior

In short, ontology is relevant to a particular domain or area of interest.

In this system, the ontology is used as the following:

Describing the content of learning subjects, learning objects,learning behaviors, learning effect, learning tools, learning evaluation, and their relations;

Using the semantic annotation to mark learners' learning contents and learning behaviors, learning tools;

Imposing a structure on the information in the domain;

Retrieving information based on the ontology which we built;

Resolving semantic heterogeneity problem through ontology rules;

According to semantic annotation data, querying the ontology base, based on this to deduce learners' learning affects, and to give the learning evaluations;

Generally, we use metadata to describe concepts and their properties in ontology, Table 33.1 [1] is part of the concepts in the network learning behavior model description with metadata.

33.3 System Architecture

33.3.1 System Functional Blocks Diagram

Figure 33.1 is the system functional block diagram of intelligent network learning behavior analysis system. Different colors of the arrows in the model represent

different block, the following illustrates each function of the block. The core of this model is the semantic parsing and the ontology base, as shown in the red.

33.3.1.1 User Interface: The Layer Include Following Part

User interface: learners can learn or operate in this web base interface. It provides a convenient operation user graphic interface.

Web Service API: provide supporting for other programs of distance learning system or famous across platform application service.

33.3.1.2 Data's Collecting Layer

The block of data collecting is used to collect the data of network learning behaviors. It has two ways to collect data. First is the asynchronous collecting, learners input the information before the first learning. Second is the synchronous collecting, the layer through real-time tracking to record the network learning behavior information.

33.3.1.3 Intelligent Semantic Parsing: This Method Focus on this Part

Data parsing: using grammar parse the data, find out the subject, predicate, and object of the sentence, make them meet the triple of subject–predicate–object, where the concepts are classified by ontology and enable the computer to

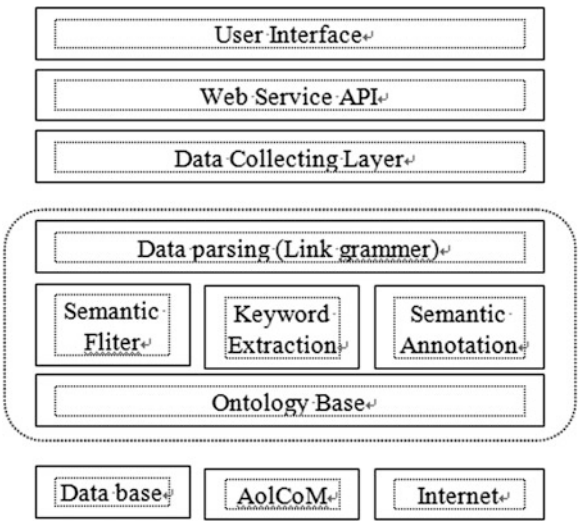

Fig. 33.1 System functional blocks diagram

understand or distinguish the relations between words and sentence in grammar structure.

Semantic filter: this engine cooperates with syntax analyzer to precede keyword extraction. It applies to wrong grammar check [2].

Metadata extraction: metadata extraction is to extract critical words based on Table 33.1; it focuses on extracting metadata which can reveal the word indexing of theme of the resource.

Semantic annotation: the metadata is extracted, but it is lack of machine reasoning ability. After metadata extraction, we need to semantic annotation of data, and then use the data pattern matching with the data in the ontology base.

33.3.1.4 Store Data Layer: The Layer Includes

Ontology base: ontology base is important in the system. In our research we use Protégé_3.4 (http://protege.stanford.edu) as an ontology-developing environment.

Concrete steps are as following:

First, according to the definition of the metadata and their attributes in Table 33.1 construct the classes, properties, and examples.

Second, build relation among the concepts. Developing the class hierarchy and defining relation of concepts are important.

Typically, we create a few definitions of the concepts in the hierarchy and then continue by describing properties of these concepts and so on. The two tasks are always twisted and should be done at the same time

Data base: data base used to store the collecting the data of network learning behavioral and final analysis result which are basis for the next analysis.

AOlCoM: the ALOCoM ontology is a generic content model that defines a framework for Los (Learning objects) and their components [3]. It is the network learning standard material developed by XML.

Internet resource: the source of knowledge extraction includes various Internet data, which is useful to analyze the learning behavior. First, according to the definition of the metadata and their attributes in Table 33.1 construct the classes, properties, and examples.

33.3.2 Datas Flow in the Somatic Layer

Figure 33.2 is the data flowing in the Semantic layer. The process as following:

The block of data collecting collects the data of learners' behavior;

Syntax analyzes the collected data through the data parsing, and mark them meet the triple of subject–predicate–object;

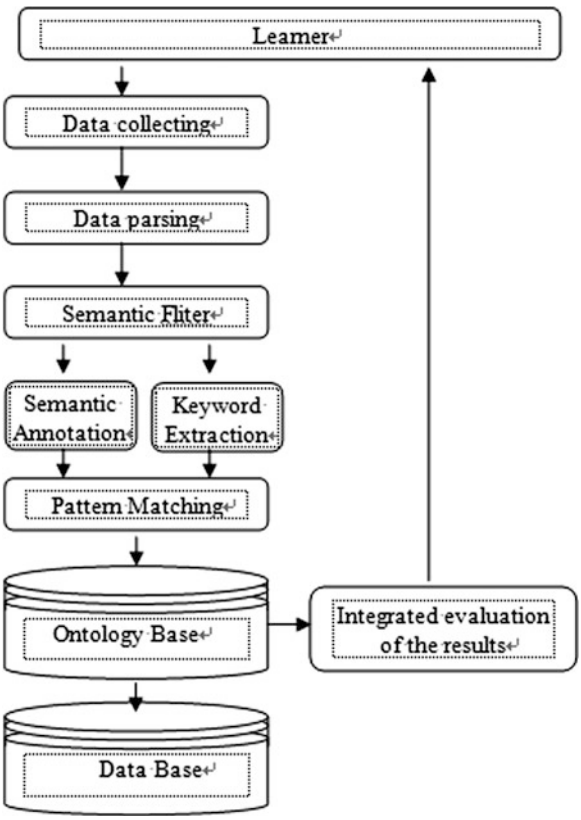

Fig. 33.2 Data flowing in the SEMANTIC layer

Semantic filter check the analysis result;

Extract metadata's from the syntax analysis result and semantic annotate the analysis data;

Use the semantic annotation data or the metadata to match with the ontology base, to evaluate learners' behavior, to infer learning motivation, learning strategy, and the behind learning effect;

Integrate the analysis results and display it for learners and store the evaluation result and data of learners' behavior in database for the next analysis' input.

33.4 An Application Example

In this section we depict a simple application on intelligent network learning behavior analysis system in order to illustrate the proposed model.

One learner (Lily) for the first time study in the network learning and she inputs some information about her learning custom, educational background, learning

object, and so on. And then she learned aIl through browsing page, asked three questions and answered one question, exchanged information with other students. Data collecting layer collect some information based on Table 33.1, extract the metadata or semantic annotate the data, construct the ontology structural drawing, matched it with the original data in the ontology base, to deduce learner's learning effect, to given a evaluation for Lily's learning and some advice of learning more effectively, and store the analysis result in database, As a basis for the next analysis.

33.5 Conclusions

Network learning behavior can be defined as learning based on the environment which is created by modern information technology and include new communication mechanism with rich resources, to carry out web-based or distance autonomous learning behavior. But, the system cannot be logical deduction; ontology base is built manually rather than automatic extending. Of course, some behavior evaluation is not very accurate. Future research we will focus on these issues.

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Chapter 34
IOT Intelligent Monitoring Terminal Based on ARM+Linux

Li Lu and Qi Ren

Abstract Based on acknowledgment of the Internet of things, this paper builds the Linux system on the ARM9 platform with researches of industry application needs and the key technologies of the intelligent monitoring terminal. Moreover, combining with the corresponding drive and service, it integrates with the video signal and analog monitoring information and uses B/S architecture to implement the system, and put forward a complete design of the intelligent monitoring terminal and corresponding network system.

Keywords The Internet of things · Intelligent monitoring · ARM+Linux · B/S

34.1 Introduction

With the social economy development and the urban modernization acceleration, there increases the various potential safety hazard and improves the prevention complexity. Therefore, we need to develop the basic safety supervision, security monitoring, predetermination, precaution, management, rescue, and the research of technology security system. Determine the security monitoring through bringing the new technology. Moreover, the various systematic solutions will apply into the security monitoring that headed by the IOT technology. How to strengthen the system engineering level of safety production monitoring and improve the present

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monitoring efficiency will be the important assignment and development direction during the period of safety in production and monitoring [1].

Embedded system's center is the application. The special computer system has district requirement in system function, cost, size, and power dissipation. Beside, it has the characteristics of small power dissipation, high performance, low cost, and strong instantaneity. Therefore, this system obtains the wild application in industry control, transportation, security, finance, communication, and other industries.

This article researches the present security monitoring system and find out the existed high cost of building and maintenance, worse compatibility, and the problem of single function. Moreover, the article will combine various functional module s on the ARM platform, comprehensive use the embedded system, communication system to design the terminal of security monitoring in order to provide one set of application system design with strong function.

34.2 Internet of Things Introduction

Following the definition of ITU, Internet of things is the network that goods associate with goods. The English name is 'The Internet of Things'(IOT) . By using the sensor, video identification technology and the global positioning satellites, the Internet of things can real-time monitor any thing that need monitoring, communication, interactive objects, or process. Moreover, collect the specified information of sound, heat, light, electricity, chemistry, mechanics, organisms, and geographic position. At last, it can achieve the communication of objects between object, objects between human to finish the intelligent perception, identification, and management of object and process [2].

Through the intelligent perception and identification technology, the Internet of things applies with the wild network and ubiquitous computing. It is the third information industry revolutionary period after computer technology and Internet . The Internet of things' essence and core center is the business and applications as well as the application continuation in the objective material world [3]. Therefore, the application innovation about the Internet of things is the assurance to keep the development. The application development of user center is the target and standard to develop the Internet of things.

From the information technology, the Internet of things is the identifying objects with perception and intelligent processing ability. Based on the standard operated communication protocol, and under the support of broadband mobile communication, next generation network and the cloud computing platform, the Internet of things can obtain and process the objects or the environmental information around. Moreover, it can judge the event development, provide management, and control decision in order to form the global information system of information acquisition, object management, and control [4]. The Internet of things is combined with information object technology, automatic network technology, and the intelligent application technology [5].

On the various parts of the Internet of things industry, different enterprises and organizations will explain its meaning from the own view. However, the industry has the unique understanding about the completed system. In basically, the Internet of things includes three layers: perception layer, transport layer, and the application layer [6]. The perception layer is responsible for the total perception of the objects that need to be monitored and identify the identification or information collection. The transport layer takes charge of supporting the transport channel for the reliable data. It can transport the collected perception information to the application layer through the different wire or wireless communications. The application player means to do the intelligent processing when receiving the perception information and use or express the data after processing.

34.3 Design of IOT Intelligent Monitoring Terminal

34.3.1 System Structure

Based on the system requirement evaluation, the terminal needs to collect the site video information, temperature, and concentration sensor data. At the same time, it needs to start the Web Service, and provide data service for the browser or Smartphone client through inserting the Internet. Clients can check the monitoring information while control the IO point output by browser (Fig. 34.1).

Based on the function design of terminal system, there need to include processor module, camera, sensor signal collection, network processing module, IO control interface, display module, power module, and other basic function modules.

34.3.2 Hardware Model Selection

Embedded system has the center of application and computer technology is the basement. Moreover, we can clip the hardware and software for applying into the special computer system that has strict requirement on function, reliability, cost,

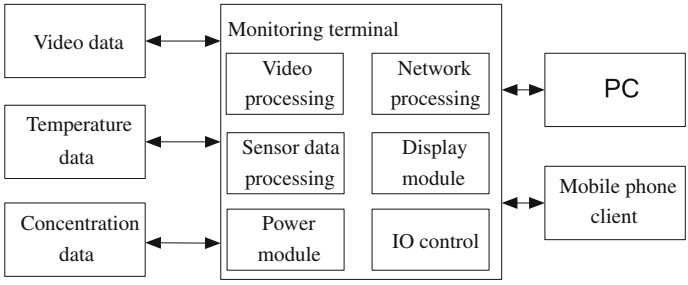

Fig. 34.1 The figure of terminal system function

size, and the power consumption [7]. The technology of embedded system belongs to the arrangement of object control technology. ARM9 processor is the 32 positions processor with low power consumption. It is suitable for the low consumer of cost and power consumption that has been wildly applied into the filed of industry control, network equipment, and data communication.

Connect the processor module with other modules can take charge of all the control and data processing. It includes single chip and other outside circuits such as ROM, RAM, and clock generator. Processor module needs the high operation frequency and processing speed that can load into the embedded Linux system.

The processor uses S3C2440 clip from SAMSUNG Company. This clip uses 32 positions RISC command set, and provide the microcontroller solution with lost price, los power consumption and high function for the handheld device and common applications. This chip has the ARM core, uses the design of los power consumption, the dependent 16 KB command Cache and 16 KB data Cache. Moreover, it reduces the system cost and useless components that specially design for the low power consumption. S3C2440 has the high practical applicability [8].

Processor, RAM, and ROM combine the data processing system module. Onboard ROM includes one clip 2 MB nor Flash of onboard BIOS and one clip ROM of 256 M N and Flash System; two circumscribed 64 MB SDRAM clip, and include the 12 MHz clock generator circuit and other outside circuits. The S3C2440 needs the 1.2 V core power supply and 3.3 V outside power supply. Therefore, the module needs to bring two kinds of power supply interfaces.

The sensor is the electronic element that transmits the physical quantity into the electrical parameter. The design uses one temperature sensor. There have been various temperature sensors and based on the measurement mode, they can divide into contact and noncontact. Based on the electrical element character it can divide into thermal resistance and thermocouple [9]. The design uses temperature sensor to collect the present environment temperature and transmit the collect data through processor and communication module in order to support for client request and record.

The common temperature sensor uses 0–10 mA or 4–20 mA standard circuit output. However, it needs the 24 V direct-current power supply. At the same time, it cannot satisfy the design requirement of low power consumption. Therefore, this design uses stainless steel package DS18B20 digital temperature sensor. The sensor has small size, wear resistance, long operating life, convenient usage, good antiexplosion that can suite for the boiler, tunnel, generator room, refrigerator, air-condition, storage tank, and other measuring temperature places. At the same time, the antiexplosion design can satisfy the requirement of antiexplosion filed. DS12B80 can use the single line port to achieve the double communication with the microprocessor [10].

PerkinElmer Company produces TPS2534 series of gas concentration sensor. It is the infrared thermopile gas sensor of nonspectral two-channel. This sensor has small size, high precision, high applicability, and rapid response. It is designed aiming at the gas concentration detection that has been widely applied into the various detection of infrared gas concentrations.

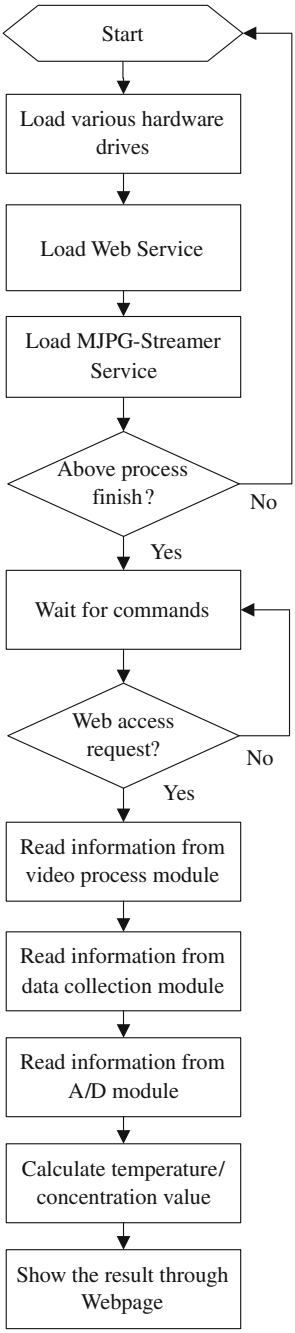

Fig. 34.2 The figure of terminal system function

TPS2534 infrared thermopile gas sensor of nonspectral two-channel uses TO-5 package with whole sealing nickel metal case that filled with dry nitrogen. TPS2534 sensor has two infrared sensing windows with the sensitive response area of 1.2×1.2 mm^2 and 2.6×2.3 mm^2. We can use it to calculate and refer to the channel light intensity. Otherwise, the internal TPS2534 uses 30 Ωk thermistor can detect the element outside temperature as the reference variable of the temperature compensation. TPS2534 has four important pins they are gas channel pin, reference channel pin, temperature channel pin, and the ground connection pin.

34.3.3 Software Design

The software design is collecting relative data and start the network service at the same time. The various normal functions depend on the software structure and function. This system is building base on the Linux operation system. It has the multitier function processing that need the communication. Except the arithmetic code, there includes system core, various drive programs, algorithm programs, and different service programs. The completed assignment process is shown in Fig. 34.2.

As Fig. 34.2 shows, when the system power up, start the Linux operation system, we need to initialize the various outside equipments in the first place. Moreover, we load various corresponding drive programs (especially the drive of temperature and concentration sensor). Then, we load Web Service and MJPEG service to prepare for the information display and video streaming. After everything is ready, the system will begin to wait for the request information from WEB. When receiving the request, the system will send request to the module of video processing and sensor data processing. After receiving the real-time video data and original data of temperature and concentration, we can obtain the detailed value through analog digital conversion. At last, we send result to the terminal users through the Web service.

34.4 Summary

This article provides the design proposal of intelligent monitoring terminal that is based on S3C2440 processor and Linux operation system, through inserting the internet, use Web Service to integrate video and sensor information for providing users to check. This design has the character of low cost and wide application. At the same time, it has the strong function, and the high systematic instantaneity. The ARM architecture chip is more suitable for the wild application of multimedia portable productions on the cost control. Therefore, we can use the low cost to build the security-monitoring network that has strong functions.

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Chapter 35
Study of Security Technology in Wireless Sensor Networks

Chunjie Tang

Abstract Due to its own characteristics, wireless sensor networks are different from the wired network security issues in the operating system and network protocol design. ZigBee technology, for example, is the use of security technology to analyze its security features and security requirements from multiple perspectives, and describes the specific application of the ZigBee network security encryption technology.

Keywords Wireless sensor network · Security · Encryption technology

35.1 Introduction

Modern information technology includes sensor technology, communications technology, and computer technology [1]. The information collection, transmission and processing by the sensor network technology combined with sensor technology, communications, and computer technology to form an organic whole.

In recent years, wireless communications, microprocessors, microelectro mechanical systems technology has changed widely in the rapid development of sensor network technology , and this technology is gradually becoming more mature. At the moment, there have been many articles in this regard, but are still in the fledgling stage. The development of sensor network technology is of great strategic significance for the social stability and economic development [2]. However, wireless sensor networks, there are a lot of faults, which result in

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security problems, the use of security technology for wireless sensor networks, security analysis, and to take measures for protection, can better promote the progress of the wireless sensor network technology.

35.2 Wireless Sensor Network Technology

At present, with the computer network technology development, system on chip wireless communications, microelectronic mechanical systems, and embedded technology advances have contributed to the emergence of wireless sensor network technology. Wireless sensor networks include a large number of laid in monitoring area, small size, low cost sensor nodes, sensor nodes with wireless communication, sensing and data processing capabilities, and wireless transmission to the formation of multihop network systems. Network coverage area, the information of the monitored object can be the network system, perception, acquisition and processing, and sent to the observer. Through wireless networks, sensor nodes can also change each other with information; you can transmit the information to the remote end of the wireless transmission and data processing functions. Figure 35.1 shows the wireless sensor network structure.

Each sensor node can sense the sonar, shock waves, infrared and other forms, and they can also target information data acquisition, transmission and control, implementation, and ultimately monitoring, tracking, positioning, and forecasting. Wireless sensor networks have many types of sensors can monitor a wide variety of phenomena of earthquakes, temperature, noise, pressure, speed, and direction. Figure 35.2 shows the structure of the wireless sensor network node.

With the deepening of China's economic reform and modernization process continues to accelerate, increasing national attention on mine safety, regulatory efforts have been strengthened, small and medium-sized coal mines and large towns have a lot of equipment, mine safety monitoring system, effectively controlling the major gas explosion the accident [3]. However, the lack of information on the location of underground personnel monitoring, is still widespread well into the personnel management difficulties, Inoue it difficult to promptly and accurately the distribution of underground personnel and operating conditions, in the event of an accident, disaster relief, security aid is inefficient, especially accident after the

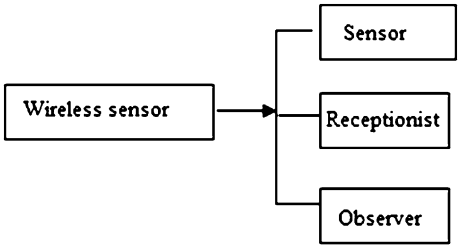

Fig. 35.1 Wireless sensor network structure

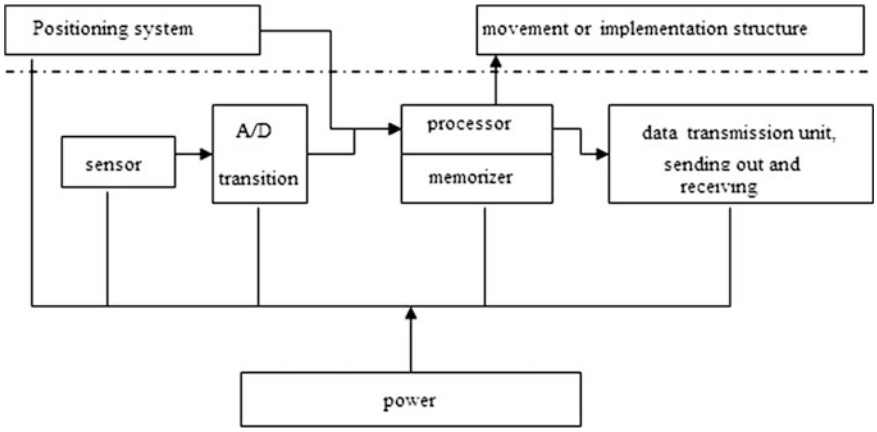

Fig. 35.2 Wireless sensor network node structure

rescue personnel on the mine location of the lack of reliable information, severely restricted the efficiency of disaster relief, to save the most precious time lost. Safety is the core of human security. Therefore, the coal mine on the use of appropriate personnel tracking and locating equipment, all-weather mine into the well of real-time automated tracking and staff attendance, keep track of each employee's position and activities in the underground track, the location of all mine personnel distribution and other urgent needs. Location of underground personnel monitoring and management system is a set of underground staff attendance, tracking and positioning, disaster first aid, equal to the daily management of integrated applications.

35.3 ZigBee Network Securities

ZigBee technology is a two-way wireless communication technology with short distance, low complexity, low power, low speed, and low cost. It is a way of communication in wireless sensor networks, mainly used for short distance, low power consumption and transmission rate between a variety of electronic equipment for data transmission as well as typical periodic data, intermittent data and low-latency data transmission applications. The ZigBee characteristics of security threats are: the security threat to the physical layer, link layer security threats, network routing layer security threats. Figure 35.3 shows the ZigBee framework protocol.

Due to the characteristics of ZigBee technology, the transmission of information between the communication link can easily be tapped, and analyze the data less reliable. Can also be tapping the sensor information package to analyze the transmission of network traffic, and then was informed that the position and role of

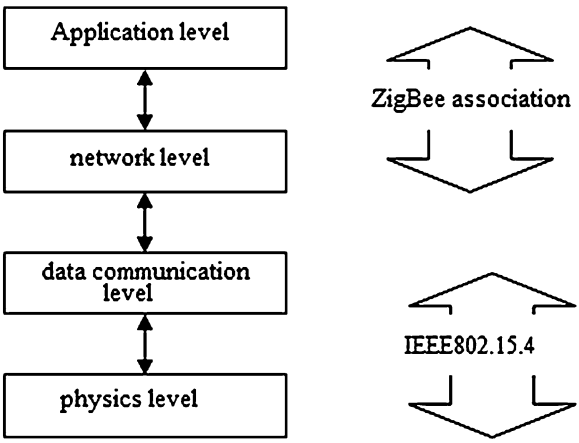

Fig. 35.3 ZigBee framework protocol

the sensor node. Once the sensor node is positioned, the eavesdropper can capture sensor nodes through the node to obtain important information such as the key so the addition can also modify the captured node and it once again into the wireless sensor networks, further more subtle attack and destroy. Node location information of practical significance for many ZigBee networks, the node location information is correct or not largely affected its effectiveness [4]. ZigBee network location protocol or algorithm, the common node is generally through a class of special nodes called anchor nodes to determine their own position. Safe positioning of the need to study the problem, including the reference value of the security of the location of the anchor node, namely: the location of the reference value for all anchor nodes are correct, the ordinary location of the nodes can be accurately positioned, if a position reference value to be forged, or the existence of the damage to the beacon node, so we can not accurately locate it.

35.4 Analysis and Countermeasure of Security Technology Based on the ZigBee Network Security

35.4.1 ZigBee Network Security Objectives

In the process of transferring data in the wireless network nodes, only nodes legitimate, correct understanding of the information captured, illegal node cannot correctly understand the information contained in the data [5]. By using data encryption before transmission, we can prevent unauthorized users to decipher, so that legitimate users through the decryption to obtain information, and we can also improve the security of data transmission through data encryption, thus ensuring the integrity of data transmission. In sensor networks, data integrity, message authentication code to test this is with the shared key of the hash algorithm, it

shared key and the message to be tested are connected together, and then hashed minor changes to the data will be more serious impact on the value of the message authentication code.

In ZigBee network, a lot of processing of the data collections need base station to prevent the attackers only to ensure the freshness of each message. This freshness is mainly reflected in the sender is the latest data and the latest shared key sent to the recipient. The data transfer process, the attacker would information into a website, the receiver only through the data origin authentication can be sure that the correctness of the message of ZigBee networks are often used to share a unique symmetric key for data origin authentication.

35.4.2 Security Encryption Technology in ZigBee Network

The security technology is the methods we need to prevent a variety of injuries, as well as fires, explosions and other accidents in the production process and provide workers with safe, good working conditions and to take technical measures. In network security, security technology mainly refers to the secure encryption technology. ZigBee network is encrypted protection, the use of secure encryption technology can effectively prevent eavesdropping during data transfer, and malicious tampering, thus ensuring the normal operation of the data transmission.

The use of secure encryption technology for the existence of the ZigBee network security issues and threats, imposed to protect specific process includes three steps, encryption, decryption and key expansion. In the ZigBee network, using the Rijndael algorithm to encrypt the data transmission to ensure the security of data transmission, the Rijndael is an iterated block cipher with variable block length and variable key length, block length and key length can be specified as 128, 192 or 256, three lengths correspond to the number of rounds of 10, 12, 14. Each one includes a linear mixed layer, nonlinear layer and the key added layer. From the linear mixed layer diffusion; the confusion from the nonlinear layer; key encryption and decryption process respectively $r + 1$ sub-key.

(1) Encryption

Figure 35.4 shows the AES-the Rijndael encryption process, in which the S-box (S-box) from the byte substitution (Byte Sub) role; SP structural password, in the P layer or linear layer here is the line shift transform (shift row transform) and column mixing (mix column), with diffusion, and cannot be out in the last cycle of confusion.

We presume that X is a 128-bit input; Y is the output of a 128-bit, and AES-the Rijndael encryption is expressed as [6]:

$$Y = (O_{K_r} \circ T \circ \ \Gamma) \circ (O_{K_{r-1}} \circ \prod \circ T \circ \Gamma) \circ \ldots \circ (O_{K_{r1}}(X) \circ \prod \circ T \circ \Gamma) \circ O_{K_0}(X) \tag{35.1}$$

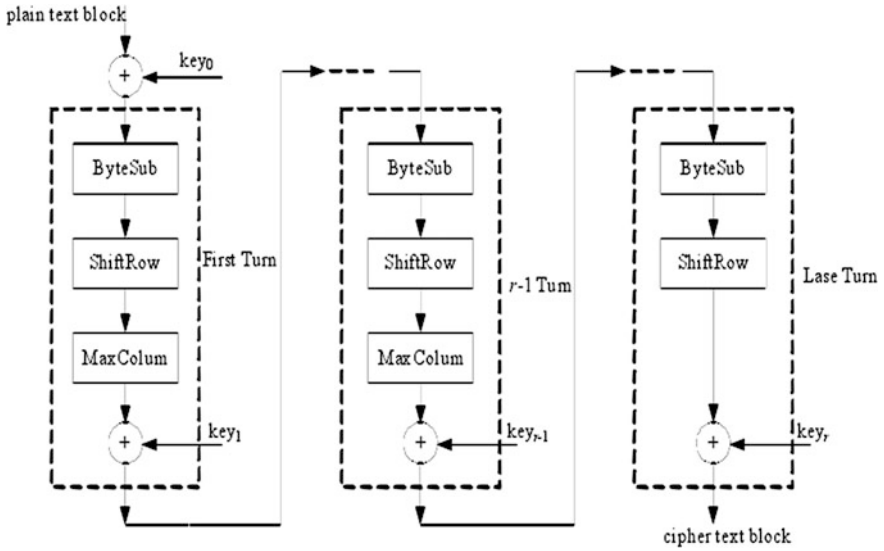

Fig. 35.4 Specific steps of encryption

In the equation, "∘"is the composite symbol for the replacement, K_0, K_1, …, K_{r-1}, K_r is the sub-key.

o_{K_i}: $F_2^{128} \rightarrow F_2^{128}$ is a permutation; $X \in F_2^{128}, O_{K_i} = X \oplus K_i$

Γ is the byte substitution and replacement from $F_2^{128} \rightarrow F_2^{128}$, which is composed by the 16 S-box of F_2^{128}.

$S = L \circ F$ is the equation for the S-box operations, in which F is the inverse algorithm for $GF(2^8)$; L is the affine transformation on a finite field $GF(2^8)$.

From the matrix, we can get

$$B = \begin{matrix} 1 \\ 1 \\ 0 \\ 0 \\ 0 \\ 1 \\ 1 \\ 0 \end{matrix} \tag{35.2}$$

(2) Decryption

The encryption process of computing uses the matrix inverse operation to decrypt and uses the inverse S-box byte to show its changes.

(3) Key expansion

The encryption process must be realized by $r + 1$ sub-key; other sub-keys also must be able to form 4 $(r + 1)$ 32-bit word. If the packet length is 128 bits, then a key is constituted by 126-bit AES key, and 11 128-bit sub-keys, each sub-key is composed by four 32-bit words $W[i](0 \leq i \leq 43)$, the seed density the key main W [0], W [1], W [2], W [3] the other by the following expression [7]

$$W[i] = \begin{cases} W[4] = W[0] \oplus S(\text{Rotl}(W[3])) \oplus R\text{con}[1] \\ W[5] = W[1] \oplus W[4] \\ W[6] = W[2] \oplus W[5] \\ W[7] = W[3] \oplus W[6] \\ W[8] = W[4] \oplus S(\text{Rotl}(W[7])) \oplus R\text{con}[2] \\ \ldots\ldots\ldots \end{cases} . \tag{35.3}$$

According to the above equation, Rolt byte is circulation shift; S (x) is bytes instead; Rcon is the round constants can be defined by the following expression [8]:

$$\text{Rcon}[i] = (\text{RC}[i], '00', '00', '00'). \tag{35.4}$$

In the above equation, $\text{RC}[i] = '01', \quad RC[i] = x \times (\text{Rcon}[i-1])$.

By replacing the permutation network, and using the inverse operation of multiplication over finite fields, AES-Rijindael is security encryption technology and nonlinear layer in addition to the plus mode, mode subtraction, modular multiplication, shift a large number of simple and effective computing, but they must be adequate resources for wireless sensor network nodes can be realized. ZigBee network security encryption technology processing safety performance will be greatly enhanced. We can see great significance to the security technology used in wireless networks.

35.5 Conclusion

Through the analysis of the safety performance of wireless sensor networks, ZigBee network threats exist and need to achieve security goals, we found that ZigBee network is encrypted using the AES-Rijndael security encryption technology to more effectively ensure that the data smooth transmission and to overcome the drawbacks of wireless transmission, in order to realize the efficiency and security wireless data transmission.

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Chapter 36
College Student's Poineering Work Ability Analysis Based on the Network Environment

Zhijin Wang

Abstract Affected by the world financial crisis, the employment situation of college students is not very good in the past 2 years; pioneering work of students has become a trend. But their pioneering work also has many weaknesses, so they are serious obstacle for their pioneering work process. Therefore, this chapter has discussed from the four influence factors of developing their own pioneering work capacity of the contemporary college students based on the network environment, and has use the fuzzy comprehensive evaluation method to analysis College Students starting an undertaking ability. At last, the result of College Student's poineering work ability belongs to a higher level is pointed out.

Keywords College students' pioneering work · Pioneering work ability · Network environment · Fuzzy comprehensive evaluation method

36.1 Introduction

With the advent of the financial crisis, according to our country's human resources ministry statistics, many students choose to be boss of them; pioneering work has become a new trend of College Students' employment. The pioneering groups of college students are mainly come from college students and graduates from the university. Because increasing enrollment of college students has led a series of problems, it is very hard for many College Students to find a good job. Although this part students with high knowledge and high academic qualifications

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characteristics, they need help and attention because of lacking the social experience. Students pioneering work should seriously analyze the risks of entrepreneurial process. Some risks can be controlled; some risks cannot be controlled; some risks need to be avoided; some risks are fatal or not can be managed. Faced with these risks, college students should know how to deal with them and resolve them. Students can select many items. For example they can choose their own interest professional; they can choice the hot project of market consumption or purchase; they can choose the low cost investment; they can choose low risk and small projects; they can select customer awareness higher project; they can select projects that range from web shop to the entity undertaking project [1]. However, the network is the important weapon that cannot be ignored for contemporary college students. The network can help students to improve their ability, can provide college students start their entrepreneurial dreams, and can enhance students' spirit of innovation and pioneering work.

36.2 Analysis of the Current Situation of College Students' Pioneering Work

The following four aspects are discussed for the investigation of the contemporary college students' pioneering work status in this paper: family, school, national policy (government), social environment (network). The information is shown in Fig. 36.1.

First, college students' pioneering work ability cultivation mode contains individuals and families; Second, college will help students for their ability of starting undertaking; third, our government can put forward some policies to encourage pioneering work and play a supporting role; finally, the social and network environment is a requisite weapon for College Students' innovative undertaking [2]; in order to better realize their entrepreneurial dreams, college students should make good use of the network. The following picture shows the four factors that dominate the whole process of pioneering work of College Students (Fig. 36.2).

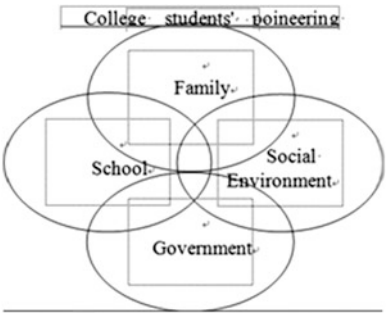

Fig. 36.1 The influence factors of college student' pioneering work

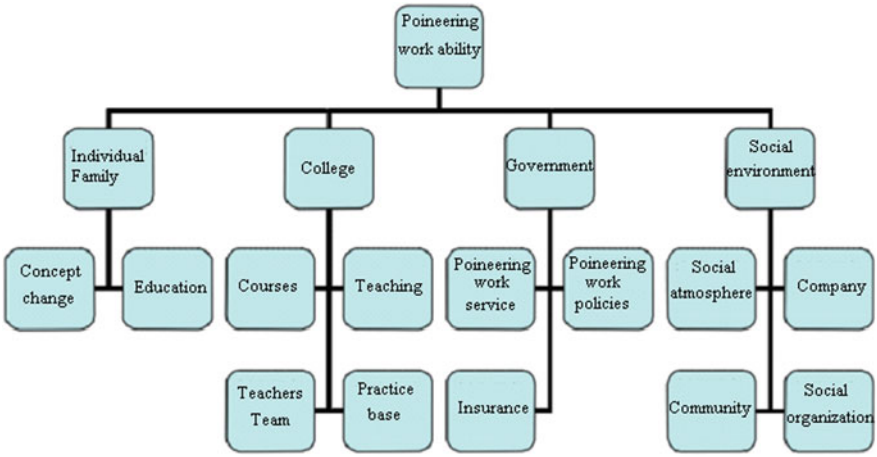

Fig. 36.2 Four factors of pioneering work ability cultivation

The following discussion is the current situation investigation that based on the network environment:

(1) The investigation of the concept of pioneering work

This paper, through the concept of the investigation, has found that most college students have not understood very much the concepts of pioneering work [3]. A lot of people think that is to be the boss, even some students think pioneering work is the development of science and technology project. But we can found that contemporary college students' pioneering work is still very curious from Fig. 36.3.

(2) In the College Students' innovative undertaking education survey, many college students want to learn career guidance courses [4]. It indicates that they are really very interested into the venture of pioneering work. In the

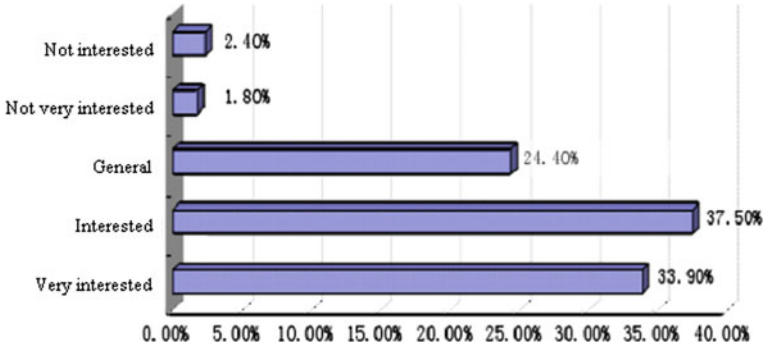

Fig. 36.3 The interest of college students

Table 36.1 The poineering work education

Problem	Pioneering work course			Pioneering work knowledge			
Option	Y	N	N/A	Company Management	Relationship	Individual help	Social practice
Percent	84.7	2.8	12.5	28.6	43.1	8.4	40.7

Table 36.2 The requirement of students for the government

Option	Percent
College students' innovative undertaking fund support	72.6
All kinds of Service	64.2
Loan policy	54.8
The new business approval	50.1
Preferential tax	36.9
Urge schools opened poineering education courses	39.7
The support of public opinion	48.6
Widen financing channel	43.3

courses, students are more hopeful toward courses on interpersonal, communication skills, and team spirit and so on. Therefore, we should set up some useful courses for students [5]. Table 36.1 is a reflection of some college students' pioneering work education.

(3) Table 36.2 is a reflection of college students in the entrepreneurial process. Many students think they require the government to provide funds to support them and relevant agencies to provide services. And some students need to relax the lending policies, tax incentives and broaden the financing of preferential policies [6] (Fig. 36.4).

Through the above analysed various factors, we can find that the contemporary College Students actually have high enthusiasm. They do not know enough about the concept of pioneering work and the related problems. The students also put forward their ideas; they need the school open for the relevant professional courses, and give them more social practice activities for exercising their own entrepreneurial ability. Similarly, students want to get government as they establish preferential policies and to provide them with financial support [7].

Through the above analyzed issues, three suggestions are put forward for students:

Intellectual services belong to the areas of pioneering work. On one hand, home field is traditional channel that is very suitable for students. College students have accumulated rich experience; on the other hand, college students can make full use of educational resources, and more easily earn first pot of gold. If the conditions are not mature, it may cause the bad results.

Students can make full use of cyber source. In the high-tech area, college students have the advantage, but not all students are suitable for the high-tech pioneering

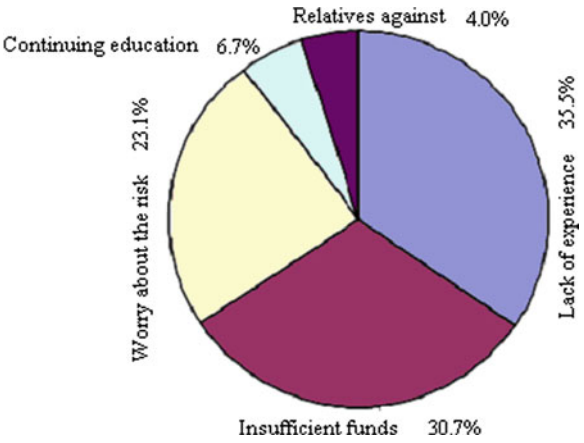

Fig. 36.4 Problems for college students

standing results can succeed [8]. Therefore, contemporary college students must grasp the network on their own business role. In order to strengthen the use of network, college students should believe that the entrepreneurial dream can be realized smoothly.

Students can make full use of their network. On one hand, college students can make full use of university customer resources; on the other hand, college students familiar with peers' consumption habits, thus it is getting more easily for college students. Since the students rely on the cheap route, customers are attracting with low price. In addition, due to their limited funds, college students cannot choose good location shops. Therefore the promotion work is particularly important [9].

36.3 Fuzzy Comprehensive Evaluation for College Students' Innovative Undertaking Ability

For the twenty-first Century students, the network has already become the key factors for their career success, so the contemporary college students' entrepreneurial capacity has been evaluated in this paper based on the network environment. But the evaluation cannot be used for a simple score to evaluate, so we use the fuzzy comprehensive evaluation. Fuzzy comprehensive evaluation is the system of multiple interacting factors comprehensive evaluation based on fuzzy mathematical knowledge. Fuzzy set theory by Professor Chad, the American automatic control expert, it uses to express uncertainty in 1965.

(1) The classification of evaluation factors and formula

Evaluation is given: $Y = \{y_1, y2, y3, \ldots, y_m\}$.

In order to facilitate the weight distribution and evaluation, the evaluation factors are divided into a number of categories. Primary evaluation factors can be set up under the second evaluation factors $X = \{x1, x2, x3, \ldots, x_m\}$.

The fuzzy mapping from X to Y is created. f: $x \rightarrow F(y)$.

F can induce the fuzzy relationship R which is can be represented in matrix form:

$$R = \begin{bmatrix} r_{11} & r_{12} & r_{13} & r_{14} & r_{15} \\ r_{21} & r_{22} & r_{23} & r_{24} & r_{25} \\ r_{31} & r_{32} & r_{33} & r_{34} & r_{35} \end{bmatrix} \tag{36.1}$$

Establishment of weights: according to their importance of different concentration, factors are given the corresponding weights:

$$A = (a_1, a_2, a_3) \tag{36.2}$$

On the evaluation subjects, set M is selected:

$M = \{$A (high), B (high), C (general), D (poor), E (poorly)$\}$.

Comprehensive evaluation and results: a comprehensive assessment can be made. The formula is shown as follows:

$$B = A \times R = (b_1, b_2, b_3, b_4, b_5) \tag{36.3}$$

$$B = (a_1, a_2, a_3) \times \begin{bmatrix} r_{11} & r_{12} & r_{13} & r_{14} & r_{15} \\ r_{21} & r_{22} & r_{23} & r_{24} & r_{25} \\ r_{31} & r_{32} & r_{33} & r_{34} & r_{35} \end{bmatrix} = (b_1, b_2, b_3, b_4, b_5) \tag{36.4}$$

To get an accurate evaluation results, each grade variable values can be got. A (very high): 100–90, B (high):90–80, C (general):80–70, D (poor) 70–60, E (bad): 60–0.

According to Table 36.1, we can find the corresponding evaluation results.

(2) Data analysis

The fuzzy comprehensive evaluation method is described; a certain college students' pioneering work ability is calculated:

First, weight should be established:

Through mathematical calculation, the weight of every factor can be got: A = (0.41, 0.37, 0.25, 0.32).

Then the matrix is established:

This paper is through expert grading method. Experts give the fuzzy evaluation results (Table 36.3). The frequency and probability is shown in (Table 36.4).

Table 36.3 Evaluation table

Grade	A	B	C	D	E
Score	100–90	90–80	80–70	70–60	60–0

Table 36.4 The frequency of evaluation factors

College students' pioneering work	A	B	C	D	E
Consciousness	0.84	0.20	0.04	0.01	0
Ability	0.73	0.21	0.13	0.02	0
Level	0.68	0.17	0.18	0.07	0

Evaluation on the results is shown as follow:

$$B = (a_1, a_2, a_3) \times \begin{bmatrix} r_{11} & r_{12} & r_{13} & r_{14} & r_{15} \\ r_{21} & r_{22} & r_{23} & r_{24} & r_{25} \\ r_{31} & r_{32} & r_{33} & r_{34} & r_{35} \end{bmatrix} = (b_1, b_2, b_3, b_4, b_5) \quad (36.5)$$
$$= (0.54, 0.137, 0.147, 0.072, 0)$$

Finally, according to the assessment of college students' pioneering work capacity, the final result is calculated: $C = B \times P = 85.21$.

The school students' pioneering work ability belongs to a higher level.

36.4 Conclusion

With the advent of the twenty-first century, the network era becomes main trend in our daily life. Internet is a modern fashion in the new era. Under the network environment, contemporary college students should know how to make use of the network's huge resources to realize their pioneering work dreams. This is worth for our further discussion. In order to guide students join in multichannel employment and encourage pioneering work and flexible employment, government puts forward some favorable policies for college students. We see not hard, the state is to encourage and promote students to start their own businesses. So, the contemporary college students must grasp the current opportunities and make good use of cyber source for improving their ability of pioneering work.

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Chapter 37
College English Teaching Resources Library Based on Campus Network

Fuqiang Wang and Lijun Xu

Abstract By the analysis on the present situation of college English teaching resources library construction, beginning with the module and function of college English teaching resources library construction, the constructional ideas of college English teaching resources library is put forward, covering the following aspects as listening, speaking, reading, writing, translation, which has important significance on the integration of teaching resources, the construction of students' autonomous learning platform and the improvement of the quality of English teaching.

Keywords Campus network · College english · Teaching resource library

37.1 Introduction

With the rapid development of campus network in colleges and universities, more and more English teachers can use the network to carry out all kinds of teaching activities, but scattered and limited English teaching resources and the lower resource sharing rate and utilization rate became the "bottleneck" restricting the further improvement of teaching efficiency [1]. Under this background, to realize the informatization of our higher education and scientific research, it is necessary to give full play to the advantages of modern information technology, build, manage, and make good use of teaching resources, so as to speed up China's higher education modernization pace. At present, how to share distributed

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resources in English teaching, to improve English teaching resources utilization, establish a standard, rich, practical, and widely shared college English teaching resources library, already became the problem that should be solved urgently [2].

37.2 The Design of System Structure of College English Teaching Resources Library

Modular design is the foundation and key of construction of the resources library, and it is necessary to consider the data structure, storage format, input/output device and the application mode of soft, hardware choice, and also pay attention to the teacher's use habit, classroom teaching needs, following the coordination, interaction, the flexibility, and the ease construction principle [3]. The author thinks, the functional structure system of college teaching resource library can use Microsoft Visual Studio 2005 as a development platform, SQL Server 2000 supporting the ODBC interface is chosen as background database, ADO.NET is chosen as Web database access interface, through the combination of ASP.NET and ADO.NET, build and provide the page content containing database information. The use of the Enterprise Manager (Enterprise Manager) and Query Analyzer (SQL Server) and other powerful tools provided by SQL Server, can easily perform on the design, development, deployment, and management of database.

In general, a complete database system can be divided into 3 categories of users: system administrator, resource administrators, and ordinary users.

The system administrator. The system administrator has the highest authority in the system, and has authority to operate all the features the system provides. The main responsibility is to undertake resource library system maintenance and configuration, carry on the statistical analysis on the system's overall situation, and manage the classification of resources and the user (mainly on resource administrator), also responsible for the safety management of system.

Resource administrator. The permissions of resource administrator is only after the permissions of system administrator, and have a certain user permissions (mainly to the ordinary user management). The main responsibilities are resource evaluation, resource review, resource maintenance, and resource requirements support services [4]. Resource manager's specific responsibilities include the following two aspects.

37.2.1 Resource Management

(1) Resource review. Review and store the resources uploaded; in the end, resources uploaded exist in the form of the resource list, which can be seen by the users only after the administrator reviewed and published.

(2) Resource maintenance. Add resource. Upload resources from the management side, including the upload of single file and multiple file package; Delete resources. To delete the duplication of resources; resource modification. Make necessary changes on the resource name, resource type, resource classification, the information of name uploaded.

37.2.2 Service Center

37.2.2.1 User Management

Management of all registered users, including the removal of illegal users, setting the member integral.

37.2.2.2 Service Management

Service content includes: needs support and View resource requirements the user sends and then reply. Comments management. View users' comments on resources, adjust timely resource evaluation grade; the feedback on suggestions. Give feedback on time on the user's complaints, suggestions; the average user. Common users are end users and beneficiaries of system, including registered users and non registered users. Non registered users can browse all resources, but can only download zero integral resource of "tourist zone", but cannot enjoy other services.

For the convenience of using resources provided by the system, system provided such functions for registered users as resource retrieval, download resources, resources collection, resource requirements. In addition, for the convenience of communication between the administrator and registered users and is convenient for registered users to expand resources, system also provides resources reviews, resource upload and other functions to achieve the purpose of co-construction and co-sharing of resources.

(1) Fast browsing and retrieval. The fast browsing. According to the discipline and profession classification developed by the Ministry of education and educational resource types, browse resources hierarchically; the resources retrieval. In accordance with the keyword, resource categories to find resources required.
(2) Tourist area. For unregistered users to download zero integral resource.
(3) Resource use. The downloading of the resource. To download resources needed to the local computer; the resource evaluation. Conducting subjective and objective evaluation on the resources quality, afterward, rewards are available; the resources collection. Resources can be collected to the

member's personal favorites, to facilitate the next use; needs support. Requesting support when the resources users required cannot be retrieved, sending to the resource manager in the form of short message in station.

(4) The member center. Modify personal information. Registered users modify their own basic information and passwords; upload resources. Registered users upload the local resources and URL resources to the resource center, waiting for a resource manager audit, the user can receive bonus points passing audit; the uploaded resource. Registered users view the uploaded resource, which can be modified before audit; my favorites. Registered users view, delete collection resources; the complaints and suggestions. Registered users complain or make personal recommendations on the unsatisfactory library service.

37.3 Resources Classification Design of College English Teaching Resource Library

Resource classification design, must aim at serving for the teaching, meeting the needs of teaching, based on the practical, convenient, sharing design principles.

According to the sources, it can be divided into the following modules:

(1) Introduction to the course. Including syllabus, teaching schedule, teaching goal, content, evaluation means, and learning method. The plate is designed to help students understand the course, master learning methods, better play the main role of students, prompting them to assume supervision on their own learning responsibility.

(2) The electronic teaching plan, network courseware: electronic lesson plans and the PPT courseware compiling according to textbook provide the students the necessary help for previewing before the class, reviewing after class as well as autonomous learning.

(3) Exercises: exercises and homework in each paper help the students to carry on self detection, not only offer students learning focus and direction of learning, but also help them effectively assess their study effect.

(4) Video and audio data: add the video data related to curriculum content, such as "I have a dream", "westward movement." which reflect the cultural background on English, and thus students can more intuitively understand American culture, improving the intercultural communication ability.

(5) The network link: search and link to the high-quality goods curriculum websites related to online courses, provide students more professional, more comprehensive information on the study to learn the course, and expand the horizons of students.

Libraries can be divided into the following ten modules as listening resource Library, oral resource English library, reading resource library, writing resource

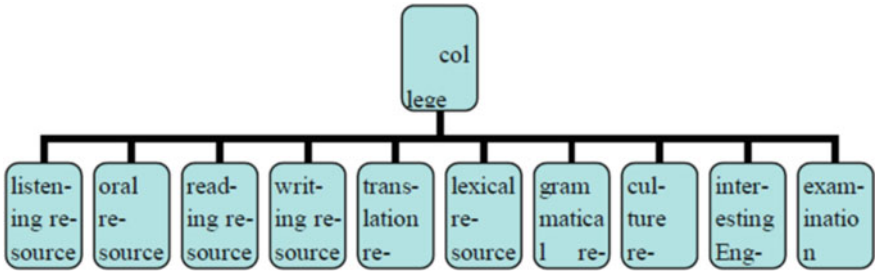

Fig. 37.1 Resource first order classification

library, translation resource library, lexical resources library, grammatical resources library, culture resources library, interesting English library, examination questions and examination papers library [4]. As are shown in Fig. 37.1.

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Please ensure running headers are no longer than one line. When dealing with particularly long paper titles please shorten them to an acceptable length in the running header only.

37.4 Conclusion

The campus network has powerful functions, but in many universities have not been fully developed and utilized. Especially in the aided English teaching, their value has not been reflected. The construction and application of college English teaching resource library based on campus network, provided a good teaching environment for the majority of teachers, provided students with a better learning platform, which can develop college students' English comprehensive skills and learning strategies highly efficient, improve the students' English and human quality meanwhile greatly improve the utilization value of campus network.

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Chapter 38
A Novel Secure Pairwise and Groupwise Synchronizing Scheme in WSN

Qin Dong

Abstract Existing solutions yet for time synchronization in sensor networks are not resilient to malicious behavior from external attackers or internally compromised nodes. The feasibility of a pulse-delay attack (external attack), whereby an attacker can introduce arbitrarily long delays in the packet propagation time directly can affect the achieved synchronization precision. It is assumed in the proposed approach that all nodes are directly connected to one another. Hence, propagation delay is minimal. The proposed approach is able to overcome from external as well as internal attacker problems in group synchronization. The external attacks are resolved with the help of message authentication codes (MAC) and the use of private keys and internal attacks are found out on the basis of send and receive time. Once the group is secure from external as well as internal attacker i.e., no malicious node is present in the group then each node synchronizes to the common clock in the group.

Keywords Wireless sensor networks · Time synchronization · Malicious nodes

38.1 Introduction

Wireless Sensor Network (WSN) consists of hundreds or thousands of micro sensor nodes that are joining together to form a network. WSN [1] accurately monitors remote environment intelligently by combing the data from individual nodes. Applications of sensor networks are in providing health care for elderly,

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surveillance, emergency disaster relief, and battlefield intelligence gathering. Time synchronization is a critical building block in distributed WSNs. The special nature of WSN imposes challenging requirements on secure time synchronization design.

38.2 Requirement of Time Synchronization

There are several reasons for time synchronization in sensor networks. First, sensor nodes need to coordinate their operations and collaborate to achieve a complex sensing task. Data fusion is an appropriate example of such coordination in which data collected at different nodes and aggregation of data gives a meaningful result. Second, synchronization can be used by power saving schemes to increase network lifetime. When using power-saving modes, the nodes should sleep and wake-up at coordinated times, such that the radio receiver of a node is not turned off when there is some data directed to it. This requires a precise timing between sensor nodes.

38.3 Related Work

Till date a number of protocols are proposed for time synchronization [2]. There protocols are broadly classified in receiver–receiver-based [3, 4] time synchronization or sender–receiver-based [3, 5] time synchronization. For discussion we have considered reference broadcast synchronization (RBS) [6] protocol and time synchronization protocol for sensor network (TPSN) [7] as receiver–receiver-based protocols. On the other hand, secure pairwise synchronization (SPS) [8] protocol is considered as sender–receiver-based protocol.

38.3.1 Receiver–Receiver Protocols

Reference Broadcast Synchronization protocol [6] is receiver–receiver-based time synchronization protocol which reduces some uncertainty in packet delay over the time synchronization protocols. The send time and access time are typically the largest source of error and biggest contributors to the none-determinism in the latency. RBS does not need to consider about sender‘s nondeterministic packet delays: send time (This is the total time of building the message and transfer it to the network interface to be sent. This time highly depends on the operating systems in use) and access time (This is the time needed to access the channel. Every network employs a medium access control (MAC) scheme, like time division multiple access (TDMA), and total access time depends on that scheme. In TDMA

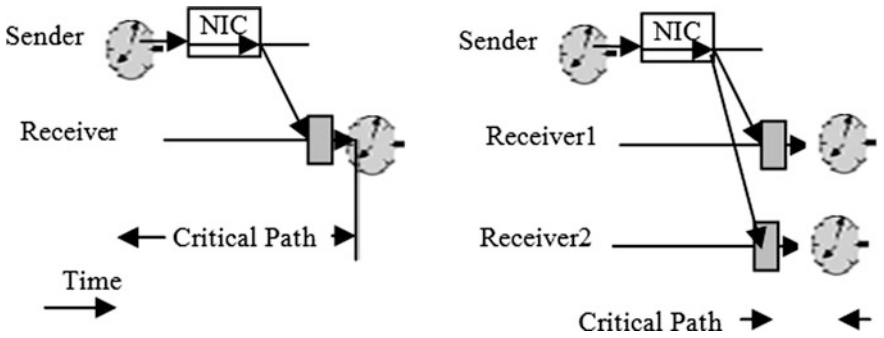

Fig. 38.1 Time-critical path for traditional protocols and RBS protocol

for example, network node has to wait for its slot to start transmitting while in other schemes, network nodes wait for the channel to be idle. To remove sender's non-deterministic packet delays, RBS provides high precision of time synchronization.

Figure 38.1 shows benefits of RBS over traditional protocol. As shown in fig In RBS a reference message is broadcast to two or more receivers. Each receiver records its local time when it gets the reference message and then receivers try to synchronize their respective local clocks [9] by exchange of time synchronization packets.

Another receiver–receiver-based protocol is Timing-sync Protocol for Sensor Networks (TPSN) [7] which is generally used as a multihop time synchronization protocol. TPSN has two phases in its process: "level discovery phase" and "synchronization phase".

38.3.2 Sender–Receiver Synchronization

In sender–receiver approach all receivers must be synchronized with sender. Sender–receiver approach basically includes three steps.

(1) The sender (initiator) node periodically broadcasts a message with its local time as a timestamp to the receivers.
(2) The receivers then synchronize with the sender using the timestamp it receives from the sender.
(3) The message delay between the sender and receiver is calculated by measuring the total round-trip time from the time a receiver requests a timestamp until the time it actually receives a response.

The pseudo code (see Table 38.1) for in sender–receiver synchronization [8]. Here, T1, T4 represent the time measured by the local clock of node A. Similarly T2, T3 represent the time measured at node B. At time T1, A sends a synchronization pulse packet to B. Node B receives this packet at T2, where $T2 = T1 + d + \delta$. Here, δ and d represent the offset between the two nodes and end-to-end delay

Table 38.1 Pseudo code for in sender-receiver synchronization

Sender-receiver synchronization
1. A(T1) —›(T2) B : A, B, sync
/* At Time T1 node A sends a synchronization packet which is received by node B at time T2. Packet contains synchronization message time stamp along with node-id of node A and B. */
2. B(T3) —›(T4) A : B, A, T2, T3, ack
/* In response to synchronization packet at time T3 node B sends response packet which is received by node A at time T4. The response packet contains node-id of nodes A and B along with receiving time of synchronization packet T2, sending time of response packet T3 and acknowledgement. */
3. A calculates offset between the nodes A and B.

respectively. At time T3, B sends back an acknowledgement packet. This packet contains the values of T2 and T3. Node A receives the packet at T4.

Similarly, T4 is related to T3 as T4 = T3 + d − δ. Node A can calculate the clock offset [8] and the end-to-end delay [8] as:

$$Offset(\delta) = ((T_2 - T_1) - (T_4 - T_3))/2 \tag{38.1}$$

$$Delay(d) = ((T_2 - T_1) - (T_4 - T_3))/2 \tag{38.2}$$

Without any pulse delay attack the T2 = T1 + δ + d and T4 = T3 − δ + d. If an attacker performs pulse-delay attack (e.g., on the initial sync packet), the equations will change to: T2* = T1 + δ + d + Δ and T4* = T3 − δ + d + Δ. Here Δ is the pulse-delay introduced by the attacker [10]. In presence of pulse delay clock offset and the end-to-end delay will be

$$Offset(\delta) = ((T_2 - T_1) - (T_4 - T_3) + \Delta)/2 \tag{38.3}$$

$$Delay(d) = ((T_2 - T_1) - (T_4 - T_3) + \Delta)/2 \tag{38.4}$$

Secure pairwise synchronization is a sender–receiver-based approach. In Sender–receiver synchronization approach security mechanism is integrated to make it resilient to adversarial attacks from external attackers. In this protocol, message integrity and authenticity are ensured through the use of Message Authentication Codes (MAC) and a key KAB shared between A and B. This prevents external attackers from modifying any values in the synchronization pulse or in the acknowledgement packet. Furthermore, the attacker cannot assume an identity of node B as it does not hold the secret key KAB. An attacker can hear the packet over the wireless channel and can use the MAC in future to generate authenticated packets. Using a random nonce, NA, during the handshake safeguards the protocol against such replay attacks.

In SPS, pulse delay attacks are detected through a comparison of the computed message end-to-end delay, *d*, with the maximal expected message delay d*. Note that the calculation of the end-to-end delay, *d*. If the computed delay is greater than

Table 38.2 Pseudo code for in secure pair-wise synchronization

Secure pair-wise synchronization (SPS)
1. A (T1) — > (T2) B: A, B, NA, sync
/* At Time T1 node A sends a synchronization packet which is received by node B at time T2. Packet contains synchronization message time stamp, nonce NA (pseudo-random number issued in an authentication protocol to ensure that old communications cannot be reused in replay attacks) along with node-id of node A and B. */
2. B (T3) — > (T4)A : B, A, NA, T2, T3, ack, MAC {KAB}[B, A, NA,T2, T3, ack]
/* In response to synchronization packet at time T3 node B sends response packet which is received by node A at time T4. The response packet contains node-id of nodes A and B, nonce NA, receiving time of synchronization packet T2, sending time of response packet T3 and acknowledgement along with all above contains encrypted by shared key KAB and then protected by MAC. */
3. Node A calculates end-to-end delay
$d = \{(T2–T1) + (T4–T3)\}/2$
if $d \leq d^*$
then $\delta = \{(T2–T1) - (T4–T3)\}/2$,
else
abort
end if

the maximal expected delay, we recognize that there is replay on packet. The pseudo code for SPS protocol is given in Table 38.2.

38.4 Proposed Protocol

38.4.1 Assumptions in Proposed Approach

Here, an approach to develop secure time synchronization protocol is proposed using benefits of sender–receiver as well receiver–receiver-based approach. Approach first identifies malicious node(s) in group and then synchronizes all non-malicious nodes to a common clock i.e., fastest clock in the group.

Let us assume that group membership is known to all group nodes in the group and all group nodes reside in each other‘s power ranges i.e., assume that the position of each host is known to other hosts in the group. A group leader (cluster head or sender node) is elected on the basis of energy level.

In the proposed approach although it is considered that cluster head is non-malicious it may be malicious. A malicious cluster head will not report exact time at which it sends reference packets to all intended receivers i.e., it will send a false time to all receivers. This false time will be used by group members for synchronization. Hence, all group nodes will synchronize to false time. This can be overcome by fixing the initial sender node as non-malicious.

Let us consider G_s is a sender node which is a non-malicious. Node G_s will broadcast reference message. This message is received by all intended receivers in

the group. Now each receiver will exchange their local clocks for synchronization. The node G_i will send challenge packet at time Ti and receiving time of packet by node G_j is T_j (already sent by node G_i). These times are measured by two different clocks. Ti is measured in the local clock of node G_i (i.e. C_i) where as T_j is measured by the local clock of node G_j (i.e. C_j). The offset (or the difference between the local clocks) between the two nodes is represented by δ_{ij} (calculated by node G_j with respect to node G_i). The delay for the packet transfer from G_i to G_j is represented by d_{ij}. In proposed protocol we have assumed that a node is said to be malicious, if it does not report the exact time at which it receives or sends the packet. Here in, we assume that malicious node does not report the exact time at which it receives the packet.

38.4.2 Steps in Proposed Protocol

Step 1 Sender node Gs is selected as group (cluster) head on the basis of energy level. Considered group head is a non-malicious node and treated as source node for initial communication. Node Gs broadcasts reference message. All receivers of the reference message will form group of sensor nodes. Lets us consider size of group is n. Now synchronization takes place among receivers as follows.

Step 2 Node G_i sends packets containing its node identifier (ID) and challenge nonce (N_i) to all group members. If there are N nodes in the group then in the first step the number of messages transmitted is $N - 1$. In proposed protocol the initiator node is taken as sender node.

Step 3 In this step of the protocol, each receiver records its local time when it gets the challenge packet from cluster head and every node G_j, which have received the challenge packet acknowledges back to sender node G_i, known as response packet. This packet contains triples $\{T_j, N_i, G_i\}$, where T_j is the receipt time of the challenge packet from node G_i, N^i is nonce by sender and G^i is node-id of sender respectively. It also contains MAC, which enables G^i to authenticate the packet sent by G^j in this step. The response packet also includes the sending time (T'_j) from node G^j. MAC is used to provide resiliency against external attacker. So in this step N MACs are calculated one for each Gi and G^j pair and then each G^j sends messages to G^i. A pair wise secret key (K^{ij}) which is shared between nodes G_i and G_j is also used in the response messages.

Step 4 Now node G_i calculates the delay occurred (d_{ij}), corresponding to challenge-response and if all the calculated delays for each node are less than a maximal delay (d*) then node G_i calculates the offset for each node G_j. If any node's calculated delay is more than maximal delay then G_i assumes that G_j is external attacker.

Step 5 Node G_i will calculate for every other node, G_j, in the group S_{ij} (S_{ij} is sent time of packet from node G_i to G_j) and R_{ji} (R_{ji} is received time of packet from node G_j to G_i). If G_j is malicious then S_{ij} should not be equal to R_{ji}.

Step 6 Repeat steps 2–5 for every pair of nodes and find out malicious nodes in the group. After detecting the malicious nodes synchronize the local clock of each nonmalicious node to fastest clock in the group. The pseudo code for proposed protocol is given in the Table 38.3.

Table 38.3 Pseudo code for in secure time synchronization

Proposed protocol for time synchronization
{∀ Gj ∈ (1,……,N)}
1. Elect a sender node Gs (cluster head) which will broadcast reference message to all receivers. All receivers of the reference message will form a group.
2. For each node (receiver which gets reference message) in the group.
Gi (Ti) → Gj (Tj) : Gi, Ni, sync; j = 1,……..,N
/* Node Gi sends a challenge packet for synchronization, containing its node-id Gi and nonce Ni at time Ti to all nodes in the group and node Gj receive the packet at time Tj */
3. Gj (T′j) → Gi (T′i): Gj, T′j, m, M, ACK
m = {Tj, Ni, Gi}
M = {MAC{Kij}[Gj, T′j, Tj, Ni, Gi, ACK]}
/* Node Gj neighboring node of Gi will send response packet to Gi at time T′j. The packet also contains receiving time of challenge packet at Gj i.e. Tj from node Gi with nonce Ni. */
4./* Finding External attackers */
Compute d = {[(Tj − Ti) + (T′i − T′j)]/2, j = 1,..,N}
/* calculate end-to-end delay between each node from Source node. */
if all dij ≤ d*
/* calculate offset set between each node from source node. */
then δ = {[(Tj − Ti) − (T′i − T′j)]/2, j = 1,…,N}
else Gj is Malicious (external attacker)
end if
5./* Finding internal attackers */
for each pair of Gi and node Gj in the group
if (| Sij | ≠ | Rji |)
/* Sij = sent time of packet from node Gi to Gj. Rji = received time of packet from node Gj to Gi.*/
then Gj is Malicious (internal attacker)
end if
end for
end for (of step 2)
6. Synchronize all non-malicious nodes to a common i.e. fastest clock

38.5 Conclusions

Further Synchronization of nodes depends on packet transfer among nodes which consumes energy. The proposed protocol can further be modified to reduce the communication overhead, so that energy consumption can be further reduced.

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Chapter 39
Study of Gender Feature in Computer Mediated Communication

Xiaoyi Zheng

Abstract Nowadays computer mediated communication (CMC) is rapidly turning our world into a global village. We are able to talk to each other in online chat rooms, mediated by nothing but computers. And we are increasingly seeing the benefit of the Internet which empowers women, who are considered less powerful in the traditional patterns of male-dominated communication, not only participate in the CMC "equally" but also find community to pursue their own interests. Thus, the Internet is said to eradicate gender prejudice in communication, leading to greater gender equality and gender became a lesser issue than it had been in previous times.

Keywords Feature of gender · Computer mediated communication · Network

39.1 Introduction

According to previous researches on gender and language, women and men do talk differently, adopting different styles in face-to-face communication due to the different cultural myths they have absorbed [1, 2]. My study aims to see what the communication between women and men in online chat room will be like; whether it will remain the same as that of the face-to-face interaction; whether the new way of communication under the anonymity provided by computer mediated communication (CMC) will neutralize distinctions of gender and whether the Internet will really provide an escape from gender differences. By examining the messages

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posted by women and men when chatting online, the language features of women and men under investigation will be analyzed [3].

To investigate the impact that the Internet is making on language, in his 2001 book—'Language and the Internet', Crystal discusses how the language used in various Internet communities has developed in separate papers [4]: on the language of e-mail, "chat-groups", virtual worlds (MODS and MUDS), and the World Wide Web [5]. It give answers to the questions "Is the Internet bad for the future of language?" and "Will creativity be lost? Are standards diminishing?" by concluding with a look at the effects of the Internet on language as a whole, Crystal argues positively, that the "Net speak" will change fundamentally the way we think about language.

As more women begin to venture online and more research being done in this area, the findings of studies with respect to gender and CMC tend to problematize claims that the cyberspace is gender-free and the notion that the CMC improves communication between women and men [6]. Susan Herring (1993a) in one of her article 'Participation in electronic discourse in a "feminist" field' presents results about activity on two academic e-mailing lists, claiming that instead of women and men participating equally, the discourse and choice of topic are still dominated by men. She concludes that it was "because of social conditioning that makes women uncomfortable with direct conflict thus they tend to be more intimidated by these practices and to avoid participation" [7].

Later, in the article 'Gender and power in online communication' Herring (2003) first presents evidence regarding gender in relation to online access, computer mediated communication and the World Wide Web. Then, Herring brings together research findings on gender and the Internet to answer whether and how gender and power relations are affected in and through Internet communication. The idealistic notion that the Internet would create a gender-free environment receives little support from this study. Herring finally concludes that the Internet neither alters the social gender stereotypes nor has it redistributed power equally to women and men [8].

To explore current representations of gender identities in cyberspace, Louise Mullany (2004) conducted a linguistic analysis of the strategies that advertisers use to address their targeted subjects via e-mail in her article 'become the man woman desire: gender identities and dominant discourses in email advertising language'. Instead of breaking down the boundaries of gender identities, the advertising language using e-mail helps to foster dichotomies, questioning the utopian gender-free cyberspace what Haraway depicted [9].

Some other researchers have argued that women and men in CMC tend to use different discourse styles [10]. In 'Gender and democracy in computer-mediated communication' Herring (1993b) analyzes a bulletin board and generalizes woman's language and men's language as recognizably two different styles. She describes women's language as "attenuated assertions, apologies, questions, personal orientation and support", whereas men's language is full of "strong assertions, self-promotion, rhetorical questions, authoritative orientation, challenges and humor."

However, it seems that relatively little work has been done on how women and men communicate with each other in online chat rooms. And that is where my idea of doing this research stemmed from [11].

39.2 Methodology

I randomly joined in an online chat room named "Parenting" offered by the world famous Yahoo Messenger with a randomly chosen username [12]. The conversation shown on the screen was monitored and recorded for one randomly selected week. Three periods of day: 9–11 a.m., 14–16 p.m., and 20–22 p.m. was chosen, thus the different "timetable" adopted by different gender would not affect the results. And since I was not supposed to post any message—I set the status of myself always to be "away" so as not to get involved in the conversation, which would also affect the result of the survey. While 1 week is not statistically significant, I feel that the data collected are representative of women and men chatting online.

Presumably most of the participants chatting in this room should be "parents" according to the name of the chat room. The survey was based on the assumption that the participants reveal their real identity by choosing a cartoon picture of male or female face to represent their gender, which was shown in front of their username. In addition, I also made the editorial decision to correct some spelling mistakes in the messages, unless the speaker purposely did so.

The project will then commence by a quantitative survey which comprises all the messages collected related to the research during that randomly selected period, and followed by a detailed qualitative analysis analyzing the different language features of women and men in online chatting.

39.3 Results

The results found are a large body of evidence, showing that language features of online chatting between women and men are a version of the face-to-face conversation, which are to the contrary of the claim that CMC neutralizes distinctions of gender.

39.3.1 A Quantitative Survey

During this period, some 28,000 messages were collected totally, among which men contributed nearly 66 % messages, with contrast to 34 % from women. Moreover, message posted by men is on average longer than that from women.

From this result, it was clear that the chat room under investigation was dominated by the male participants. Although female did take part in the communication, the voices from two genders are still unequal. Another explanation could be made to response to this result is that men use the Internet far more frequently than women.

39.3.2 A Qualitative Survey

The qualitative section of the results will focus on the analysis of the different features represented by women and men when chatting online by examining the content of the recorded messages. And the results found will be compared with the face-to-face communication counterparts.

Different "Facial Expressions and Body Language" At first glance, this title might looks odd, keeping you wondering how these differences could be found when women and men chatting by typing into the screen. As Lillian Glass (1992) argues, women provide more facial expressions and display smiling and head-nodding when listening, while men provide fewer facial expression and display frowning and squinting when listening. What was found in this aspect turns out to be exactly the same as what Lillian mentioned in face-to-face communication, and all these are vividly realized by the cartoon and flash representations provided by the chatting system. In my study, women are found to use more representations such as smile and laughter than man, and they "kiss" and "hug" others more. In addition to this, the results also agrees with what Cherny (1994) points out, that women tend to use more neutral and affectionate verbs (such as 'hugs' and 'whuggles'). For example:

Littlemiss (female): ☺I'm back.
Tweaky (female): Okay, I gotta go, see you later…hugsssss.
Punkin (female): my stomach aches from laughing lololol. (lol means laugh loudly.)

Different "Voice, Loudness and Tones" Lakoff (1975) illustrates the differences between how girls and boys are taught to communicate—girls are taught a more passive voice and boys emerge from their "rough talk" stage with a more forceful, active voice. And as Lillian Glass (1992) argues, men usually speak in a louder voice, using it to emphasize their points and they sound more monotonous in speech, using approximately three tones when talking. While women speaker in a soft voice, using pitch and inflection to emphasize points and they sound more emotional in using more tone tones. These are all replicated in online communication: men in this chat room resort to capitalize every letter in their sentence to "speak loudly" and even using more exclamatory marks to be "heard" more clearly. While women there are more likely to type words in different fonts, different colors and using all kinds of marks to indicate their emotional tones.

For example:

Bl@ck P@nther (male): ANY GIRLS WANNA CHAT PM ME!!!!!!!
Hailed13jeep (male): OH, I SEE LADY!!!!
Hermit (male): NOOOOOOOOOO!!!!!
Ladycat (female): Merry Christmas Everyone!
Coolrain (female): ～～～ ***I love snow *** ～～～

Different Language Features Table 39.1 generalizes the different language features between women and men when chatting online. In a whole, the results found again turn out to be a reduplication of the face-to-face communication between women and men.

In this study, women are found to make more tentative statements, try to qualify and justify their assertions by adding tag questions such as "isn't it", pragmatic particles "I think", "sort of" and modal verbs "maybe", which as Coates mentions (1996), have the effect of damping down the force of what they say. However, men assert opinions strongly and directly as "facts", what are much the same as those have been previously described for face-to-face interaction. For example:

Linda 2004 (female): That is better, isn't it?
merryl_d2000 (female): It seems to me that he would love it.
Lucky 317(female): I'm afraid you might be wrong….
Dead-bird (male): You are too tight to give anyone anything!
Egg breaker (male): Noooo, it's completely nonsense!

Women use more embedded imperative to make accusation, while men tend to use more direct accusations. For example:

Amityant (female): Could you please show me how to clean the feeding-bottle?
Sinppedforlife (male): Listen, tell me your reason!
Dusty3006 (male): Change your setting so they need permission to view!

In this study, women asks nearly triple as many questions as men. Men always make themselves appears to be expert, dashing along the latest news in sports politics and business. However, women are more humble to raise information-seeking questions and to stimulate the conversation by asking questions. Here are examples of questions asked by women:

Jessika loves David (female): how old is our baby?
Funny sweet (female): I'm planning a family anyone else?

Table 39.1 Different language features between women and men when chatting online

Women	Men
Make more tentative statements	Make more declarative statements
Make more indirect accusations	Make more direct accusations
Ask more questions	Ask fewer questions
More expressions of thanks, compliment and apology	More verbal aggressiveness
Disclose more personal information	Disclose less personal information

Giggle lady (female): What r u doing there?

And in this study, the women participants appear to be much politer than men which agrees with what Mills (2003) demonstrates, that at a stereotypical level, politeness is often consider to be a woman's choice. In addition to the tentative statements and indirect accusation women made so as to be polite, greetings, compliments, and apologies, which according to Holmes (1995)—linguistic devices expressing politeness, are post mostly by the female participants. In general, women are more considerate, attentive, and protective of the participant's want to be liked, supported, and accepted. The conversation took place among women aims to create a supportive atmosphere. However, men carry on their conversation by making fun of each other and they do not mind offending others by using aggressive and rude remarks. And they prefer anarchy, regarding conflict full of hostility inevitable. For example:

Fredrica (male): fuck off, don't chat naked here!
Mango (male): Your wife must weigh more than a truck lololol.
Virginia wolf (male): Shit, god damned it!

Though the text-only CMC is less revealing of personal information than face-to-face communication, gender is often visible on the Internet on the basis of features of a participant's discourse style as I have analyzed above. However in addition to this, participants themselves also "give off" information about their life, especially gender, directly and unconsciously in interaction. Among which, women disclose more personal information when chatting. It agrees with what happens in face-to-face conversation, just as Coates (1996) points out that woman talk predominantly about people and draw heavily on personal experience, and Coates (1986) found that all-women conversations are therapeutic, they share their own experience, offering reassurance and advice. For men, the discussion of personal problems is relatively rare, instead of responding by bringing up their own problems, they take on the role of expert, and lecturing others. Thus in this way, in spite of the anonymity the Internet provides, there are still cues to reveal the real gender identities of the participants. For example:

Pretty mama (female): I got a freezer full of meat gift from friend, wow pretty mama gonna put on weight☹.
Tweaky (female): I gotta go, seeing Harry Potter tonight with hubby.
Savea Turkey Eata Bunny (female): sorry what did I miss? hubby called lol.

What is Different from Face-To-Face Communication All the results found above show that the interaction between women and men is a reduplication of the real-life face-to-face communication. But, I still find one phenomenon which is opposite to the real-life situation that is the response and attitude of women in responding to sexual harassment. As we know, in real life women are more likely to keep silent when they are faced by sexual harassment.

However, thanks to the anonymity provided by the Internet, this time women tend to be much braver to beat back the offensive action from men by using even more dirty and profane language in reply. The lack of physical appearance in communication can allow them to make bold statements without having to worry about how their gestures or voice might falsely render them.

39.4 Discussion

It is clear from the analysis of the messages posted by women and men when communicating online that the Internet has not managed to neutralize gender, on the contrary, it appears to be a version of which exist in real life—the language features of women and men and still "gendered". The previous "old" theories of gender styles in face-to-face communication can be still applied to the online communication based on the new media Internet, which also has component of gender and is not a completely egalitarian space.

The results presented indicate that it is impossible to create an identity in cyberspace without having one's true identity, and it unavoidably duplicates what currently take place in everyday life. Since it reflects our social values a whole, and as gender bias does exist in the broader culture, the gender bias surely exists in cyberspace. Thus, it just reflects both the negative and positive qualities within the individuals and cultures.

As we know, women and men have different "culture" of communication which they learned as they grow up. They are taught to behave appropriately what suit their gender. They naturally value different kinds of online interactions as appropriate and desirable when they communicate with each other online. Thus when it comes to chat online, they just use the already given culture to "run" the new way of communication in this territory. Understandably, what emerges in online communication is just the continuation of what take place in the present practices of communication in real everyday life. The language features of the two genders are formed gradually in the thousands of daily conversations, and at the mean time it also gradually shaping the new culture of cyberspace.

In chat room, the feature of women's language remains less direct, avoiding arguments, while men are focusing on exhibition of their knowledge and skill. It is also because of their different concept and purpose of communication, as Holmes (1995) states: most women regard talking as an important means of keeping in touch with friends and them use language to establish, nurture, and develop personal relationships. Men tend to see language more as a tool for obtaining and conveying information. Thus, when it comes to communicate online, women still seeks to share their own experience, they reveal a lot of their personal information, and they still speak a language of intimacy and stress support within their specific online community.

However, we should admit that besides being a version of face-to-face communication, to a certain extent, Internet does help to make women more

"powerful". As analyzed above in "what is different from face-to-face communication", sexual harassment also exists in cyberspace, which could be seen as a tactic used by some men to drive women away from the chance of being in the favorable position in communication, to draw back from the Internet affairs. But women failed this plan by posting similar insulting words in reply. The anonymous communication of Internet can play an important role of protecting women from violation of politeness from men in a profoundly new way.

39.5 Conclusion

After the analysis and discussion of women's and men's language features when chatting online, I may safely come to a conclusion that though the Internet is absent of physical and social status cues, which is supposed to improve the state of gender issues, gender does not really disappear. In my study, the language features and the way of communication between women and men turn to be a version of the face-to-face communication. In other word, it duplicates what currently take place in conversations of real life.

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Part IV
Information Security and Network Protection

Chapter 40
A Tibetan and Uygur Sensitive Word Tracking System

Xiaodong Yan, Xiaobing Zhao and Guosheng Yang

Abstract "Sensitive words" are the terms, certain words, and other bad words which are restricted to be used by the state or institutions. Here, we built a Tibetan and Uygur sensitive word tracking system, in it we first built a sensitive word vocabulary and classified the sensitive words. Then in order to track Tibetan and Uygur sensitive word effectively, we tried to search sensitive word on Web based on the sensitive word vocabulary. According to the search results, we have found the high focused sensitive words on Web, so these words are those we will track next. In our track system, we adopted a new link analysis algorithm to track high usage frequency Tibetan, Uygur sensitive word. From the experiments, we can see that it has effective performance.

Keywords Sensitive words · Classify · Topic tracking

40.1 Introduction

Sensitive information refers to a variety of text or video, audio information, such as the company's trade secrets, the country's political and military secrets, and personal privacy of users of information, and so on, which do harm to the interests of country and people. "Sensitive words" are the terms, certain words, and other bad words which are restricted by the state or institutions. Sensitive words include politically sensitive terms, confidential information, curse of the original words, dialect, bandits, then black or yellow information-sensitive words, and so on [1].

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For the text on the network, for the different forums or different games, there are different sensitive words. Such as a word of this forum is sensitive to the word of a sentence, but it is not sensitive in other places. Such as plug-in, winning, administrators, and other information are all sensitive words in network games. If you input these words, they all show ***, but these words are all in normal vocabulary in the general QQ chat or e-mail.

In this paper, relying on the support of National Science and Technology Project, we did a great deal of statistics and analysis on Tibetan, Uygur commonly used sensitive words and built Tibetan, Uygur sensitive word vocabulary. In it, we classified the sensitive words and defined sensitive degree level. We also achieved a Tibetan, Uygur sensitive word tracking system.

Web information searching based on the sensitive vocabulary helps us retrieve sensitive information in the network effectively and determine whether there exists any sensitive information we focused in media information. By this, we can find sensitive information data and monitor on sensitive information.

40.2 Real-Time Building, Enlarging, and Tracking for Sensitive Word Vocabulary

40.2.1 The Establishment of a Static Vocabulary

According to need of the project, we have established a Tibetan, Uygur sensitive word vocabulary. This vocabulary is a kind of computerized vocabulary. In it, the information is stored in the computer and it takes word as its basic unit for standardization. It can provide specifications for word processing. There are two kinds of vocabulary; basic vocabulary and professional vocabulary in general. And sensitive information vocabulary is a kind of professional vocabularies, mainly used to store secret information of users and it is also used for users to query and provide the original data for acquisition system and local search. This Tibetan, Uyghur vocabulary is based on a static basis, but it can also provide real-time dynamic updates on the vocabulary. Static part of the basic vocabulary is built according to the commonly used sensitive words, for example, words on political, yellow, weapons as well as other commonly used illegal advertising class sensitive words. The static vocabulary is the keyword vocabulary and the words in it are manually added and deleted. The dynamic updating of the words is done by the real-time system to achieve. Figure 40.1 shows the structure of the sensitive word vocabulary.

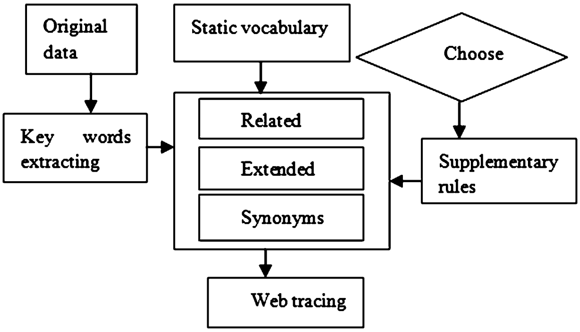

Fig. 40.1 The structure of the sensitive word vocabulary

40.2.2 The Specification of Sensitive Degree

As there are a wide range of sensitive words and it is not easy to define them. Usually, there are four kinds of sensitive words, namely: lifestyle, violence, political, yellow. We use a detailed classification of static sensitive words and define the sensitivity of sensitive words nine degrees, from one to nine representing form low sensitivity to high sensitivity. They are: name of leaders (one), speech blockade (two), bad language (three), sensitive current affairs (four), vulgar porn (five), military weapons (six), regional ethnic (seven), advertising garbage (eight), illegal information (nine).

40.2.3 Extended Sensitive Word Vocabulary

According to the current network characteristics of the language, some sensitive words will appear in changed form. Compared to Chinese, the Tibetan and Uighur are all phonetic system. Some change characters will not be in them as well as Chinese, but there are also changes in terms in the Tibetan and Uighur. Thus, the expansion sensitive word vocabulary is used to store some special forms of sensitive words. Each form of expression is generated by a set of rule. We design the following three main rules:

1. Special symbols are inserted: Some special symbols are inserted in the sensitive words, such as སྙི་བདེ་$ལམ་ཁྲངས་.
2. English is used to express the sensitive words: English translation of sensitive words.
3. Synonyms: there are words with similar meaning. For example, Uighur language: تېز and ئىتتىك (fast), كۆڭۈل and دىل (heart).

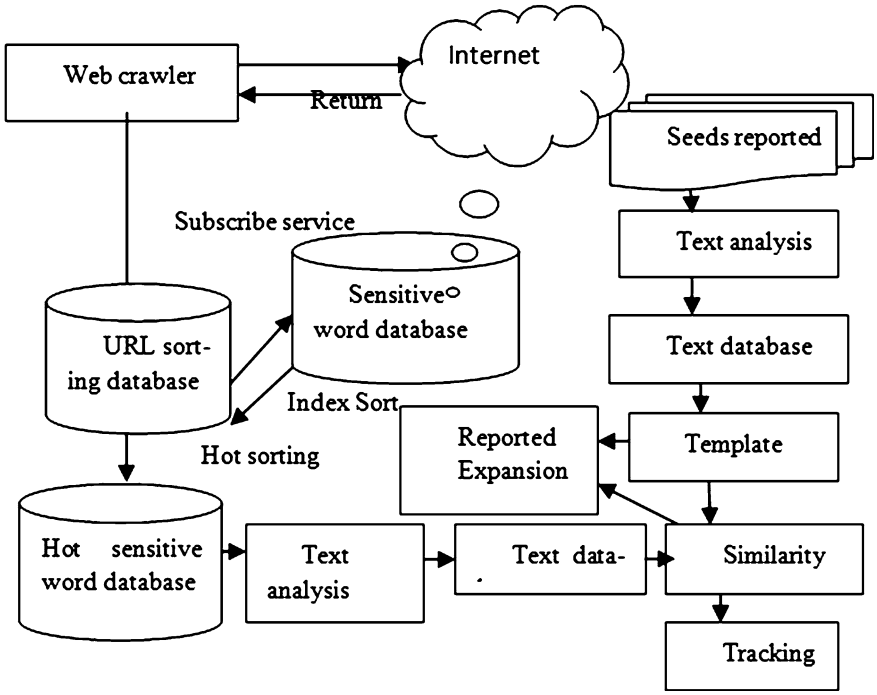

Fig. 40.2 The structure of the sensitive word vocabulary

40.3 Tracking System

We would have to build tracking system to search websites for concerned sensitive word in order to find relevant websites, sort hot words and track sensitive words. By this, we can find out the usage and focus circumstances of the sensitive words. The tracking method is not only a simple keyword search, but also a topic track [2, 3]. We would design and develop a search engine for sensitive words searching on www, which has the following features [4, 5]:

1. Collecting Tibetan/Uyghur sensitive information resources.
2. Marking and indexing the collected information resources to extract useful information for searching.
3. Sorting the sensitive words according to the hot degree.
4. Tacking the high hot sensitive words.
5. The system can run cross-platform.

System design structure as shown in Fig. 40.2:

The difficulty in the detecting and tracking system architecture is how to achieve the tracking words, because we need to track specific sensitive word for the individual topics. It is also said sensitive topic tracking. Topic tracking is to

find out the relevant reports and topic according to one or more topic of a given report. From the definition of topic tracking, we find that there are two steps in it: first, there are a set of seeds reported, then they are trained and a topic model is achieved. Then, we can find all reports which are about target topics. In order to achieve tracking topics, we can use information retrieval technology, it includes the following steps:

1. Building the tracking and tracing items of current topic from the seeds reports;
2. Comparing the new document in reports with the tracking and tracing items by use of algorithm;
3. If they are similar, we should mark it in the sequent tracking process to make the topic relevant identification;
4. We can use the report expand algorithm to obtain new topic model;
5. By use of the model which is obtained by training, we repeat steps 1–3;
6. Tracking the relevant reports regarding the topic clues.

40.3.1 Weights Calculation

In order to achieve a better topic tracking, we adopt a classification method to calculate weight in vector space model. The importance of feature words is measured by the grade of the words. In this method, the title and content and the first line of the text are all considered to be the first level. The appearing sequence of the sentence in text is the level of the sentence. The later the sentence appears, the smaller the value of the word in the sentence has. If a feature t appears n times in reports, then the rating score of t is calculated as follows:

$$rt(t) = \sum_{k=1}^{m} \frac{1}{2^{\ln t_k}} \tag{40.1}$$

40.3.2 Similarity Calculation Method

The ratio of the weights of reported and topic model intersection parts with the sum the weights of reported and topic model is the document similarity [6]. For example, X, Y is the word sets of two characteristics, and then the weight of similarity (RWS) is:

$$RWS(X,Y) = \frac{\sum_{k=1}^{|x||y|} rs(t_k) * IDF(t_k)}{\sum_{j=1}^{|x|} rj(t_j) * IDF(t_j) + \sum_{l=1}^{|x|} rt(t_l) * IDF(t_l)} \tag{40.2}$$

40.3.3 The Introduction of Link Analysis Method

Link analysis, also known as structural analysis, its basic idea is from the citation ranking method, which is based on the assumption that: page 1 is pointing to page 2 by hyperlink, then page 1 and page 2 are related and page 2 is the noteworthy page for page 1. This assumption is applied to topic tracking: a report is linked to report d, and then usually d is revenant to this report.

We use pointing score calculation method such as Eq. 40.3, in which PS (A) is the score of page A. RWS (Ti) is the content similarity value of page Ti which is pointing to page A and given topic. D is the relevant factor [7].

$$PS(A) = d(RWS(T1) + RWS(T2) + \cdots + RWS(Tn)) \tag{40.3}$$

40.3.4 Topic Tracking Algorithm

The importance of Topic Tracking is to determine whether the new report is a related topic or not. We processed it in the following steps [8]:

1. Calculating content similarity.
2. Comparing the similarity with the threshold, if it is greater than the threshold, we will consider it as the relevant report and execute step 3. If less than the threshold we will start processing the next report.
3. Extracting links according to the target text, deleting the links which are not in the set of Web pages, adding PS scores for the pages which are pointed by this links.

When all reports are processed according to the above steps, adding PS scores operation is completed, too. PS (d) is equal to the value calculated by Eq. 40.3. Finally, each report content similarity and PS are summed to determine the relevant reports of which final score are greater than the threshold, and then these reports are output.

40.4 Conclusion

We studied how to design Tibetan, Uygur sensitive word vocabulary and developed a tracking system on it. In this tracking system, we tracked high usage frequency Tibetan, Uygur sensitive word.

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Chapter 41
Intrusion Detection System Model Based on CGA

Zongjiang Wang and Xiaobo Li

Abstract In the face of the growing network security, intrusion detection system, and the traditional shortcomings of more and more prominent. It is the false alarm rate, missed alarm rate, and the problem of poor real-time has not been resolved. In this paper, the lack of it, will make a concerted genetic algorithm combined with intrusion detection systems, designed a co-evolutionary genetic algorithm-based intrusion detection system model, it is great to make up for the lack of intrusion detection system now. I use a specific simulation experiments show the usefulness of this model in the final.

Keywords Genetic algorithm · Collaboration · Intrusion detection system · Model

41.1 Paper Background

With the development of high-speed networks, data packet transmission rate more quickly, which requires detection of intrusion detection system must be a corresponding increase in response speed, and accuracy should likewise increase. However, whether misuse or anomaly detection technology, all data are necessary features of the library with a large number of models to compare, so the efficiency

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of the two is not high. So how to improve the accuracy of intrusion detection system and rapid response has become a reality.

41.2 Collaborative Genetic Algorithms

41.2.1 Introduction Genetic Algorithm

Genetic algorithm is a fitness function based on genetic manipulation imposed by the individual groups of individuals within populations restructuring to achieve the iterative process. Genetic algorithm involved five major factors: parameter coding, initial population configuration, the design of fitness function, genetic operators and algorithm control of the design parameters set.

41.2.2 Collaborative Genetic Algorithm

In this paper, it is the co-evolutionary genetic algorithm (CGA); it is the difference between common genetic algorithms: co-evolutionary algorithm the population is divided into several sub-species, by sub-populations are independent and mutually constraining the evolution to achieve with the evolution of all sub-populations, so the need for species identification, coding, fitness function, genetic operators to re-consider. Collaborative genetic algorithm and the general genetic algorithm is the same as the computing process, but also code to calculate the fitness value, genetic manipulation. The basic idea of CGA is to [1]: First of all complex systems will be optimized variables grouped into several less variable optimization problems; then many fewer variables were coded system, the formation of multiple independent sub-populations, each sub-population of independent evolution. As a single sub-population of individuals represent only a part of a complex system, so individual fitness assessments for other sub-populations must use the individual information, known as the generation of table individuals. Optimization system that is to be a complete solution set by the representatives of each sub-populations of individuals, each sub-population of only cooperate with each other to complete the optimization task. We often choose the current best individual as the representative on behalf of individual species. It is assumed that the optimization of complex issues to be formed two separate sub-populations; named population and test solution were known species.

Collaborative Genetic Algorithm can be described as follows [2]:

Step 1. Initialization, generate an initial solution population and test population.
Step 2. Initial solution by the fitness of individuals randomly selected individuals meet the n-number of test calculations, contrary to test the fitness of individuals randomly selected populations n Solutions to calculate the number of violations.

Step 3. From the two populations were randomly selected. Paired individuals, and arrange face. In each encounter, such as the solution is consistent with the individual situation, it would increase the fitness of 1, 0 otherwise. The calculation of individual fitness tests just the opposite.
Step 4. Selection of the solution population is poor, mutation operation to produce the next generation of solution population.
Step 5. If stopping criterion, the end of the output is the best individual. Otherwise, turn Step 3.

41.2.3 Research Method and Implementation Steps

First of all, the intrusion detection features of the rules of the library as a solution species, feature library rules have been a more optimal rules, Then the host or network from data collected as a test species, through CGA, co-evolution of two populations of data, can achieve fast response, but also to update the rules evolved to the rule base [3]. To show that this species is used to test pre-processing and classification with the good features of the library rules and similar data, it is possible intrusion.

41.3 Intrusion Detection System Model

41.3.1 The Basic Framework of the Model

In order to CGA better applied to intrusion detection systems go, this is designed based CGA model of intrusion detection systems, mainly for the application of collaborative genetic algorithm for modular design. From the functional point of view based intrusion detection system is divided into the four modules: detection module, database module, responding module and control center, shown in Fig. 41.1.

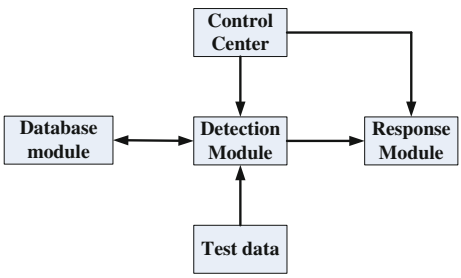

Fig. 41.1 Structure of intrusion detection system module

First, the control center to respond to the detection module and control module, detection module placed in the need to protect the network segment on the test data in real-time intrusion detection. If the detection module found "exception" to respond directly trigger module; and also update the database of rules. Response detection module test results in accordance with the implementation of appropriate response strategies [4]. Administrators can control the center of the user interface for system configuration and maintenance. Of course, in addition to these four modules, system operation can not be separated intelligence module, the application of collaborative genetic algorithms.

41.3.2 Intrusion Detection System Model Based on CGA

In the above-mentioned intrusion detection system architecture is based on the use of collaborative genetic algorithm with intelligent modules. System model described in detail the workflow. First of all, from the host or network, the data collected, preprocessed, and then to detect whether there has been invasion, and then on the test results using data mining techniques, classification and characteristics of library rules out a similar rule, then algorithm is used, you can timely response to the invasion, but also draw more optimized than the previous rules, adding features of the library [1, 2]. CGA-based intrusion detection system model for the whole of the components, detection and analysis module and optimization module is one of the key parts of the core, when they find intrusion; the control center will send real-time alarm information, then a combination of CGA optimization feature library, where the focus is the application of CGA includes the optimization module. In Fig. 41.1, it is based on evolutionary genetic algorithm combined with the design of a CGA-based Intrusion Detection System. System model shown in Fig. 41.2, contains the modules are: preprocessing module, detection module, intrusion response module, category module, CGA optimization module. CGA-based intrusion detection system model, the components division of labor worked together to accomplish system tasks.

1. *Pre-processing module.* As from the network or host to a large number of data collection is complicated and messy, and so conducive to intrusion detection module for the detection work, the system before the data packets on the received pretreatment. The pretreatment includes: useful data suggested that the network protocol decode the data and host data classification and so on. On the one hand the invasion of information can be found, on the other hand to prepare for the test analysis module.
2. *Detection analysis module.* As the use of co-evolutionary algorithm is to optimize the characteristics of the rule base, so pre-processing module detection analysis module of the data submitted, it is matching algorithms and the use of common rules in the rule base a comparative analysis to determine whether the intrusion.

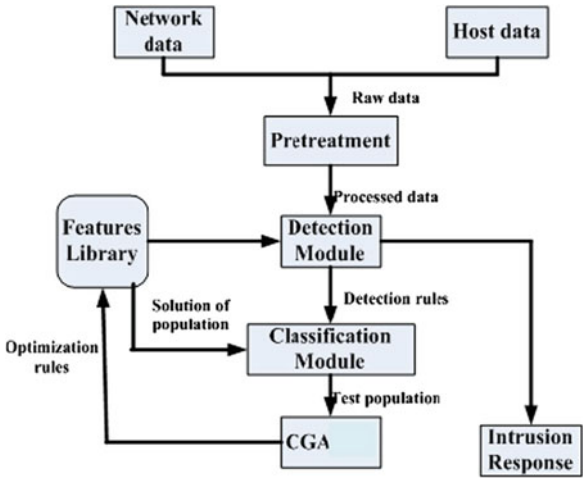

Fig. 41.2 Intrusion detection system model based on CGA

3. *The intrusion response module.* Of the detected intrusion alarm timely response, and later co-evolutionary algorithm derived by the type of response to the invasion, the invasion of different types can make a different response to the invasion.
4. *Classification module.* Classification algorithm used to detect intrusion data classification, the main population for the optimization of test modules, while in the feature library to find the similar rules to provide solution for the optimization of module populations.
5. *CGA from the optimization module.* Use of test solution population and populations of co-evolution, and produce optimal population, the type of timely response to the invasion, and to optimize the rules more features added to the library.

41.3.3 System Features

Genetic algorithm-based intrusion detection system, in addition to good to genetic algorithm is applied to them to go outside, but also reflect the characteristics of the genetic algorithm; CGA is the co-evolution through a variety of groups to achieve common optimization. Feature library in the optimization process, it has been used to detect the invasion of rules, and rules to detect intrusion code. Then with the characteristics of library rules apply genetic algorithm to achieve the characteristics of the library to optimize the rules. The main features of the system are:

- Intelligence is good, high degree of automation, due to the genetic algorithm can automatically optimize the characteristics of library rules, thus reducing human

involvement, to reduce the burden of the intrusion detection analyst, but also to improve the detection accuracy.

- Timely response to intrusion detection system after the invasion characteristics of library rules and rules similar to co-evolution, which can invade the invasion of the type of timely response, and the rules of the new features added to the library go.
- Since the optimization of, the intrusion detection system, the characteristics of the library will have a direct bearing on the efficiency and accuracy of detection, current intrusion detection system, feature library are mostly hand-coded based on expert knowledge, it is difficult to produce comparison of optimization rules. The system combines evolutionary genetic algorithm, feature library updated in real time rules, to detect an attack could be related to a co-evolution, resulting in more optimized rules and added features of the library.
- Detection efficiency, low false, precisely because of CGA optimization feature library, improve the quality of rules, which can improve the matching accuracy and can reduce the matching time.

41.4 System Simulation Model

In this paper, it is from the MIT Lincoln Laboratory 1998 DARPA [2] intrusion detection evaluation program data sets of experimental data. Currently, 1998 DARRA data are widely used in intrusion detection system evaluation, a total of 494,021 connections recorded 20 different types of network attacks, and there are nine network eager values. Here in the genetic algorithm to consider six kinds of network features, which are connection time, protocol type, source address, destination address, source IP addresses, IP addresses purpose, and to Dos in the Back and Probe Case of Ipsweep experiment.

This article uses the software environment for the Windows xp operating system, SQLserver 2000 database, and C language test. In the experiment, select two sets of data, a group of select 1000 records, with a general genetic algorithm to form a feature database, the other group used as a test species selection, Back intrusion choice of which 340 records, Ipsweep intrusion select 360 records. To $= 0.8$, $n = 50$. For IDS, the evaluation of its argument that many, including CDR (correct detection rate) is an important measure of IDS performance, is mainly reflected in the FNR (false negative rate) and FPR (false positive rate). Here are a few evaluation parameters:

Detection rate = correct number of detected intrusion events/total number of intrusion events $\times$ 100 %;

False positive rate = false alarm number of events/total number of normal events $\times$ 100 %;

False negative rate = not detected intrusion event number/total number of intrusion events × 100 %;

Experimental steps: First, using ordinary genetic algorithm to form feature library, detect intrusion test population can reach a detection rate, then, use the CGA, on the characteristics of library rules (solution species) and the evolution of a test populations, The optimized rule added to the feature library, and then a second test, then repeat the above steps, evolutionary three. Experimental procedure is shown in Fig. 41.3.

The results are shown in Table 41.1. You can see, the second evolved, the detection rate is significantly improved, while the FPR of decline, While the third time evolution, the effect did not evolve much better than the second, but the

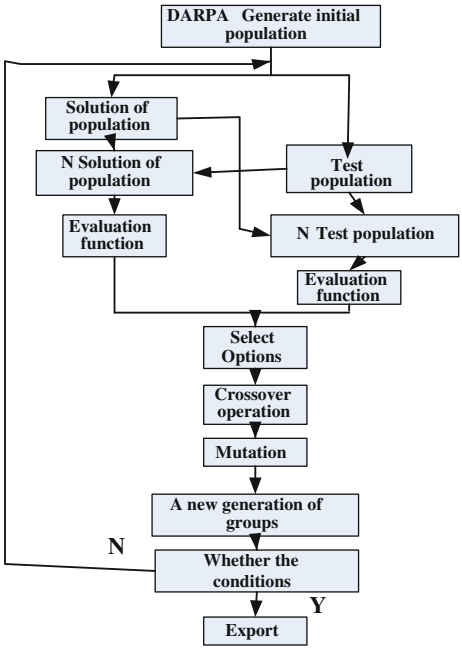

Fig. 41.3 The experimental flow chart

Table 41.1 Experimental results

Type	Record number	General genetic algorithm		The first evolution		The second evolution		The third evolution	
		Detection rate (%)	False alarm rate (%)	Detection rate (%)	False alarm (%)	Detection rate (%)	False alarm (%)	Detection rate (%)	False alarm (%)
Back	340	92.3	0.9	92.2	0.8	96.6	0.5	95.9	0.7
IPsweep	360	88.9	0.6	88	0.5	93.8	0.3	92.6	0.6

overall trend is improving. Therefore, after CGA to improve intrusion detection system will continuously update the features of the library rule set, and constantly improve the rule quality, and thus able to continuously improve the detection rate and reduce false alarm rate.

41.5 Conclusion

This paper first the CGA to intrusion detection systems specific to the proposed CGA-based intrusion detection system model, and analyze the main features of the model, and analyzed by simulation performance of the system.

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Chapter 42
Research on Risk of Knowledge Sharing Based on Risk Assessment and Energy Analysis

Bingfeng Liu

Abstract This paper analyzes the related literature at home and abroad, dividing different risk types and its origin of knowledge sharing, focus on the risk assessment of knowledge sharing, discusses the risk energy model of knowledge sharing. Research shows that the risk of knowledge sharing is one kind phenomenon which generates, exist and change in the exchange process of material and energy between system and environment. The source of knowledge sharing risk can be summed up in the fuzziness of knowledge, the knowledge dependence of information asymmetry and opportunism and core competence. Only the benefits outweighed the losses, the knowledge sharing will occur. When the energy of cumulative risk reaches a certain level, risk will happen; inevitable produces a certain loss, even influence the normal operation of knowledge cooperation.

Keywords Knowledge sharing · Risk management · Risk assessment · Risk energy

42.1 Introduction

Christopher Marrison [1] put forward, risk management is the all endeavors that the enterprise or the organization for control of accidental loss risk, to preserve profitability and asset. Williams and Heins [2] believe that risk management is the management methods that through risk identification, measurement and control

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risks at the lowest cost to the loss caused by a variety of risks process to minimize. Rosenbloom [3] pointed out that risk management is a kind of method that process pure risks and decide the best management technology. Study of modern risk theory is closely related to risk management theory, substantive research of risk and risk management began in the early twentieth century. In the 1930s, driven by global economic crisis and quantitative economics development, enterprises pay attention to risk prevention, meanwhile, appear to risk type enterprise that study risk occurs characteristics and possibilities, such as insurance enterprises. During the same period appeared basic theory and methods of risk type enterprise operation, such as insurance actuarial science, expect utility theory, risk theory [4].

To the 1980s, with technology innovation fund and globalization market appears with formation, except insurance, securities, Banks and other traditional venture enterprises outside, risk effective manage of other type enterprise are growing demand, makes the economy system risk definition occurs fundamental change, enterprise range of risk management from pure disaster prevention expanded to the business process. In the research of knowledge sharing risk, Zhao [5] think, the risk of knowledge sharing from the fuzziness of knowledge, information symmetry, opportunism and the knowledge dependence of the core competence. Tong [6] through empirical analysis found that the enterprise on inter-organization knowledge flow exist in the management of many doubts, one of the most afraid of is technical knowledge of the disclosure. Because the knowledge fuzziness, information asymmetry and the opportunism existence and the knowledge dependence of core competence, the influence of sharing enterprise self-owned knowledge could be damaging to the core competence of enterprises, make its organizational core knowledge leak lead to intellectual property rights disputes or competitive advantage loss; or knowledge protection excessive makes up knowledge sharing inefficient, brought the big risk to participate in the knowledge sharing organization.

Knowledge sharing risk is a difficult problem of modeling and analysis, current study though gives some measures to prevent risks, but in-depth research was relatively less. From the view of information theory analysis, because the Knowledge sharing risk has high-dimensional feature and policy-makers can obtain information incomplete. Domino theory is in two main ways to observation the risk reduced-order, the first is to reduce to analysis the risk factors quantity, and the second is to simplify the relationship between risk factors. Energy release theory is based on individual risk factors reduced-order and achieves to observation the risk reduced-order. The two theories were observed in limited dimension of risk, and present two different dimension reduction strategies.

The goal based on the analysis of the risk energy is to find a way to describe the risk characteristics and dimensions of the basic amount is not high, so as to minimize the dimensions of risk factors for the purpose. According to the system view, this paper argues that the risk of knowledge sharing is one kind phenomenon of generation and existence and change in the process of material and energy exchange produces in system and environment.

42.2 Types and its Origin of Knowledge Sharing Risk

42.2.1 Risk Types

As is known to all, profit and risk is equivalence. Want to obtain higher income, its risks borne will be bigger, therefore, the knowledge sharing should strictly control the risks, reduce the rate of failure, risk control is important aspect of knowledge sharing. As shown in Table 42.1, according to different criteria, we can be Knowledge sharing risk is divided into the following categories:

From the knowledge sharing extent we can be divided into the risks deficiency and excess two kinds of risks. Knowledge sharing deficiency can lead to share the effect not beautiful, excessive sharing is making knowledge sender suffer not due loss or premature exit cooperation. From the knowledge sharing risk consequences or performance forms, can be divided into knowledge sharing performance risks, risks and core ability to lose relationship risk. Performance risk refers to the knowledge sharing revenue failed to reach its targets set expectations in advance. Knowledge sharing behavior inevitably involve the enterprise's core competence protection problems, some partner often in knowledge sharing in the process, excessive absorb the other side of knowledge, the question the opportunism behavior processes improper, easy cause relationship risk and core ability to lose risk. From the knowledge sharing sources of risk, can be divided into the enterprises produces different knowledge itself characteristics of risk, enterprises organization causes of risk and risk of knowledge sharing environment produce. As mentioned above analysis, enterprises itself participation of knowledge sharing knowledge characteristics are obviously different. It's very easy to produce sharing risk. Knowledge sharing were enjoying environmental impact is very clear. Knowledge sharing from the subject can be divided into knowledge sharing integral of the risks and knowledge sharing members of the enterprise of the risks. Knowledge sharing is a dynamic process, in which the enterprises only unify the part of the function and knowledge sharing relates in together, correspondingly enterprises only obtain some of these gains. By returns and risks of the correspondence and coexistence, enterprises only partly share the risks. The co-construction and sharing of partial often assume overall risk entity; enterprises share some of the risks.

Table 42.1 Classifications on knowledge sharing risk

Classification standard	Risk categories
Knowledge sharing degree	Knowledge sharing knowledge sharing insufficient risk, excessive risk
Risk consequences	Performance risk, relationship risk, core knowledge loss risk
Risk source	Knowledge itself risk, organizing risk, environmental risks
Risk subject	Cooperative overall risk, enterprise risk

42.2.2 Causes of Risk

The reason caused risk is varied, reasonable to its classification and rationalize causality, make it's appear more structured, also more easy to control. In the co-operative, knowledge sharing risk causes can be summed up in the fuzziness of knowledge, information asymmetry and opportunism and core competence of the knowledge dependence, as detailed below.

42.2.2.1 Fuzziness of Knowledge

According to the above the classification, knowledge can be divided into the explicit knowledge and tacit knowledge. Tacit knowledge in knowledge system in proportion, the greater the knowledge of fuzziness is stronger. Knowledge of fuzziness makes knowledge sharing process with viscosity; especially the knowledge sharing in, this kind of viscous knowledge is often dependent on the environment. If not dispose of the ambiguous question of knowledge, it is difficult to eliminate the uncertainty of sharing, knowledge sharing over the greater the likelihood of the risk.

42.2.2.2 Information Asymmetry and Opportunism

In the knowledge sharing as the primary motive industry-academy speaking, the information asymmetry and contract incompleteness phenomenon has increased the opportunism behavior exist probability.

42.2.2.3 Knowledge Dependence of Organize the Core Competence

Ability to hide behind the organization and decided to organize a competitive advantage is the key to organizational knowledge, in particular, is very difficult to imitate by competitors and with the knowledge and tacit knowledge is closely related to ability to learn. Core competence is to make the organization unique competitive advantage for the organization of knowledge. However, core competencies cannot be imitated is not difficult to imitate, the stronger the organizational core competencies, its partners, the stronger the motivation to learn the knowledge, the knowledge the greater the risk of over-sharing.

42.3 Risk Assessment and its Energy Model of Knowledge Sharing Risk

42.3.1 Risk Assessment

Enterprises participation knowledge sharing directly obtained by the profit set as U_v, enterprises from its partners after learning knowledge by enhancing playmaker capacity and the income gained set to U_c, and enterprises participation in knowledge sharing may suffer losses are set to U_l, obviously, when $U_v + U_c > U_l$, knowledge sharing occurs, which is involved in constraint.

Assuming the performance and sharing of knowledge sharing X relevant with knowledge value transformation coefficient K, and the coefficient is constant, that is, $U_A = KX, U_A$ for knowledge sharing all income, $X = X_1 + X_2 + \cdots + X_i, i = 1, 2, \ldots, N$.

Among them, the number of N said cooperative members, X_i said the members i contribution, of course, the knowledge of contribution different members of the proportion is different; the distribution of interests is calculated according to the contribution ratio, $U_{vi} = KX_i$.

If the profits of the enterprises study knowledge also only relevant with the knowledge and knowledge value transformation coefficient λ, namely, $U_{ci} = \lambda Y_i, Y_i$ says the agency i from other than oneself outside of organizational learning knowledge.

Assuming the loss of knowledge sharing and the extent relevant with knowledge value transformation coefficient μ, then $U_{li} = \mu X_i$.

Therefore above equation can be expressed as $KX_i + \lambda Y_i > \mu X_i$ or $K + \lambda Y_i / X_i > \mu$.

Can be K, λ, μ as a fixed value, from the above inequality can see, enterprises whether to launch from Shared knowledge sharing and absorb the knowledge and their contribution to the related knowledge proportion. Of course, we can consider income uncertainty and enterprises to risk of different preferences and will letters into the utility function. Meanwhile, enterprises in determining cooperation, the inevitable means losing participate in another to share the may the benefits.

Therefore, in the risk assessment of knowledge, only considering joining constraint is not comprehensive, consider incentive compatible constraint, namely to join a shared earnings should not be placed to join another cooperation benefits. Can send above inequality expanded into this form:

$$U_v + U_c - U_l > U'_v + U'_c - U'_l \tag{42.1}$$

The right of inequality (42.1) said gain or loss with joining other cooperative organizations. After in these goals and determinative conditions be determined, can build to evaluate decision-making function model of the knowledge sharing degree.

$$\begin{array}{l} Max \quad U_v + U_c - U_l \, S.t.(IC) \\ U_v + U_c - U_l > U'_v + U'_c - U'_l(IR) \;\; U_v + U_c > U_l \end{array} \tag{42.2}$$

By using the model, we may to carry on the weight about Knowledge sharing risk, to help us to whether to launch the knowledge sharing decisions [7].

42.3.2 Energy Model of Knowledge Sharing Risk

In risk study, few people study risk energy, knowledge sharing risk energy very low, also won't form a loss the truth, but there exist certain degree the possibility of loss. Or even if occurrence loss, but recipients can afford the risk, do not affect the normal operation of the knowledge cooperation. When a cumulative risk of energy reaches a certain level, risk will happen; inevitable meeting produces a certain loss, even influence knowledge cooperation in normal operation.

42.3.2.1 Physical Quantities of Risk Conduction

Risk conduction speed (V): a speed that potential risks through a risk to bear body, the unit is $1/d$. If the risk is not appeared, the project has been finished, the risk disappeared. But system inside and outside the other risks will with the original risk interaction, will increase or reduce its spread speed. When risk in risk nodes are large, and the system and unable to bear, is risk will become a loss into reality. Risk spread faster, the risk of not easy absorption and digestion, vice versa [8].

Risk transmission flow (Q): every day by risk to bear the risk of body and said it every day with financing volume how much loss may appear, the unit: yuan/day. Obviously more flux, dissolve and digested difficulty are bigger.

The risk loss difference value ratio (P) : the ratio of real risk loss value and the anticipated risk lose the differential value accounts for the anticipated risk loss value ratio (%). The P value is bigger, then the risk is bigger.

Dissolve coefficient (r): the coefficient of digestion in the system and risks reduce; when $r = 1$, original risk within the system operation, no change; when $r < 1$, original risk within the system operation to be amplified; when $r > 1$, original of risk is resolve or reduced. May through the statistical over the years risk fund anticipated loss and the actual loss, to determine the coefficient r.

Risk cycle (T): risk cycle refers to the total time of venture investment project operation, unit: days. Apparently time to grow more, can have a plenty of time to cope with the possible risks, but system inside other risk accumulated the likelihood of. In effective control system in other risks, appropriate extension risks, which is beneficial to the risk cycle. The risk cycle is longer, its total risk shares the daily risk energy to be smaller, the risk heir withstands the risk intensity is lower; the risk cycle is shorter, its total risk shares the daily risk energy to be stronger, the risk heir withstands the risk intensity is bigger.

42.3.2.2 Risk Energy Model

Set risk energy E by the following four parts: the original risk when project activated E_1, project operation process, reduce or growth internal risk E_2, external new risk E_3 and internal increase or decrease risk after the within system running E_4. Computation formula is as follows:

$$\begin{bmatrix} E_1 = tQV^2 \\ E_2 = (1-r)E_1 \\ E_3 = t'Q'V'^2 \\ E_4 = (1-r)E_3 \\ E = E_1 + E_2 + E_3 + E_4 \end{bmatrix} \tag{42.3}$$

In the formula, t, Q, V represents 'time', 'flow', 'velocity' of initial risk, t', Q', V' represents the new risk of cooperation process corresponding to 'time', 'flow', 'velocity'. E_0 is the critical risk energy which in the cooperation process can withstand, may biggest risk loss value statistics determination which can withstand by the former cooperation. $U = E/E_0$ is the risk warning target or the risk intensity, when $U < 0.2$, risk-free, $0.2 < U < 0.4$, acceptable risk, $0.4 < U < 0.6$, have certain risks, $0.6 < U < 0.8$, high alert risk, $0.8 < U < 1.0$, need risks, $1.0 < U < 120$, are converted into unbearable loss, $U > 1.2$, risk risk-drivers unable to bear, potential losses has become the actual loss.

When the risk index is high, the risk factors exist too much, these factors can cause accidents happen sooner or later or loss occurs.

42.4 Conclusions

Because the cross characteristics of the knowledge sharing itself inhered, enterprises although were independent of each other different organizations, as free-riding and opportunism that exists in reality situation, without effective organize and control in knowledge-sharing, there will be difficult to avoid the risks of knowledge sharing. Knowledge sharing control is more difficult than internal organizational knowledge sharing risk control. This paper constructs the knowledge sharing assessment and risk energy model can help cooperative parties effectively reduce risk, promote cooperation efficiency.

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Chapter 43
A Novel Cache Prefetching Algorithm for Restoration Operations of Deduplication Systems

Zhike Zhang, Zejun Jiang, Xiaobin Cai and Chengzhang Peng

Abstract Sharing data chunks and sequentially writing data chunks result in data fragments in deduplication systems, which may degrade the reading throughput of these systems. To improve the reading throughput of deduplication systems, we propose a novel cache prefetching algorithm, referred to as WSP, which can detect weak sequential reading in the read requests of restoration operations and prefetch data for them, unlike the traditional cache prefetching algorithm, which cannot. Experimental results show that, when the cache size is 256 MB, the average cache miss rate of WSP is 77.5 % of that of the traditional cache prefetching algorithm for all 21 workloads.

Keywords Deduplication · Fragmentation · Cache prefetching

43.1 Introduction

Current research on deduplication systems focuses on solving the chunk-lookup disk bottleneck problem to improve the writing throughput, such as Jumbo Store [4], Bloom Filter [9], Sparse Indexing [6], and Extreme Binning [1]. There are also

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some deduplication clusters [2, 3] proposed to provide scalable throughput and capacity. To maximize the writing throughput of deduplication systems, most deduplication systems and deduplication clusters sequentially store new data chunks in disk. The data chunks are organized using chunk containers in the disks. A chunk container is of a fixed size. After one chunk container is full, a new chunk container is created [8].

However, this method of storing data chunks sequentially in log style surely results in data fragments as the deduplication system grows. First, the deduplication system chunks the data stream. It tries to find duplicate chunks from the already stored chunks, and only stores new chunks to the disk. The new chunks are probably not stored adjacent to the duplicate chunks. The data stream is represented by the new chunks and the reference of the duplicate chunks. Thus, the chunks of a file or data stream may become scattered in the disk. Then, when we restore or retrieve a file stored in a deduplication system, a lot of disk seeks may be needed because of the data fragmentation. Thus, data fragments may degrade the reading throughput of a deduplication system.

A cache prefetching algorithm can be used to improve the reading throughput of a deduplication system. The traditional cache prefetching algorithm prefetches the following data blocks when contiguous reading of data blocks is detected. A common reading operation in a deduplication system is restoring one specific backup version of a user. For this kind of reading operation, there are a lot of random reads, even for a single file, because of data fragmentation in the deduplication system. The traditional cache prefetching algorithm is not suitable for this kind of reading operation.

We propose a novel cache prefetching algorithm for restoration operations of deduplication systems, using the access pattern of weak sequential reading. If one page-reading request is the successor of one page already in the cache, weak sequential reading is detected, and cache prefetching happens.

In order to verify our algorithm on different workloads, we collected three realistic datasets. Each dataset represents a different type of workload. The experimental results show that:

The cache miss rate of our algorithm is better than that of the traditional cache prefetching algorithm for all 21 workloads and various cache sizes.

When the cache size is 256 MB, the cache miss rate of our algorithm is on average 77.5 % of that of the traditional cache prefetching algorithm for all 21 workloads.

43.2 Our Method

43.2.1 Architecture

First, we briefly describe one famous deduplication system, Extreme Binning (EB) [1] and show its deduplication process. When a file stream comes into the deduplication system, the files are processed one by one. A file is first chunked by a

general chunking algorithm, based on the Rabin hash algorithm [7]. TTTD [5] is the most popular variable-size chunking algorithm. The mean chunk size is usually 4 KB. Then, the minimum chunk ID of the file is computed. The chunk ID is usually a hash value of the chunk using sha-1 hash function. Extreme Binning uses this minimum chunk ID to find the corresponding bin address from the main index in RAM. Then, it loads the bin from the bin store. New chunk IDs are found and inserted into this loaded bin. After this, the old bin is deleted and this new bin is stored in the bin store. Then, new chunks are stored to the chunk store in the disk. Finally, the file manifest of this file, including all chunk IDs and other metadata, is stored in the file manifest store.

To maximize the writing throughput of the deduplication system, most deduplication systems sequentially store new chunks in the disk, e.g., Bloom Filter [9], Sparse Indexing [6], and Extreme Binning [1]. The chunk store contains a number of chunk containers. Each chunk container contains data chunks and some metadata, including the offset of the chunks and their ownership, etc. A chunk container is usually implemented as one single file. When one chunk container is full, a new chunk container is created. The size of a chunk container is typically 4 GB. After one chunk is stored in the chunk store, the chunk store returns the chunk address. Then, the system saves the chunk address in the file manifest.

When a file is read, first the file manifest is read from the disk, and then the chunks of this file are read from the chunk store according to the chunk addresses in the file manifest. The page addresses of one chunk are computed from the chunk address. We actually read the pages from the disk first and then construct the chunk from the pages. Note that one chunk may span several pages. When we read one chunk, we may need to read several pages from the disk.

43.2.2 Weak Sequential Reading in Restoration Operations in Deduplication

If one page reading request is the successor of a page already in the cache, we call it weak sequential reading. There are a lot of weak sequential readings in restoration operations in deduplication systems because of the sequential writing used and the data fragmentation which occurs. When deduplicating one backup of a user, the deduplication system writes new data chunks sequentially to the disk. Every backup is stored in a contiguous area in the disk. The different backups of one user may be stored in several different areas, one by one, and sequentially stored inside every area. When one backup of a user is read from the disk, the order of page reading requests is the logical order of data in the backup, and may not be sequentially stored in the chunk containers. One page reading request is probably not contiguous with the next page reading request. However, because all areas storing the backup data of one backup of a user need to be read entirely, it is highly probably contiguous with another page reading request in the near future.

The number of areas in which one backup gets scattered is almost the same as the number of that user's backups. We call this access pattern, weak sequential reading. We believe that there are lot of weak sequential readings in the page reading requests of restoration operations, because of data fragmentation and the sequentially stored new chunks. A traditional cache prefetching algorithm only prefetches data when contiguous reading operations happen. Thus, traditional cache prefetching algorithm is not suitable for this access pattern.

Figure 43.1 shows an example of a weak sequential reading, which is common in a deduplication system. Three backups are stored in a deduplication system. The latest backup is restored. We can see that the page read requests for restoring the latest backup are completely random. However, there are several weak sequential readings.

43.2.3 WSP

We propose a novel cache prefetching algorithm for the restoration operations of a deduplication system, using the access pattern of weak sequential reading. If one page reading request is next to one page already in the cache, weak sequential reading is detected, and cache prefetching happens.

When a page reading request comes, we first decide whether this page is in the cache. If it exists in the cache, the requested page is found and nothing happens. If not, we search the previous page address of the requested page address from the cache index. If the previous page address is found in the cache index, which means that the previous page is already in cache, a weak sequential reading is detected and cache prefetching happens. Otherwise, cache prefetching does not happen. The size of the read ahead window is twice as large as the current window. We maintain a cache index in RAM to search a page quickly. The index contains the page addresses and also the sizes of the current window of every page in the cache. When the cache becomes full and also a cache prefetching is called for, we use an LRU cache replacement algorithm to free some pages in the cache.

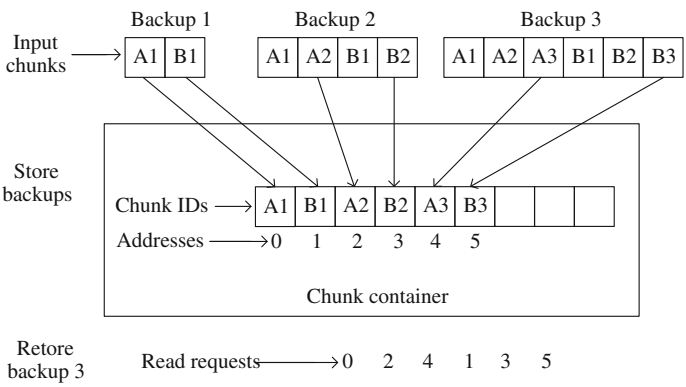

Fig. 43.1 Weak sequential reading in restoration operations of deduplication

Table 43.1 Datasets used in the experiments

Set	Number of files	Size (GB)	Number of unique files
HDup	17669935	4540.209	1034353

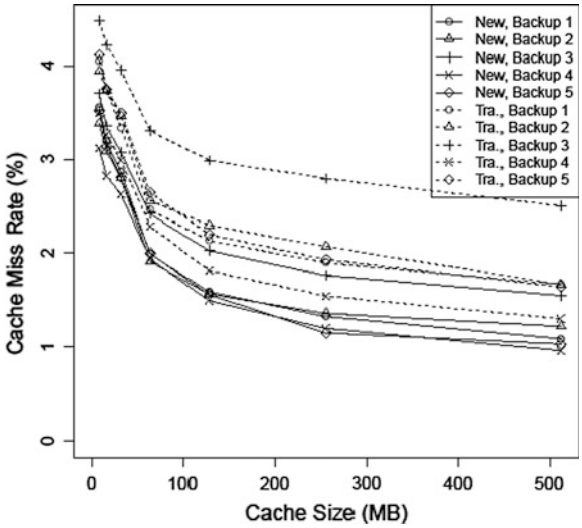

Fig. 43.2 Comparison of the cache miss rates of our cache prefetching algorithm and the traditional cache prefetching algorithm for various workloads. Every workload is one full backup for one single user. We tried various cache sizes (8, 16, 32, 64, 128, 256, 512 MB)

43.3 Evaluation

43.3.1 Datasets

In order to verify our algorithm on real workload, we collected one realistic dataset. The dataset consists of all the full backups and incremental backups taken from 21 engineers for about 30 days, namely HDup. The HDup dataset consists of 162 full backups and 416 incremental backups, and contains much duplication. This is the dataset where we only had information on the chunks, but not direct access to the files. We summarize the size information of the three datasets in Table 43.1.

43.3.2 Comparison of Cache Miss Rates

We used the HDup dataset to compare WSP with the traditional cache prefetching algorithm. This dataset consists of the backups of 21 engineers for a period of 1 month. We restored the last full backup for every engineer in the dataset, and measured the cache miss rates for both algorithms.

Figure 43.2 shows the comparison of cache miss rates for five workloads. It is clear that the cache miss rates of WSP are lower than those of the traditional algorithm. We can also see that as the cache size increases, the cache miss rates for both algorithms decrease too. When the cache size is larger than 256 MB, there is no further significant decrease of the cache miss rates. When the cache size is 256 MB, the average cache miss rate of WSP is 77.5 % of that of the traditional cache prefetching algorithm for all 21 workloads.

43.4 Conclusions

To improve the reading throughput of deduplication systems, we proposed a novel cache prefetching algorithm, namely WSP. WSP can detect weak sequential readings in the read requests of restoration operations, and prefetch data for them. The experimental results show that:

The cache miss rates of WSP are better than those of the traditional cache prefetching algorithm for all 21 workloads and various cache sizes.

When the cache size is 256 MB, the average cache miss rate of WSP is 77.5 % of that of the traditional cache prefetching algorithm for all 21 workloads.

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Chapter 44
Balance Theory-Based Model for Discovering Trust Network

Guangming Yang, Xiangjun Hou, Zhenhua Tan, Liangyu Zhang and Hainan Yu

Abstract Relations among users on social network often reflect a mixture of positive (trust) and negative (distrust) interactions. It is necessary to extract the trust relationships among people and discover a trust network from the complex social network. The trust network can be used to calculate the trust confidence and can infer the trust values among the nodes in it. In this paper, we propose a method to estimate a trust network and it is the first time that the balance theory is applied to solve the problem of discovering trust network. The method makes use of balance theory to estimate the credibility of the relationships among the nodes. First, we analyzed the core content of the balance theory and the similarities with trust network. Then, we proposed the rules of building the trust network, and summarized the process of the implementation. The experiment runs on Epinions data set which consists of more than 130,000 nodes. The experiment results demonstrate that our algorithm performs well in building trust network.

Keywords Trust network · Balance theory · Trust · Distrust

44.1 Introduction

A social network is a set of nodes connected by a set of relationship, such as friendship, affiliation, or information exchange [1, 2]. People in the social network are transferring information every day; they do a lot of interactions. It becomes particularly important to extract the trust relationships among people in the social

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network. Social networks underlying current social media sites often reflect a mixture of positive and negative links. It means each link is created by one user to another, so the networks can be viewed as directed graphs. The trust network can be used to calculate the trust confidence and can infer the trust values between the nodes in it.

The experts have proposed many ways to build trust networks and solve the problem of trust computing. The CONFIDANT protocol [3, 4] is used to calculate the local historical information. Structured by a bidirectional circle topology, the p2p network has a short routing table to record one super node, one successor node, one previous node, and several cache nodes, but it cannot exclude the interference of the spy node [5]. The SUNNY algorithm that uses probabilistic sampling to separately estimates trust information and our confidence in the trust estimate and uses the two values in order to compute an estimate of trust based on only those information sources with the highest confidence estimates [6]. Although it produced more accurate trust estimates than the well-known trust inference algorithm TIDAL TRUST, it still has a lot of problems about the complex network path. Jøsang uses subjective logic to compute trust among arbitrary parties in the network, and proposed an analysis method of trust chains which simplifies the structure of the network to calculate according to the series–parallel networks [7, 8]. However, this method loses lots of trust information and costs too much communication overhead. In addition, there is a paper which describes a context-based trust model [9]. The model computes direct trust basing on the truster's direct or similar recommendation about a trustee with respect to a given context, but it does not compute recommended trust. While we propose to process the nodes first in order to both filter out redundant and useless nodes and to extract nodes with certain requirements from the original network.

In this paper, the main focus of our work here is to examine the interplay between positive and negative links in social network and describe a new method which is based on Hyde's balance theory to build a trust network. We analyzed the basic knowledge of the balance theory. Our algorithm is the first algorithm that applies the balance theory to discover a trust network. We conduct our experiment results on the Epinions data set, the results show that using balance theory to build a trust network performs very well.

44.2 Related Work

The proposed algorithm based on the balance theory in which it views all the relationships as the three edges of a triangle. Next, we define some symbols and notations that will be used to explain the algorithm.

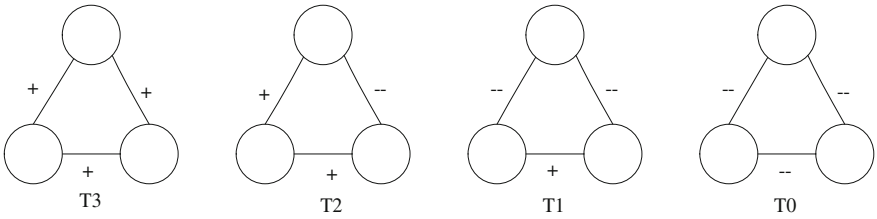

Fig. 44.1 There are four types of triples whose edges are with positive or negative signs

44.2.1 The Balance Theory

The balance theory which originated in social psychology in the mid-twentieth century was formulated by Heider in the 1940s [5, 10]. Each vertex of the triangle has a positive or negative relationship with the other two vertices. To judge the current status of the triangle, we first pick up the signs of the three edges (positive be "1", negative be "−1"), then multiply the three signs. If the result is "1", then the triangle is balanced. Otherwise, the triangle is unbalanced. As is shown in Fig. 44.1, triangles with three positive signs ($T3$) or two negative signs ($T1$) tend to be balance. On the contrary, triangles $T2$ or $T0$ tend to be unbalanced.

44.2.2 Symbols and Formulas

Social network is denoted by S. There are millions of nodes in the social network S; N is the set of the nodes.

Both $S1$ and $S3$ are subnets in which there are nodes satisfying the case $T1$ or $T2$ in Fig. 44.1. For example, taking two nodes n, n' from $S3$, we can find a third node n'' in $S3$ which satisfies that the signs of the edges between these nodes are "+".

In Eq. (44.1), E is an adjacency matrix which is established according to the positive links in the data set. The elements in E represent the edges with a sign of "+". We use exy to describe the elements of the Matrix E, the subscripts of x and y denote the row and the column of the elements. Such as, the element e15 in E indicates that the sign of the edge from node 1 to node 5 is "+" and node 1 trusts node 5.

$$\mathbf{E} = \begin{array}{c} \\ n1 \\ n2 \\ n3 \\ n4 \\ n5 \\ n6 \end{array} \begin{array}{c} \begin{array}{cccccc} n1 & n2 & n3 & n4 & n5 & n6 \end{array} \\ \begin{pmatrix} 1 & & & & 1 & \cdots \\ & 1 & 1 & & & \cdots \\ 1 & 1 & & & 1 & \cdots \\ & & & & & \cdots \\ & 1 & & 1 & 1 & \cdots \\ & & & & 1 & \cdots \\ \vdots & \vdots & \vdots & \vdots & \vdots & \ddots \end{pmatrix} \end{array} \tag{44.1}$$

In Eq. (44.2), E′ is also established according to the negative links in the data set. The elements in E' represent the edges with a sign of "−". We use e′xy to describe the elements of the Matrix E'. For instance, the element $e'21$ in E' indicates that the sign of the edge from node 2 to node 1 is "−" and node 2 distrusts node1.

$$\mathbf{E}' = \begin{array}{c} \\ n1 \\ n2 \\ n3 \\ n4 \\ n5 \\ n6 \\ \vdots \end{array} \begin{array}{c} \begin{array}{cccccc} n1 & n2 & n3 & n4 & n5 & n6 \end{array} \\ \begin{pmatrix} -1 & & & & -1 & \cdots \\ & & & & -1 & \cdots \\ -1 & & & & & \cdots \\ & & & & -1 & \cdots \\ & -1 & & & & \cdots \\ \vdots & \vdots & \vdots & \vdots & \vdots & \ddots \end{pmatrix} \end{array} \tag{44.2}$$

44.3 Algorithm Analysis

The core of the algorithm is to extract the nodes which satisfy balance theory, and then we build a trust network according to the nodes and the relationships between them. Considering of the directions and the signs of the edges, we divided the analysis into two kinds of triples $T1$ and $T3$. We can see by the above description, we need to find out the triples satisfy the rules in Fig. 44.1 for $T1$ and $T3$.

44.3.1 Case of T3

In order to find the triples in the data set which satisfy the rules of $T3$, we divide the search into four cases according to both the sign and the direct of the edges in the triples. The four cases are as shown in Fig. 44.2.

The main aim here for picking out the triples of case $T3$.a ($T3$.d) in Fig. 44.2 is to take two elements from elements whose values are "1" for each row (column) in E. Then we write down the coordinates of the elements, denoted as ($x1$, $y1$), ($x2$, $y2$). At last we determine whether the value of $ey1y2$ or $ey2y1$ is "1". If the value is "1", then we add this triple to the set $S3$. Circulate the steps above until all the probabilities have been tested. For case $T3.b$ and case $T3.c$ we process the diagonal elements of E. For each element (x, x), we take two elements, one from the xth row whose value is "1", the other from the xth column with the value of "1". The coordinates of the two elements are(x, $y1$), ($x1$, x). We aim to check whether the value of element ($x1$, $y1$) or ($y1$, $x1$) is "1" in E. After all the possible elements are processed, we get the subnet $S3$.

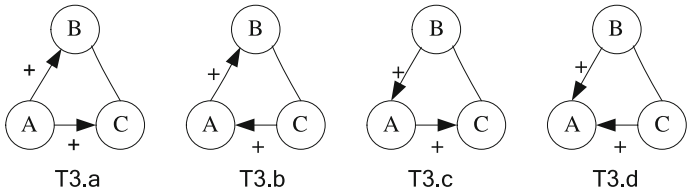

Fig. 44.2 Four cases of triples with directed edges for $T3$

44.3.2 Case of T1

We can see by the above description, taking into account of the sign and the direct of the edges, we also divide the search process into four cases for $T1$ as shown in Fig. 44.3.

As the number of edges with a sign of "−" is far less than the sign of "+", so we do searching on E'. To extract the triples of case $T1.a$ ($T1.d$) in Fig. 44.3, first we choose two elements $(x, y1)$ and $(x, y2)$ with the value of "−1" from every row (column) of E'. Then determine whether the value of element $(y1, y2)$ or $(y2, y1)$ is "1". If it satisfies, join the triple to $S1$. Similar with the case $T3.a$, circulate the steps. For case $T1.b$ and $T1.c$ we need to deal with each of the diagonal elements (x, x) in E'. We choose one element $(x, y1)$ whose value is "−1" in the xth row from E' and the other $(x1, x)$ from the xth column. If the value of the element $(x1, y1)$ is "1" in E, add the triple to $S1$. At last, we need to take two elements whose value is "−1" from every column of E'. The remaining steps are the same with case $T1.a$.

Note that the results of $S1$ and $S3$ contain redundant nodes and edges. Thus, we need to eliminate the redundancies when join the triples to $S1$ or $S3$. Then, we combine the set $S1$ with $S3$. Finally, we get the trust network.

44.4 Experiments

We make experiments on Epinions with 130,000 nodes and 840,000 edges. In the data set, there are 710,000 edges with a sign of "+", and 130,000 edges with a sign of "−". We extracted the edges from the triples which satisfy the rules of $T3$ or $T1$

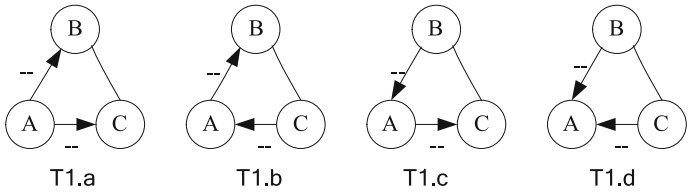

Fig. 44.3 Four cases of triples with directed edges for $T1$

Table 44.1 The comparisons between case *T*3 and case *T*1

Triple Ti	Number
*T*3_*a*	3,206,203
*T*3_*b*	2,025,624
*T*3_*c*	3,207,569
*T*3_*d*	3,198,077
*T*1_*a*	296,080
*T*1_*b*	68,562
*T*1_*c*	271,534
T1_d	52,385

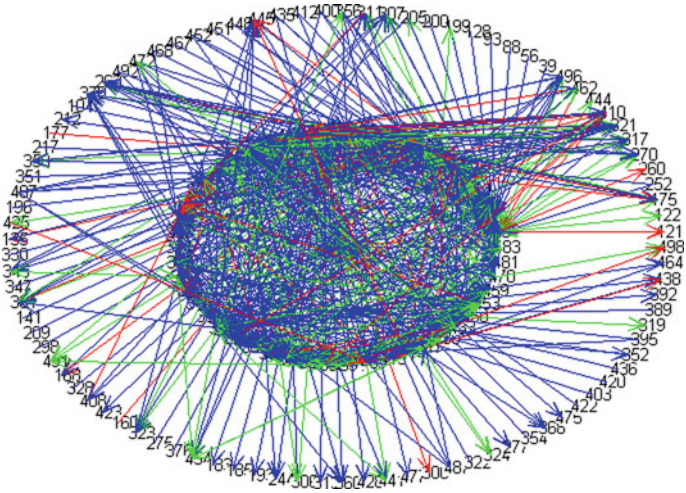

Fig. 44.4 Trust network graph which consists of more than 500 nodes

from the data set, and count up the number of different types of triples. The results are shown in Table 44.1.

In Table 44.1, there is the number of the *T*3 and *T*1 triples we found. Therefore, we can use the results to build a trust network and compute the trust values based on this trust network. In the trust network, the nodes link to others positively or negatively indicating that they trust them or not, then the networks can be viewed as a directed graph. In order to demonstrate our results more intuitive, we draw a directed graph according to the experimental data in Figs. 44.4 and 44.5.

As shown in Fig. 44.4, the graph is consisted of 500 nodes with directed edges. The nodes are extracted from the experiment results. In the graph, the blue lines represent the edges with the sign of "+" and the red lines represent the edges with the sign of "−". If there are two nodes with different signs, we use green line to connect them. We also use more nodes to paint a huge trust network diagram as shown in Fig. 44.5. The diagram consists of more than 5,000 nodes and the edges

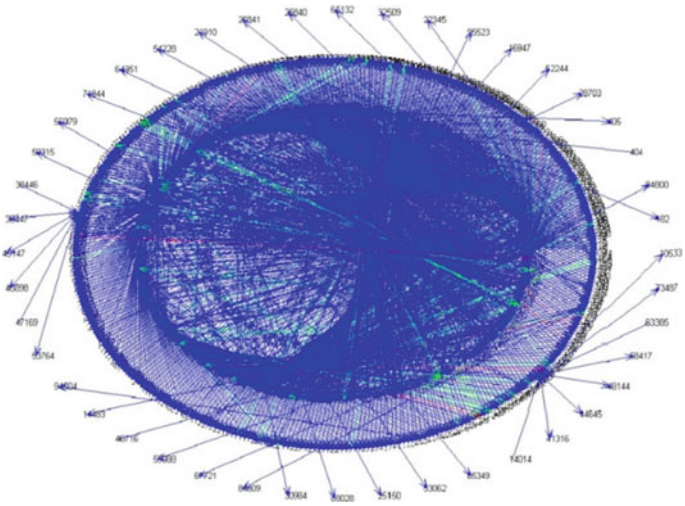

Fig. 44.5 Trust network graph which consists of more than 5,000 nodes

between them. This trust network diagram has six layers, we can see very few nodes in the layer 6 and edges there are also very sparse. This also confirms the six degrees of separation.

44.5 Conclusion

In this paper, we propose a new algorithm for building the trust network, which combines Heider's balance theory. We make a series of experiments on Epinions data set. According to the experimental results, we analyze the ratio of different types of triples, and draw a trust network graph. In the next work, we will add some filter rules to the algorithm and do some trust inference based on the trust network.

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Chapter 45
Cluster Enterprises' Internationalization Based on Cluster Risk Evaluation Model

He Huang

Abstract The cluster enterprises realize the effective integration of resources and the $1 + 1 > 2$ benefit mode; and also cluster enterprises are more competitive in the internationalization road, while the enterprise's internationalization growth still needs a stage. How to move toward the internationalization, how to carry out the growth pattern will be the focus of our analysis. Based on the cluster perspective analysis of enterprise growth pattern, we use the combination of cluster risk assessment model to analyze the risk assessment of cluster enterprises in the international development path, in order to get a better guide for cluster enterprises to control risks and strengthen enterprise management and operation. Through mutual cooperation, foster strengths and circumvent weaknesses, improving efficiency, and enhancing competitiveness, we could develop toward the internationalization.

Keywords Cluster enterprises · Internationalization · Growth model · Risk assessment model

45.1 Introduction

In today's fiercely competitive social conditions, facing the economic, knowledge, and information globalization, the growth of enterprises bear more pressure and face more and more challenges which not only from their own enterprise development problems but more from industry competition, market competition, and

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other issues [1]. If individual enterprises want to stay in the market not only they need to become strong enough and have their core competitiveness, but also need to constantly go international and realize internationalization. As for the individual enterprises after all, ability is limited, if they want to become international and face international challenge, they need to continue to integrate resources, make resource optimized allocation and utilization, namely through the enterprise cluster to achieve the advantages centralized and mutual benefit, and finally, make their own enterprise become bigger and stronger. Each enterprise may not be independent; they are interlinked in the social market; how to make enterprises integrate advantages, complement advantages, and how to internationalization growth together will be the focus of our attention. Enterprise cluster has a special advantage which can realize more features on the road of the internationalization growth, and may be able to withstand market competition and control the risks, get benefits, and achieve rapid growth.

45.2 Review of the Literature

Enterprise cluster is the companies which concentrated in a single area to product and manage, but the quantity of these companies are required; companies without a certain number cannot be a cluster enterprise, and those enterprises connected by industry. However, the enterprise cluster differs from the industrial cluster, industry cluster is a broader conception of enterprise cluster, and the enterprise cluster prefers to the division and cooperation of labor among enterprises.

Figure 45.1 shows the industrial cluster resources and enterprise cluster core dominance relation. Enterprise cluster cannot only realize the resource of element division, but also capable of using environmental resources and enterprises' relationship net. In the mean time, enterprise cluster can reduce cost, improve efficiency, enhance core competition ability, and build an enterprise cluster image in order to gain more advantages on the internationalization road.

Figure 45.2, for individual enterprises especially the small- and medium-sized enterprises, they have certain competitive advantages, but the efficiency is relatively low. When a single enterprise develops into enterprise cluster, it can improve the efficiency of enterprise cluster and achieve a division of labor, they can fully develop their advantages, implement advantage complementary, and make progress together.

The enterprise growth pattern in the enterprise growth stage shows relatively stable development and embodies the characteristics. Growth model changes with internal and external environment change, and it is also a process that the enterprises adapt to the environment and the change of environmental factors. They have their own characteristics, for example, state-owned enterprises, private enterprises, joint ventures, and so on; they all have the obvious differences in the growth path, so this is so called the difference of growth pattern. Therefore, this

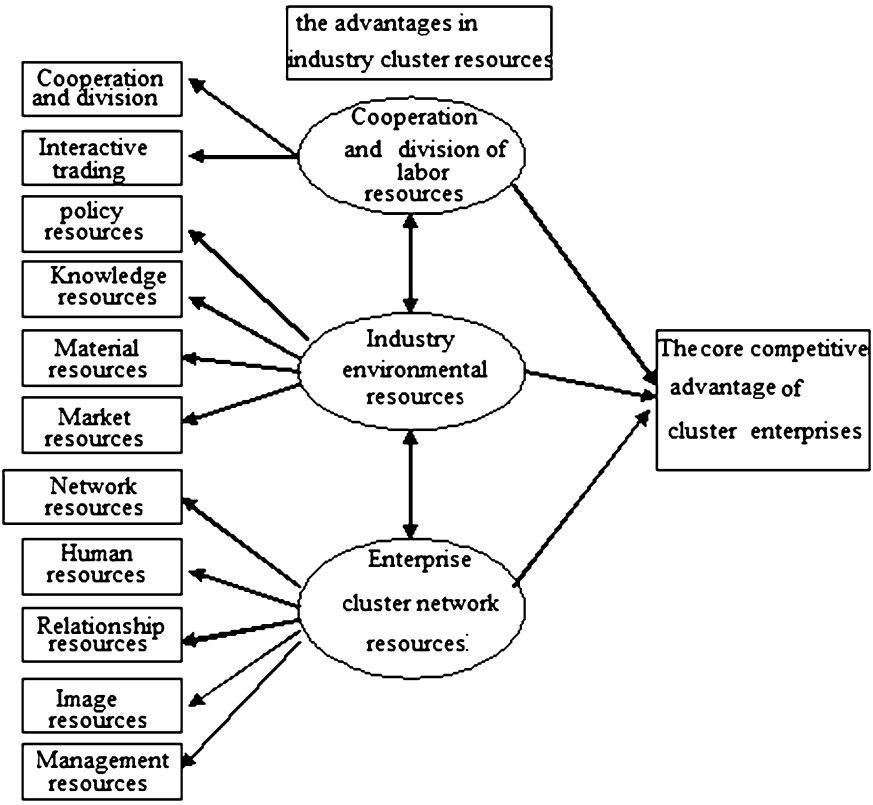

Fig. 45.1 The diagram of industry cluster resource and enterprise cluster advantages

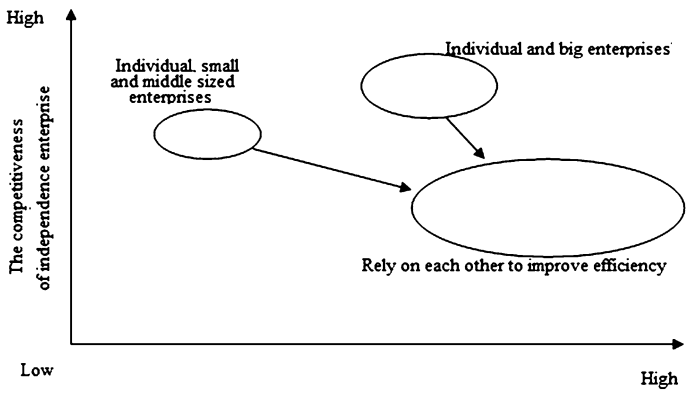

Fig. 45.2 The relationship of the individual enterprise's efficiency and competitiveness

article from the angle of clusters to analyze the internationalization growth pattern and mechanism of enterprise cluster.

45.3 Analysis of Enterprise Internationalization Growth Pattern and Mechanism Based on the Cluster Risk Evaluation Model

Cluster risk mainly includes the internal and outside risk; internal risk is from structure and network system composition risk and external risks include industry competition and external policy risk system. Cluster risk evaluation model uses fuzzy comprehensive evaluation method to process and analysis data.

There are four identified cluster risk evaluating, first indexed in fuzzy comprehensive evaluation method, namely [2]

$$u = \{u_1, u_2, u_3, u_4\} \tag{45.1}$$

Second, cluster risk evaluation index determines a corresponding fuzzy subset, also known as class set [3].

$$w = \{w_1, w_2, w_3, w_4\} \tag{45.2}$$

The third step is through the cluster of risk assessment index quantification, and also used to reflect the evaluation cluster risk in order to know about how dependence of the level set, then, calculated the fuzzy relation matrix [4]:

$$R = \begin{bmatrix} R| & u_1 \\ R| & u_2 \\ & \cdots \\ R| & u_4 \end{bmatrix} = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1m} \\ r_{21} & r_{22} & \cdots & r_{2m} \\ \cdots & \cdots & \cdots & \cdots \\ r_{41} & r_{42} & \cdots & r_{4m} \end{bmatrix}_{4m} \tag{45.3}$$

Fourth, according to the matrix derive the cluster risk evaluation index weight vector [5]:

$$A = (a_1, a_2, a_3, a_4), \sum_{i=1}^{4} a_i = 1,\ a_i \geq 0, i = 1, 2, \cdots, n \tag{45.4}$$

The fifth step is to get cluster risk evaluation results, the vector F [6]:

$$A \circ R = (a_1, a_2, a_3, a_4) \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1m} \\ r_{21} & r_{22} & \cdots & r_{2m} \\ \cdots & \cdots & \cdots & \cdots \\ r_{41} & r_{42} & \cdots & r_{4m} \end{bmatrix} = (f_1, f_2, f_3, f_3) = F \tag{45.5}$$

Table 45.1 The risk of firms in cluster evaluation index weight table

I	II	Weight	III	Weight
Cluster enterprise risk index system	Structure risk system	0.186	Enterprise concentration risk	0.543
			Market changes risk	0.351
	Network risk system	0.034	Information-sharing risk	0.142
			Patent technology risk	0.234
			Industry credit risk	0.424
	Industry competition risk system	0.401	Talent index A31	0.197
			Product index A32	0.201
	Group policy risk system	0.202	National policy risk index A41	0.312
			The local policy risk index A42	0.332

Final one is the cluster of risk assessment results. The last step in this article is to use the weighted form to obtain the grade of membership, rank condition. Based on the first step, we can get the judgment matrix $S = (u_{ij})_{4\times4}$ [7].

Analysis of group enterprise risk assessment model is a very complex process, and the risks of firms in cluster evaluation have many factors. Thus, under the science, system, and representation principle of index selection, finally we determine the weight of index by using expert scoring.

Table 45.1 cluster enterprise's risk evaluation index system weight table shows that cluster enterprises in the international growth, industry competition has the largest risk factors, weight accounted for 0.401, and the second is the foreign policy system which has risk factor of 0.202, the third row is the structural risk system which is 0.186, finally the smallest risk is network system which is only 0.034. But in the three levers' index, the first is the enterprise concentration risk factors accounted for 0.543; the second is the industry reputation risk factors accounted for 0.424, the third is market change risk factors, accounted for 0.351; the minimum risk factor is information access, reached 0.142. In the various index, the index weight also exists differences, which shows the difference of degrees effect the overall evaluation.

Through the expert group evaluation, finally we can get the corresponding cluster enterprise risk's fuzzy evaluation to judge matrix $S_i(i = 1, 2, 3, 4)$. According to the judgment matrix to determine I level cluster enterprise risk fuzzy evaluation index set, the determined set is [8]:

$$R = \begin{Bmatrix} R_1 \\ R_2 \\ R_3 \\ R_4 \end{Bmatrix} = \begin{Bmatrix} 0.074 & 0.264 & 0.335 & 0.148 \\ 0.039 & 0.158 & 0.372 & 0.301 \\ 0.271 & 0.303 & 0.229 & 0.118 \\ 0 & 0.125 & 0.453 & 0.322 \end{Bmatrix} \tag{45.6}$$

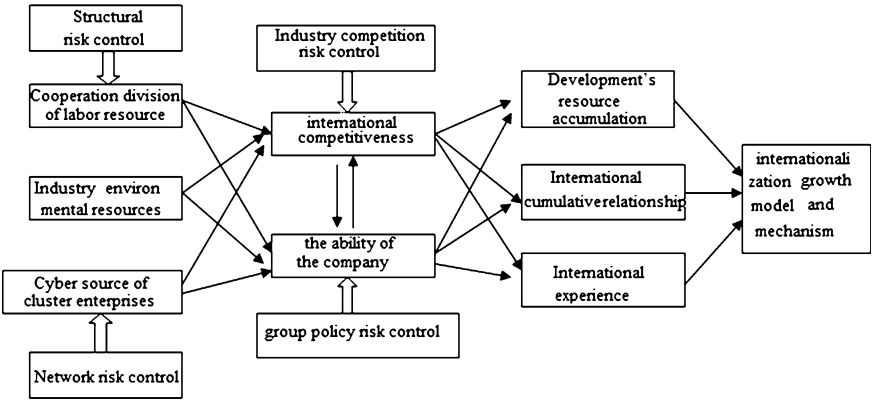

Fig. 45.3 The model and mechanism model of cluster enterprises' internationalization growth

To calculate the risk of cluster enterprise's fuzzy comprehensive evaluation matrix [9]:

$$M = A \times R = (0.186, 0.034, 0.401, 0.202) \times \begin{Bmatrix} 0.074 & 0.264 & 0.335 & 0.148 \\ 0.039 & 0.158 & 0.372 & 0.301 \\ 0.271 & 0.303 & 0.229 & 0.118 \\ 0 & 0.125 & 0.453 & 0.322 \end{Bmatrix} \tag{45.7}$$

$$= (0.186, 0.259, 0.176, 0.033)$$

By calculation, we can see that structural risk, network risk, industry competition, and external policy risks are all the strict elements which are needed for enterprise cluster to enter international. Therefore, we must pay attention to risk control, and construct cluster enterprise's internationalization growth model and mechanism model, look at Fig. 45.3.

45.4 Conclusion

Group Company can fully develop its geographical cluster advantages, reduce costs, improve efficiency, enhance the image; thus, they can stand firmly in the international business market. Enterprise cluster cannot only realize effective configuration of cluster resource and reasonable division of labor, but also can be able to sufficiently develop their own advantage. Enterprise cluster can also use cluster properties to obtain group policy and relation of network resources so as to realize the internationalization. But cluster enterprises in the international development process not only need to control the risk effectively, but also need to effectively grasp the national competitive advantages and their own advantages to realize the growth; moreover, accumulation of experience in order to develop toward the internationalization, make cluster enterprises get bigger and stronger.

It also can enhance the core competitiveness of enterprises, improve the visibility, and make international brand.

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Chapter 46
Enterprise Information Security Warning Based on Subjective Bayes

Bo Wu and Tuo Ji

Abstract Information security means protecting information and information systems from unauthorized access, use, disclosure, destruction, modification, view, and record and destruction. Forecast is one of the tasks of data mining. With data mining, we can complete the warning of information security. Subjective Bayes method is a method of uncertain reasoning. With this method, the factors that affect information security is defined as evidence, Evidence sufficiency measurement LS value is derived from the statistical or historical data given by the security experts, can deduce the value of enterprise security warning.

Keywords Information security warning · Subjective Bayes methods · Uncertain reasoning

46.1 Introduction

Information security means protecting information and information systems from unauthorized access, use, disclosure, destruction, modification, view, and record and destruction [1, 2]. Government, companies, enterprises, and others accumulated a great deal about their employees, customers, products, research, financial data, and confidential information [3, 4]. Now, the vast majority of such information is collected, generated, stored within the computer, and transmitted through

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the network to other computers [5]. In case there is a business, if confidential information about its customers, financial situation, the new product line is lost; the disclosure of this security may result in economic losses, legal proceedings, or even bankruptcy of the enterprise.

The field of information security in recent years has experienced rapid growth and evolution, which involves a number of specialized research areas, including information systems assessment, information security warning. With data mining, we can complete such tasks.

Data mining is the process of extracting patterns from large data sets by combining methods from statistics and artificial intelligence with database management. The success of data mining to solve the problem depends on the expectations of a deep understanding of the field. By understanding the data and the process of data mining, we can find a reasonable explanation for the results. With the application requirements and different data, data mining processing steps may also be different. Forecasting analysis is to grasp the law of development of the object, is to foresee the trend of the future. Forecast is one of the tasks of data mining.

46.2 Bayes Reasoning

46.2.1 Uncertain Reasoning

Because of the imprecise and incomplete information, analysis and decision system often have to deal with a lot of uncertainty, reasoning is often used in uncertain reasoning methods of nonstandard logic. Uncertainty comes from the knowledge of objective reality and subjective knowledge level of awareness. Uncertain reasoning often used is not stringent enough, but the reasoning results are consistent with the intuition of human experts, some explanation can also be given by the probability.

Uncertain problem model must explain the representation, computing, and semantics of uncertain knowledge. Expressed refers to the description of the uncertainty of the methods adopted, which is a key step to solve uncertain reasoning. Calculation mainly refers to the spread and updates of the uncertainty. Calculation of the uncertainty mainly refers to the spread and updates. Semantic refers to the representation and calculation of what is meant, that is, to interpret them. In case of information security and warning, we use the probability to express whether the security indicators can reach the standard, whether the Information security risk will occur. Usually, you can use Bayes formula to solve this problem:

With events $B1$, $B2\ldots$ Bn are not compatible, $B1 + B2 + \cdots + B\mathrm{n} = \Omega$ (complete works), event A can occur simultaneously with one of the $B1$, $B2\ldots$ Bn, $P(Bi) > 0$ $(i = 1, 2\ldots n)$, $P(A) > 0$, then the Bayes formula can be expressed as:

$$P(B_i|A) = \frac{P(A|B_i)P(B_i)}{\sum_{j=1}^{n} P(A|B_j) \cdot P(B_j)} \, i = 1 \ldots n \tag{46.1}$$

In the Bayes formula, the security standards are the events $B1$, $B2$, …, Bn, the occurrence of information security risks is the event A. Straightforward calculation of Bayes formula, however, has nothing to do with each other requires a number of premises, and the calculation is often difficult, not suitable for this paper to solve the problem of enterprise information security and early warning.

In the Bayes formula, the security standards are the events $B1$, $B2$, …, Bn, the occurrence of information security risks is the event A. Bayes formula is straightforward, but requires certain prerequisite events unrelated to each other, the calculation of $P(A|B_i)$ and $P(B_j)$ is often difficult, is not suitable for this paper to solve the problem of enterprise information security and warning.

46.2.2 Subjective Bayes Methods

Subjective Bayes methods introduced two values (LS, LN) to be measured, LS performance of the adequacy of established rules, LN performance the need for the establishment of rules, which take into account that both the emergence of the A to support B, but also the disappearance of the A to impact B.

Sufficiency measurement LS:

$$\mathrm{LS} = \frac{P(A|B)}{P(A|\neg B)}. \tag{46.2}$$

Necessity measure LN:

$$\mathrm{LN} = \frac{P(\neg A|B)}{P(\neg A|\neg B)}. \tag{46.3}$$

Establish probability function:

$$O(X) = \frac{P(X)}{1 - P(X)}. \tag{46.4}$$

The $P(X)$ of the [0, 1] to zoom into values in [0, ∞] of $O(x)$, and there is:

$O(B|A) = \mathrm{LS} \times O(B)$
$O(B|\neg A) = \mathrm{LN} \times O(B)$
$O(B|A) = \mathrm{LS} \times O(B)$
$O(B|\neg A) = \mathrm{LN} \times O(B)$

In some cases, also need to measure the uncertainty of the evidence. With $O(A)$ or $P(A)$ to represent the uncertainty of evidence A, the conversion formula is:

$$A) = \frac{P(A)}{1 - P(A)} = \begin{cases} 0, \text{when } A \text{ is false}_\circ \\ \infty, \text{when } A \text{ is true}_\circ . \\ (0, \infty), \text{general case}_\circ \end{cases} \tag{46.5}$$

In subjective Bayes methods, knowledge is represented by production rules, $P(B)$ is the prior probability given by experts. Reasoning is the process that the $P(A)$, $P(B)$, LS and LN derived $P(B \mid A)$ or $P(B \mid A)$. And a rule in the preceding paragraph may certainly exist, it may certainly not exist, or uncertain, and in different situations posterior approach to solve is not the same.

In the evaluation process of enterprise Information Security warning, all the evidence is determined by the site visits, there is no such situation: the existence of some evidence is uncertain. Therefore, the following discussion only refers to that the evidence emerges or not.

(1) Evidence A will occur, that is $P(A) = 1$, can be used directly

$O(B \mid A) = \text{LS} \times O(B)$
$O(B \mid \neg A) = \text{LN} \times O(B)$

If you need the probability that, then

$$P(X) = \frac{O(X)}{1 + O(X)} \tag{46.6}$$

Calculated $P(B \mid A)$, $P(B \mid \neg A)$.

(2) Evidence A will not occur, that is $P(A) = 0$, Using similar approach with the above:

$O(B|\neg A) = \text{LN} \times O(B)$

(3) More evidence appears at the same time:

If A1 → B, A2 → B and A1, A2 mutual independence

$$O(B|A1 \cap A2) = \frac{O(B|A1)}{O(B)} \times \frac{O(B|A2)}{O(B)} \times O(B) \tag{46.7}$$

Similarly, if the k pieces of evidence simultaneously, and mutually independent, then

$$O(B|A_1 \cap A_2 \cap \ldots \cap A_k) = \prod_{i=1}^{k} \frac{O(\text{B}|Ai)}{O(B)} \times O(B) \tag{46.8}$$

46.3 Implementation of Enterprise Information Security Warning

Because of an industry information requires higher security, regulatory authorities need to regularly check the information security of the industry enterprises. Statistics from the historical statistics to know, the industry's enterprises do not have a security problem is the rate of 82 %, it means security problems in the prior probability of 0.18. Developed by industry experts, Enterprise Information Security indicator is $A1$–$A19$ (Table 46.1), each indicator substandard will occur as the evidence of information security problems. LS value for each evidence obtained by the statistical or historical data given by the security experts, and LN values is set to 1 is based on the considerations: some evidence does not appear, will not affect the results.

An existing enterprise information security testing, the basic conditions given in Table 46.2; the value of evidence 1 indicated that occurrence of the evidence (the security indicators are not achieved). According to enterprise A and B safety test results, it can predict both enterprise information security problems of probability. By the enterprise A examples:

When enterprise A evidence $A1$, $A2$ … AK inevitable happens, we calculated the $P(B)$ of introduction to change, from subjective Bayes method of reasoning rules known:

Table 46.1 Enterprise information security indicators

Evidence (indicator)		LS	NS
A1	Firewalls and routers configured in accordance with industry standards	1.96	1
A2	Untrusted network access restrictions	2.68	1
A3	In the firewall policy to limit the access of external network	0.45	1
A4	Before the installation of the system will change the default provider	1.23	1
A5	Server security parameters established standards	1.12	1
A6	Limit the validity of the data to be written off	1.08	1
A7	To mask sensitive customer information	1.09	1
A8	Encrypt sensitive data stored in customer information	2.05	1
A9	Implementation of key management processes or procedures	2.85	1
A10	Greater use of passwords and secure communication protocols	0.95	1
A11	Communication software to prevent end users	1.24	1
A12	Deployed on the server antivirus software	1.01	1
A13	Terminals deployed in the antivirus software	1.62	1
A14	System software and hardware to install the latest security patches in a timely manner	1.72	1
A15	Related system settings in order to identify newly discovered security vulnerabilities	1.82	1
A16	Follow the safety management application development	1	1
A17	Application system upgrades follow the established change control process	0.99	1
A18	Implementation of user authentication and password management controls	0.98	1
A19	Log in application time and place restrictions	1.82	1

Table 46.2 Enterprise information security evaluation results

Evidence	Enterprise A			Enterprise B		
	$P(A)$	$O(B)$	$P(B)$	$P(A)$	$O(B)$	$P(B)$
$A1$	1	0.430	0.301	0	0.220	0.180
$A2$	1	1.153	0.536	0	0.220	0.180
$A3$	0	1.153	0.536	0	0.220	0.180
$A4$	0	1.153	0.536	1	0.270	0.213
$A5$	0	1.153	0.536	0	0.270	0.213
$A6$	0	1.153	0.536	1	0.292	0.226
$A7$	0	1.153	0.536	0	0.292	0.226
$A8$	1	2.364	0.703	0	0.292	0.226
$A9$	1	6.737	0.871	0	0.292	0.226
$A10$	1	6.400	0.865	1	0.277	0.217
$A11$	0	6.400	0.865	0	0.277	0.217
$A12$	1	6.464	0.866	1	0.280	0.219
$A13$	1	10.471	0.913	0	0.280	0.219
$A14$	0	10.471	0.913	0	0.280	0.219
$A15$	1	19.058	0.950	1	0.509	0.337
$A16$	1	19.058	0.950	1	0.509	0.337
$A17$	0	19.058	0.950	0	0.509	0.337
$A18$	1	18.677	0.949	1	0.499	0.333
$A19$	1	33.992	0.971	0	0.499	0.333
Probability			0.971			0.333

(1) From $P(B) = 0.18$, known
$O(B) = 0.220$
(2) $O(B|A1) = \text{LS} \times O(B) = 1.96 \times 0.220 = 0.430$
$P(B|A1) = 0.301$
(3) $O(B|A1A2) = \text{LS} \times \text{O}(B|A1) = 2.68 \times 0.430 = 1.153$
$P(B|A1A2) = 0.536$
(4) Similarly, can be drawn from

$$O(B|A_1 \cap A_2 \cap \ldots \cap A_k) = \prod_{i=1}^{k} \frac{O(B|Ai)}{O(B)} \times O(B) = 33.992 \tag{46.9}$$

Enterprise A value is 33.992. By

$$P(B) = \frac{O(B)}{1 - O(B)} \tag{46.10}$$

Enterprise A information security of the probability of occurrence problem is 0.971, therefore concludes that the information enterprises A is unsafe.

The calculation method of enterprise B is same to A.

46.4 Summary

Information security fields cover network and public infrastructure, safety and application software and databases, safety testing, information system evaluation, enterprise safety planning and digital forensics technology risk assessment, and other various areas. Different industries, different sizes of information security requirements are not the same; this paper presents a convenient and flexible way to warning and evaluation methods.

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Chapter 47
Intrusion Detection Based on Rough-Set Attribute Reduction

Shuyue Ma, Huifen Liao and Yuan Yuan

Abstract This paper mainly discusses the application of rough-set theory in intrusion detection, establishes the rough-set intrusion detection system model by applying the attribute reduction algorithm of rough set to mine the intrusion detection data, and improves the reduction algorithm which is based on attribute frequency, enhancing the data mining efficiency, and helping obtain concise and efficient data.

Keywords Rough set · Intrusion detection · Attribute reduction

47.1 Introduction

The rough-set theory is a mathematical tool to process uncertain, inaccurate, and fuzzy knowledge [1, 2], which has advantages to analyze and reason the incomplete data, discover the relation among data, extract useful features, simplify data, research the expression, learning and conclusion of inaccurate and uncertain knowledge [3, 4]. In recent years, the rough-set theory has attracted the attention from academia and has been successfully applied in the fields of machine learning, decision analyzing, pattern recognition, etc [5, 6]. Its application to intrusion detection can automatically discover new models or safety rules from a large number of audit data, and hence establish a highly accurate intelligent intrusion detection system [7].

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47.2 Basic Concept of Rough Set

47.2.1 Knowledge Representation System

Knowledge representation occupies a very important position in the intelligent data processing. To deal with intelligent data, it requires the representation of knowledge symbols. A knowledge representation can be expressed as a quaternion $S = (U, A, V, f)$. In this quaternion, U is the non-empty finite set of object and is called as the universe of discourse; A is the non-empty finite set of attributes; $V = \bigcup_{a \in A} V_a$, V_a is the range of a; f: $U \times A \rightarrow V$ is an information function, which gives an information value to each attribute of each object, namely $\forall a \in A, x \in U, f(x, a) \in V_a$. Knowledge representation system is also called as information system, and hence $S = (U, A)$ is usually utilized to substitute for $S = (U, A, V, f)$.

47.2.2 Attribute Reduction

A decision table is a decision information system, and contains a large number of sample information, in which a sample table stands for a decision rule and all rules constitute a decision rule set. However, in the actual application, such a rule set is no use, because a basic rule lacks adaptability and only automatically records the information about a sample and is unable to adapt to other circumstances, while a record of decision table after reduction stands for the samples with the same rules, which possesses highly strong adaptability.

In data analysis, the attributes of the original decision table are not equally important, and the unnecessary relationship in the repository is redundant. The existence of these redundant attributes not only wastes the resources but also disturbs people to make right and concise decisions. Therefore, the reduction of the decision table is to delete the redundant information from the repository. Importantly, such a reduction does not affect the classification ability of repository. Generally speaking, the condition attribute of a decision table is not the only one for the relative reduction of decision attribute. That is to say, a decision table may have multiple reductions. The number of attributes in reduction directly influences the simplification and performance of decision rules. Therefore, people often expect to find the reduction with the least attributes. However, due to the explosion problem in attribute combination, finding a minimum reduction of a decision table is an NP-hard problem. A present, the measure to solve this problem is introducing heuristic information into the attribute reduction; and the sample search space can be reduced through heuristic information, thereby accomplishing the purpose to improve the reduction efficiency.

47.3 Rough-Set-Based Intrusion Detection System Model

47.3.1 System Model

The intrusion detection system model based on rough set in this paper realizes the analysis and processing of the intrusion data on the basis of improving the rough-set attribute frequency reduction algorithm, and removes the redundant knowledge in the audit data by the corresponding processing, improving the data mining efficiency, and attaining concise and efficient safety rules.

47.3.2 Improvement on the Attribute-Frequency-Based Heuristic Algorithm

47.3.2.1 Attribute-Frequency-Based Heuristic Reduction Algorithm

The heuristic algorithm is a reduction algorithm based on attribute frequency. By now, the frequently used attribute frequency algorithm is based on the difference matrix corresponding to decision table, and calculates the total times of all non-core attributes appearing in difference matrix by considering the combination of all attributes. If a non-core attribute appears most frequently, it indicates that this attribute exerts the highly important roles in the identification of two different-decision objects, and thus it is necessary to first add it into the reduction set in consideration and meanwhile to delete all the combinations of this attribute.

The heuristic algorithm based on attribute frequency:

The input of this algorithm is a decision table $T = <U, R, V, F>$, in which U is a domain of discourse; $R = C \cup D$ and C and D are the condition attribute set and decision attribute set respectively.

The input of this algorithm is a reduction B of this decision table T.

Step1: Find the core attribute C_0, and initialize B: $C_0 \rightarrow B$.

Step2: Delete all the elements whose intersection with B in M is empty, and delete all the elements included by B from the condition attribute set. Namely, $M-Q \rightarrow M$, $C - B \rightarrow P$, and $Q = \{A_{ij} | A_{ij} \cap B \neq \varnothing\}$.

Step3: For all $c_k \in P$, calculate the attribute frequency function $p(c_k)$ in M, and find the c_q with the maximum value from all $p(c_k)$, namely $p(c_q) = \max\{p(c_k)\}$.

Step4: Add c_q into the reduction set: $B \cup c_q \rightarrow B$.

Step5: Repeat the above steps until $M = \varnothing$.

47.3.2.2 Improvement on the Attribute-Frequency-Based Heuristic Reduction Algorithm

The attribute frequency algorithm discussed in Sect. 47.3.2.1 relies on the attribute frequency to decide which attribute to be added into the core attribute. When an attribute appears in the difference matrix corresponding to decision table the most frequently, the attribute will be deemed as the most important by the attribute frequency algorithm, and hence it should be first considered to be added into the core attribute. However, in practical application, there are multiple attributes to reach the maximum frequency. Concerning such a point, the processing method of the previous algorithm is only picking up an attribute into the core attribute from the attributes whose frequency reaches the maximum. However, the reduction by such a way may not be the quite optimal reduction of decision table.

A decision table $T = <U, R, V, F>$ is given, in which U is the domain of discourse, $R = C \cup D$ and C and D are the condition attribute set and decision attribute set respectively. Assume B is a reduction to be obtained, and $POS_B(D)$ is the object set that can be accurately partitioned into the equivalence class of decision attribute based on the classification *U/R*, while $POS_B(D)/IND(B, D)$ is the repartition under the equivalence relation *IND(B, D)*. The algorithm specific train of thought after improvement is shown as follows: when there are multiple attributes to reach the maximum frequency, it is necessary to process these attributes with equivalent frequency again, namely to calculate the number of elements in $POS_{B\cup\{a\}}(D)/IND(B, D)$ when selecting the attribute with the maximum frequency to add into the core attribute, from which the attribute with the most elements can be selected to be added into the core attribute. In such a way, the attribute with the strong classification ability is added into the reduction set, and hence it is able to obtain the optimal reduction.

The improvement on the heuristic algorithm based on the attribute frequency:

Input: a decision table $T = <U, R, V, F>$, in which U is the domain of discourse, $R = C \cup D$ and C and D are the condition attribute set and decision attribute set respectively.

Output: a reduction B of decision table.

Step1: Find the core attribute C_0 of decision table, and initialize B: $C_0 \rightarrow B$.

Step2: Delete all the elements whose intersection with B in M is empty, and delete all the elements included by B from the condition attribute set. Namely, $M - Q \rightarrow M$, $C - B \rightarrow P$, and $Q = \{A_{ij} | A_{ij} \cap B \neq \varnothing\}$.

Step3: For all $c_k \in P$, calculate the attribute frequency function $p(c_k)$in M;

Find the c_q with the maximum value from all $p(c_k)$; if there is only one attribute with maximum frequency, $p(c_q) = \max\{p(c_k)\}$, and then add c_q into the reduction set: $B \cup c_q \rightarrow B$, and then turn to step 4, otherwise there are multiple attributes with the maximum frequencies, and turn to step 3.

Calculate the number of elements included in $POS_{B\cup\{c_q\}}(D)/IND(B, D)$ of all the attributes with the maximum frequency, and add the attribute c_q with the most

number of elements in $POS_{B\cup\{c_q\}}(D)/IND(B,D)$ into the reduction set: $B \cup c_q \rightarrow B$.

Repeat the above steps until $M = \varnothing$.

47.3.2.3 Experimental Analysis

To verify the validity of the improved algorithm, this chapter carries out test and analysis through the information system in UCI.

The development and running environment of experimental simulation program is shown as follows:

Processor: Intel 2.4G;
Memory: DDR400 768 M;
Operating system: Windows XP sp2;
Development tool: MS VC++ 6.0
Additionally, the experimental procedure is divided into three parts in total:

Part 1 is reducing the data set through the traditional attribute frequency algorithm. That is to say, when there are multiple attribute frequencies to reach the maximum at the same time, the adopted method is to randomly select one to add into the reduction set, in which the strategy of random selection is using the system time as the random number of random seed to be implemented.

Part 2 is conducting the reduction processing on the selected data set through the improved attribute frequency. That is to say, when there are multiple attribute frequencies to reach the maximum at the same time, the adopted method is to process these attributes with the maximum frequencies again and find the one with the strongest classification ability to add into the reduction set.

Part 3 is attaining a conclusion based on the comparative analysis on the experimental results of the former two parts.

Here, a group of 700 medical data is taken as the experimental data set. And, the condition attribute and decision attribute (class is used to express them) are as shown in Table 47.1. All these attributes are discrete data, and thus attribute reduction can directly proceed.

The results through two algorithms to experiment the test data set are as shown in Table 47.2:

Based on the reduction of the reduction set {A1, A3, A5, A6} and {A3, A5, A6, A7} on the original data, the final reduction comparison is as shown in Table 47.3:

It can be noted from the Table 47.3 that the reduction set {A3, A5, A6, A7} has higher efficiency than {A1, A3, A5, A6}. In addition, according to the results of multiple experiments, the random occurrence times of the two reduction sets obtained by the original algorithms are the same. That is to say, the reduction set obtained by this algorithm is relatively weak in 50 % of cases, which proves that the improved algorithm enhances the reduction rate and gains the optimal reduction of data set.

Table 47.1 A group of 700 medical data

Attribute number	Attribute name	Attribute value
A1	Clump_Thickness	int [1, 10]
A2	Cell_Size_Uniformity	int [1, 10]
A3	Cell_Shape_Uniformity	int [1, 10]
A4	Marginal_Adhesion	int [1, 10]
A5	Single_Epi_Cell_Size	int [1, 10]
A6	Bare_Nuclei	int [1, 10]
A7	Bland_Chromatin	int [1, 10]
A8	Normal_Nucleoli	int [1, 10]
A9	Mitoses	int [1, 10]
A10	Class	{benign, malignant}

Table 47.2 The reduction set obtained through two algorithms

Algorithm name	Reduction result
Original algorithm	{A1, A3, A5, A6}
	{A3, A5, A6, A7}
Improved algorithm	{A3, A5, A6, A7}

Table 47.3 The reduction result comparison under two reduction sets

Reduction sets	Attribute reduction rate (%)	Object number after reduction	Data object reduction rate (%)
{A1, A3, A5, A6}	55.6	317	54.7
{A3, A5, A6, A7}	55.6	279	61.4

47.4 Conclusion

The intrusion detection is very complex in reality and the number of its analysis data is also larger, while the rough-set theory is a powerful tool to handle this kind of a problem. Based on the analysis of the studies on the rough-set theory and reduction algorithm, this paper applies the data reduction technology of rough set to the analyzing and processing of network data, and improves the heuristic reduction algorithm which is based on attribute frequency. The experimental results indicate that this algorithm owns high reduction ability, which can first delete the redundant knowledge from the data set which is to be analyzed through the attribute reduction of rough set, and then gains safety rules through rules mining. It has good performance in the identification of unknown attacks and is of important value for the intrusion detection technology.

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Part V
Semantic Grid and Natural Language Processing

Chapter 48
Building of Virtual Server in Computer Laboratory

Yueping Wu, Jian Zheng and Yi Du

Abstract Today's open computer labs are required to provide diverse and personalized services and enforce the deployment of server virtualization based on the existing hardware infrastructure. Through server virtualization technology to consolidate server resources, improve server utilization, reduce the time of system installation and configuration, provide users with high reliability, high availability, opening, expanding access to services of high quality, but also facilitate the management and maintenance of server. According to the present situation of computer labs, build virtual services to meet today's requirements.

Keywords Server · Virtualization · Computer laboratory · Serve

48.1 Introduction

In recent years, open computer lab management has gradually matured and improved. It is mainly automation management, where teachers and students can work freely on the machine. But with the rapid development of computer technology and the increasing popularity of computers, the function of the computer laboratory requested by the user is also rising, and does not satisfy the laboratory which is only provided with a computer room. Teachers and students need be provided a full environment, and a diverse, personalized service. The school also requires to improve the utilization rate of laboratory equipment. To solve these

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problems, the college computer lab with existing hardware and software facilities is renovated and construction of server virtualization on the basis of meeting the actual needs of users is realized.

The lab manager's mission is service, the focus of the service is the maintenance and management of the engine room, the focus of the room is to maintain server, because a server undertakes to send the daily course information, store student work, and support test environment. In order to ensure server security, many colleges and universities usually make server-independent functions. A server installs a separate operating system to perform a specific task to increase the relative security of the server based at the expense of server utilization, generally reaching about 15 %, and increasing input costs. Therefore, to consolidate server resources through the use of server virtualization technology, to eliminate chaos of service management, to reduce system installation and configuration time, to provide users with high reliability, high availability, opening, dynamically expanding access to quality services, but also to facilitate server management and maintenance. Currently, it is more popular than cloud computing in the market. Its core technology is virtualization [1, 2], but cloud computing is still in its infancy [3], whose environment and technology are not mature, especially in the relatively small data college lab. The use of cloud computing is not necessary to achieve virtualization, hence the virtual machine is enough to meet the service operation and management requirements.

48.2 Laboratory Construction Statuses

College computer labs are now undertaking a large number of experimental tasks inside and outside school, combined with a variety of experimental needs. The college class size, class model, test and game mode, the form of school-enterprise cooperation, laboratory configurations range from dozens to more than 200 computers, respectively, which meet simultaneously the test requirements in a class, two classes, and multiple classes. The room is of higher utilization rate, the environments of hardware and software resources are constructed completely.

48.2.1 Hardware Construction

Because computer hardware and software develop fast, in recent years, laboratory equipment has updated annually, and accordingly the requirements of different laboratories have targeted to use the current higher performance configuration. For example, the multimedia room demands higher color, sound, and visuals, the corresponding computer's sound card, graphics card, and monitor is much higher than other software engine rooms, network rooms, and hardware rooms, which also ensure that equipment is not prematurely eliminated. Also, the lab buys up the

general longest service for brand computers for extending the life of a computer, essentially saving money.

To guarantee smooth network, each room has fiber access, uses three switches for Internet interconnection to speed up local area networks within the fast forwarding of data, and accesses client through layer 2 Gigabit switch.

In order to facilitate the maintenance and management of the computer room, each computer is installed a hard drive protection card, which not only can be easily implemented on the physical hard disk partitions, multi-system installation, but also can protect computers to restore to initial installation state without physical damage, to avoid viruses that inadvertently modify and delete and even deliberately destruct hard drive case. Another more important point is that the same brand and computer type can realize network transmission in a short time through the protection card. So long as the implementation of a computer software is installed, you can achieve the same software configuration for dozens or even hundreds of computers in an hour or so.

48.2.2 Software Construction

Today's computer hardware and software development is rapid. Although the computer has multiple systems installed, yet it cannot meet the teaching needs and thus needs to install the virtual machine, such as VMware and Virtual PC. The virtual machine can simulate the hardware environment in the operating system, and accordingly be installed in a new operating system in a simulated environment providing a student with more than one computer network, build network services, and installation of the operating system simultaneously.

In the previous year the lab installed the "Room Management System" software, which achieved effiective monitoring and management of the laboratory. It consists of server side, management port, card reader, and student terminals. The students using the computer must enter by card reader, so that the software can record students in the lab on—time, machine number, student relevant information, achieve automatic management of the computer room, and facilitate teacher's class attendance. Server and management side can easily send message, reboot, shutdown, and block drive, USB, network etc., to achieve remote control. The room can appointment with a machine to solve the conflicts between collective and free on computer.

Therefore, the computer rooms are equipped with "e-learning" software and projector, the teaching management software is the two-way teaching environment, where teachers can implement the broadcast presentations, send files, control clients, students can submit exercises, raise hands, and so on. In the software and hardware environment, the form of the computer lab class is rich, effective, and well received by teachers and students.

48.3 The Construction of Server Virtualization

Virtualization in the system is usuallly the processor, memory, storage, and networking hardware and running environment including operating system and application program encapsulated together in a separate virtual machine. The virtual machine is stored in files, because these virtual files have a unified format and thus can eliminate the different heterogeneous resources [4].

48.3.1 Server Virtualization Technology

48.3.1.1 Migration

Virtualization technology makes virtual server abstracted from hardware. The biggest advantage of the virtual server is that it can migrate back and forth between different physical servers; this migration allows to clone virtual server, or to migrate from one physical server to another one[5]. The benefits of migration include: (1) eliminates downtime caused by hardware upgrades or corresponding problems; (2) avoids downtime caused by software updates; and (3) migrates the virtual server to the stronger or weaker server according to demand. Of course, many virtualization solutions possess cloning or migration, but their software capabilities, limitations, and costs have considerable differences. For example, the high-end solution for zero downtime migration is of high cost, and needs the support of SAN storage. The basic function of virtuozzo virtual operation system is migration that provides another low-cost zero downtime migration between any servers in the network.

48.3.1.2 Resource Management

VMware Server provides virtual machine remote management functions based on IP address. The system administrator manages and monitors BIOS-levelly the virtual machine via the Internet at any place and via remote switch to restart the virtual machine. Through the Web management interface you can view the running time, CPU, and memory usage of the host and each virtual machine. The virtual machine console provides virtual machine screen management functions, completes to create and import the virtual machine by a new remote console, changes the hardware configuration of the virtual machine, adjusts the parameters of the virtual machine's BIOS, installs software, and debugs for running virtual machine.

48.3.1.3 Remote Desktop Connection

The operating system itself has a remote desktop connection and needs just a simple installation of components and open functions. You can operate the computer in real time, for example, install the software, run the program, copy the downloaded data, all of it directly on the computer, and you can implement more than one person operation with the flexibility to switch between local and remote computers and pass data to each other, which enables network administrators to security control work server at home.

48.3.1.4 Snapshot

VMware virtual machine "snapshot" feature has virtual machine disk files (virtual machine disk, VMDK) that creat a copy of a State. When the system is an exception, you can restore snapshots to ensure the system is normal. However, it is noticed that the virtual machine performs a reading operation when the snapshot is created. The hypervisor will check the VMDK to see whether read blocks are present. If so, provide this block for a virtual machine from the snapshot, if not, virtual machine also need to read the base VMDK consuming a large number of read I/O. Fundamentally, VMware snapshots are for two types of situations: (1) the disks of a virtual machine are isolated and no longer written data, so that it can be backed up; (2) when patching and software upgrading, snapshot can provide automatic recovery in a short period.

48.3.2 Server Virtualization Architecture

There is combine course construction, daily service work, students and teachers' requirements, as shown the server virtualization deployments in Fig. 48.1.

Physical resources that are the main underlying hardware facilities can basically utilize the existing devices, including mass storage devices, physical servers, and network devices realizing server and client, for example, three-layer and gigabit switches, fibers, routers, and so on.

The virtual layer mainly implements storage virtualization, network virtualization, and server virtualization. Storage virtualization is to centrally manage the multiple storage media module (such as hard disks, RAID) through some means. This concept is to separate the actual physical storage entities from the logical representation of the storage, with contact only with the logical volume (or virtual volumes) assigned, and with no care about their data on physical storage entities, when applying server. Mapping between logical volumes and physical entity is determined by volume management software installed on the physical server (called a host-level virtualization), or storage subsystem controller (called a storage subsystem-level virtualization), or the special device joining the SAN

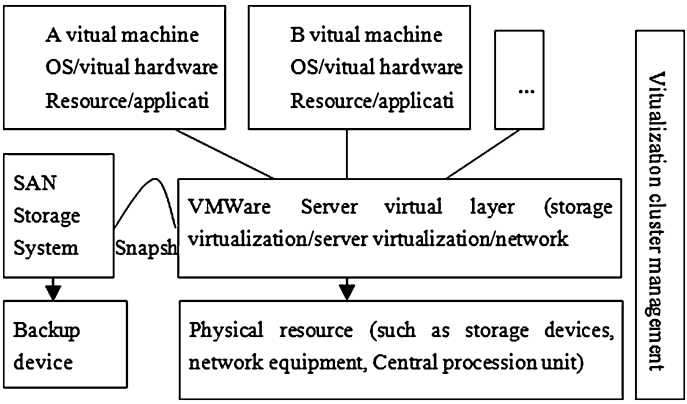

Fig. 48.1 Server virtualization deployment

storage network (called a network-level virtualization). In addition to facilitating unified management, storage virtualization realizes data movement, data backup, and at the same time, service is not affected.

In network virtualization the router and switch perform a greater number of services, which can help increase the value of the networking equipment, mainly for access control and path extraction. Server virtualization installs VMware Server and VMware Center software in physical machine, to support different operating systems to independently run in a machine and support remote management and monitoring. VMware Virtual Center [6] is a virtual cluster management software constructed platform that enables server and virtual machine to be distributed everywhere to realize central management and resource coordination, dynamic resource allocation, disaster recovery, and more.

Each virtual machine has user-oriented aspects, combining the computer lab service requests. They deploy three virtual machines and rationally distribute physical hardware resources to support three virtual machines to run simultaneously with non-interference. For example, the memory of single virtual machine cannot be more than the physical memory capacity, and the best left 1G memory to the physical machine [7] using physical network cards to configure virtual network and realizing network interconnection. The distributions of three virtual machines are as follows in the systems and application: A virtual machine mainly supports test environment, due to the limit of the test environment on the server system, so install win2003 server operating system platform, some examination and protect software; Another virtual machine mainly supports that teachers send and receive operations, teachers and students applicant and download softwares, documents, so in addition to installing a server operating system, and install some additional components to support FTP, WEB services for implementation of upload and download, support remote desktop connection that allow some users to operate the virtual machine in real time, applicant software, run program, share network resources by setting user permissions, everything seems to be operating on directly

at the computer. As long as the network allows, teachers pack up, review, copy the exercise uploaded by student anytime and anywhere. Of course, the virtual environment helps reduce the burden on administrator works in computer room, solves the problem of borrowing the software, which not only increases service efficiency, but also expands the scope of services. The last virtual machine in addition to installing the fixed service operating system, the rest application software configuration will be flexibly adapted, the virtual machine mainly supports to participate in or organize some internal and external competition in school, each competition has its own environmental requirements, now which saves as files in a virtual machine, not only conveniently move, but also easy to manage.

48.4 Conclusion

Lab server virtualization integration practice prove, on the basis of high-performance servers, server virtualization consolidation is the means of using efficiently hardware and software, sharing network resources, increasing the types of services in the application deployment process in the lab. During the implementation process, of course, also consider security of the server, other than add some protective equipment and distribute rationally rights, must also do without affecting the performance of services under a valid backup. Otherwise, require the number of effective client access through further experiments in the context of current hardware.

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Chapter 49
New Global Stability Criterion of Delayed BAM Neural Networks

Chunyan Hu and Degang Yang

Abstract The global asymptotic stability of delayed BAM neural networks is investigated. A process, which is called parameterized first-order model transformation, is used to transform the linear system. New criterion for global asymptotic stability of the unique equilibrium point of delayed BAM neural networks is obtained.

Keywords Bidirectional associative memory neural networks · Global asymptotic stability · Linear matrix inequality

49.1 Introduction

Kosko proposed bidirectional associative memory (BAM) neural networks (NNs) model with the ability of information memory and information association, which is crucial for application in pattern recognition and automatic control engineering [1]. During the past several years, the convergence dynamics of BAM neural networks have been extensively studied because of the wider application in various patter recognition and artificial intelligence, etc. Time delay occurred in the interaction between neurons will affect the stability of a network by creating instability, oscillation, and chaos phenomena. In view of this, the stability issue of

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delayed BAM neural networks is a topic of great practical importance [2–7], which has gained increasing interest in the potential applications in pattern recognition, automatic control engineering, artificial intelligence, and other fields.

In this paper, we deal with the problem of global asymptotic stability for BAM neural network with constant time delays. By constructing a suitable Lyapunov functional, a new condition for global asymptotic stability of BAM with constant delay is given in terms of LMIs.

49.2 Neural Network Model and Preliminaries

The delayed BAM model we consider is defined by the following state equations:

$$\begin{aligned} \dot{u}(t) &= -Au(t) + Wf(v(t-\tau)) + I \\ \dot{v}(t) &= -Bv(t) + Vg(u(t-\sigma)) + J \end{aligned} \tag{49.1}$$

where A and B denote the neuron charging time constants and passive decay rates, respectively; W and V are synaptic connection strengths; f and g represent the activation functions of the neurons and the propagational signal functions, respectively; I and J denote the external inputs, $\tau > 0$ and $\sigma > 0$ are positive constants which correspond to the finite speed of axonal signal transmission. $u = [u_1, u_2, \ldots, u_n]^T$ and $v = [v_1, v_2, \ldots, v_m]^T$ are the activations of the ith neurons and the jth neurons, respectively.

In this paper, we always assume that the activation functions are bounded and satisfy conditions:

(H1) There exists positive constants $M_j > 0, j = 1, \ldots, m$ and $L_i > 0, i = 1, \ldots, n$ such that, $|f_j(\xi_1) - f_j(\xi_2)| \le M_j|\xi_1 - \xi_2|, |g_i(\varsigma_1) - g_i(\varsigma_2)| \le L_i|\varsigma_1 - \varsigma_2|$.

(H2) $g_i(i = 1, 2, \ldots n)$ and $f_j(j = 1, 2, \ldots m)$ is bounded on R.

It is easy to see that the assumption (H1) implies that the activation functions are continuous but not always monotonic. Suppose that $u^* = [u_1^*, u_2^*, \ldots, u_n^*]^T \in R^n$ and $v^* = [v_1^*, v_2^*, \ldots, v_m^*]^T \in R^m$ is an equilibrium point of system, and we will shift the equilibrium points to the origin by the transformation $x_i(t) = u_i(t) - u_i^*$, $y_j(t) = v_j(t) - v_j^*$, $G_i(x_i(t)) = g_i(u_i(t)) - g_i(u_i^*)$, and $F_j(y_j(t)) = f_j(v_j(t)) - f_j(v_j^*)$. Then system (49.1) can be rewritten as:

$$\begin{aligned} \dot{x}(t) &= -Ax(t) + WF(y(t-\tau)) \\ \dot{y}(t) &= -By(t) + VG(x(t-\sigma)) \end{aligned} \tag{49.2}$$

where $x(t) = [x_1(t), x_2(t), \ldots, x_n(t)]^T$, $y(t) = [y_1(t), y_2(t), \ldots, y_m(t)]^T$ is the state vector of the transformed system. From the assumptions (H1) and (H2), we can see that the function vector, F and G possesses the following properties:

(H3) There exists positive constants $M_j > 0, j = 1, \ldots, m$ and $L_i > 0, i = 1, \ldots, n$ such that $\left|F_j(\xi)\right| \leq M_j|\xi|, |G_i(\varsigma)| \leq L_i|\varsigma|\ G_i(i = 1, 2, \ldots n)$ and $F_j(j = 1, 2, \ldots m)$ is bounded on R.

Obviously, the equilibrium point of system (49.1) with (H1) and (H2) is globally asymptotically stable if and only if the origin of system (49.2) with (H3) is globally asymptotic stable.

Recall the assumption (H3) on the activation functions, we can define, for $i = 1, 2, \ldots, n$,

$$s_i(t) = \begin{cases} \frac{G_i(x_i(t))}{x_i(t)}, & x_i(t) \neq 0 \\ 0, & x_i(t) = 0, \end{cases} \quad z_j(t) = \begin{cases} \frac{F_j(y_j(t))}{y_j(t)}, & y_j(t) \neq 0 \\ 0, & y_j(t) = 0, \end{cases} \tag{49.3}$$

Therefore $G_i(x_i(t)) = s_i(t) \cdot x_i(t), F_j(y_j(t)) = z_j(t) \cdot y_j(t)$, furthermore, system (49.2) can be rewritten as,

$$\begin{aligned} \dot{x}(t) &= -Ax(t) + WZ(t-\tau)y(t-\tau)) \\ \dot{y}(t) &= -By(t) + VS(t-\sigma)x(t-\sigma) \end{aligned} \tag{49.4}$$

where $S_i(t) = diag(s_i(t)), Z_j(t) = diag(z_j(t))$, from the assumption (H3), we have $-L_i \leq s_i \leq L_i, -M_j \leq z_j \leq M_j$ where $L = diag(L_i), M = diag(M_j)$.

Before starting the main results, we first need the following Lemma.

Lemma 1 *In* [8] *given any real matrices* $\sum_1, \sum_2, \sum_3$ *of appropriate dimensions and a scalar* $\varepsilon > 0$ *such that* $0 < \sum_3 = \sum_3^T$ *. Then, the following inequality holds*: $\sum_1^T \sum_2 + \sum_2^T \sum_1 \leq \varepsilon \sum_1^T \sum_3 \sum_1 + \frac{1}{\varepsilon} \sum_2^T \sum_3^{-1} \sum_2$.

Lemma 2 (Schur complement). *Reference* [9] *the following linear matrix inequality* (*LMI*): $\begin{pmatrix} Q(x) & S(x) \\ S^T(x) & R(x) \end{pmatrix} > 0$, *where* $Q(x) = Q^T(x), R(x) = R^T(x)$, *and* $S(x)$ *depend affinely on x equivalent to* $R(x) > 0, Q(x) - S(x)R^{-1}(x)S^T(x) > 0$.

49.3 Global Asymptotic Stability Analysis for Delayed BAM Neural Networks

In Ref. [10], the equality

$$x(t-\tau) = x(t) - \int_{-\tau}^{0} \dot{x}(t+\xi)d\xi = x(t) - \int_{-\tau}^{0} [Ax(t+\xi) + A_d x(t+\xi-\tau)]\xi \tag{49.5}$$

was used to transform the system $\dot{x}(t) = Ax(t) + A_d x(t-\tau)$ into a distributed delay system

$$\dot{x}(t) = (A + C)x(t) + (A_d - C)x(t - \tau) - C \int_{-\tau}^{0} [Ax(t + \theta) + A_d x(t + \theta - \tau)]d\theta \tag{49.6}$$

Such process is generically called a parameterized first-order model transformation since only one-integration over one delay interval is used herein. We refer the reader to Ref. [10] for the further discuss to the original system (49.4).

Applying the model transformation above to the considered systems (49.4), we derive

$$\begin{aligned}
\dot{x}(t) &= (-A + C_1)x(t) - C_1 x(t - \sigma) + WZ(t - \tau)y(t - \tau) \\
&\quad - C_1 \int_{t-\sigma}^{t} [-Ax(\xi) + WZ(\xi - \tau)y(\xi - \tau)]d\xi \\
\dot{y}(t) &= (-B + C_2)y(t) - C_2 y(t - \tau) \\
&\quad + VS(t - \sigma)x(t - \sigma) - C_2 \int_{t-\tau}^{t} [-By(\eta) + VS(\eta - \sigma)x(\eta - \sigma)]d\eta
\end{aligned} \tag{49.7}$$

From the analysis made above, the stability of (49.7) implies the stability of (49.1), (49.2) and (49.4), and hence, in what follows we mainly focus on the stability of system (49.7).

Now we will present a new result for asymptotic stability of Eq. (49.7):

Theorem 1 *Suppose that the assumption (H) is satisfied. If there exists a constant symmetric and positive definite matrix* P, Q, R_2, R_5, *diagonal positive matrices* R_1, R_3, R_4, R_6 *and constant matrix* K, N *such that for all* $t \geq 0$ *the following inequality holds*:

$$\begin{aligned}
\Omega_1 &= K + K^T - PA - A^T P + \sigma(R_2 + R_6) + KR_4^{-1}K^T \\
&\quad - PWMR_1^{-1}MW^T P + \sigma KAR_2^{-1}A^T K^T + \sigma KWMR_3^{-1}MW^T K^T \\
\Omega_2 &= N + N^T - QB - B^T Q + \tau(R_3 + R_5) + NR_1^{-1}N^T \\
&\quad - QVLR_4^{-1}LV^T Q + \tau NBR_5^{-1}B^T N^T + \tau NVLR_6^{-1}LV^T N^T
\end{aligned} \tag{49.8}$$

where $L = diag(L_i), M = diag(M_i)$, Then the origin of system (49.1) for any $\tau \in [0, \bar{\tau}], \sigma \in [0, \bar{\sigma}]$ is the unique equilibrium point and it is globally asymptotically stable. The corresponding model transformation matrix in (49.9) is given by $C_1 = P^{-1}K, C_2 = Q^{-1}N$.

Proof In order to study globally asymptotic stability of the origin of system (49.7), we consider the following general Lyapunov–Krasovskii functional below:

$$
\begin{aligned}
&V = V_1 + V_2 + V_3 + V_4 + V_5 + V_6 \qquad V_4 = \int_{-\sigma}^{0} \left(\int_{t+\theta}^{t} x^T(\xi) R_2 x(\xi) d\xi \right) d\theta \\
&V_1 = x^T(t) P x(t) \\
&V_2 = y^T(t) Q y(t) \qquad V_5 = \int_{-2\tau}^{-\tau} \left(\int_{t+\theta}^{t} y^T(\eta) R_3 y(\eta) d\eta \right) d\theta \qquad (49.9) \\
&V_3 = \int_{-\tau}^{0} \left(\int_{t+\theta}^{t} y^T(\eta) R_5 y(\eta) d\eta \right) d\theta \qquad V_6 = \int_{-2\sigma}^{-\sigma} \left(\int_{t+\theta}^{t} x^T(\xi) R_6 x(\xi) d\xi \right) d\theta
\end{aligned}
$$

The time derivative of Lyapunov–Krasovskii functional V along the trajectories of system (49.9) is derived as follows:

$$
\begin{aligned}
\dot{V}_1 &= 2x^T(t) P[(-A + C_1)x(t) - C_1 x(t-\sigma) + WZ(t-\tau)y(t-\tau) \\
&\quad - C_1 \int_{t-\sigma}^{t} [-Ax(\xi) + WZ(\xi-\tau)y(\xi-\tau)] d\xi] \\
&= 2x^T(t) P(-A + C_1)x(t) - 2x^T(t) P C_1 x(t-\sigma) + 2x^T(t) P WZ(t-\tau)y(t-\tau) \\
&\quad + \int_{t-\sigma}^{t} 2x^T(t) P C_1 A x(\xi) d\xi - \int_{t-\sigma}^{t} 2x^T(t) P C_1 WZ(\xi-\tau)y(\xi-\tau) d\xi \\
\dot{V}_2 &= 2y^T(t) Q[(-B + C_2)y(t) - C_2 y(t-\tau) + VS(t-\sigma)x(t-\sigma) \\
&\quad - C_2 \int_{t-\tau}^{t} [-By(\eta) + VS(\eta-\sigma)x(\eta-\sigma)] d\eta] \\
&= 2y^T(t) Q(-B + C_2)y(t) - 2y^T(t) Q C_2 y(t-\tau) + 2y^T(t) Q VS(t-\sigma)x(t-\sigma) \\
&\quad + \int_{t-\tau}^{t} 2y^T(t) Q C_2 B y(\eta) d\eta - \int_{t-\tau}^{t} 2y^T(t) Q C_2 VS(\eta-\sigma)x(\eta-\sigma) d\eta \\
\dot{V}_3 &= \int_{-\tau}^{0} y^T(t) R_5 y(t) d\eta - \int_{-\tau}^{0} y^T(t+\eta) R_5 y(t+\eta) d\eta \\
&= \tau y^T(t) R_5 y(t) - \int_{t-\tau}^{t} y^T(\eta) R_5 y(\eta) d\eta
\end{aligned}
$$

$$
\begin{aligned}
\dot{V}_4 &= \int_{-\sigma}^{0} x^T(t)R_2x(t)d\xi - \int_{-\sigma}^{0} x^T(t+\xi)R_2x(t+\xi)d\xi \\
&= \sigma x^T(t)R_2x(t) - \int_{t-\sigma}^{t} x^T(\xi)R_2x(\xi)d\xi \\
\dot{V}_5 &= \int_{-2\tau}^{-\tau} y^T(t)R_3y(t)d\eta - \int_{-2\tau}^{-\tau} y^T(t+\eta)R_3y(t+\eta)d\eta \\
&= \tau y^T(t)R_3y(t) - \int_{t-\tau}^{t} y^T(\eta-\tau)R_3y(\eta-\tau)d\eta \\
\dot{V}_6 &= \int_{-2\sigma}^{-\sigma} x^T(t)R_6x(t)d\xi - \int_{-2\sigma}^{-\sigma} x^T(t+\xi)R_6x(t+\xi)d\xi \\
&= \sigma x^T(t)R_6x(t) - \int_{t-\sigma}^{t} x^T(\xi-\sigma)R_6x(\xi-\sigma)d\xi.
\end{aligned}
\tag{49.10}
$$

From Lemma 1, we have the following inequalities:

$$
\begin{aligned}
&2x^T(t)PC_1x(t-\sigma) \le x^T(t)PC_1R_4^{-1}AC_1^TPx(t) + x^T(t-\sigma)R_4x(t-\sigma) \\
&2x^T(t)PWZ(t-\tau)y(t-\tau) \\
&\le x^T(t)PWZ(t-\tau)R_1^{-1}Z^T(t-\tau)W^TPx(t) + y^T(t-\tau)R_1y(t-\tau) \\
&\le x^T(t)PWMR_1^{-1}MW^TPx(t) + y^T(t-\tau)R_1y(t-\tau) \\
&2y^T(t)QVS(t-\sigma)x(t-\sigma \\
&\le y^T(t)QVS(t-\sigma)R_4^{-1}S^T(t-\sigma)V^TQy(t) + x^T(t-\sigma)R_4x(t-\sigma) \\
&\le y^T(t)QVLR_4^{-1}LV^TQy(t) + x^T(t-\sigma)R_4x(t-\sigma) \\
&\int_{t-\sigma}^{t} 2x^T(t)PC_1Ax(\xi)d\xi \le \int_{t-\sigma}^{t} \left[x^T(t)PC_1AR_2^{-1}A^TC_1^TPx(t) + x^T(\xi)R_2x(\xi)\right]d\xi \\
&= \sigma x^T(t)PC_1AR_2^{-1}A^TC_1^TPx(t) + \int_{t-\sigma}^{t} x^T(\xi)R_2x(\xi)d\xi
\end{aligned}
$$

$$
\begin{aligned}
&\int_{t-\tau}^{t} 2y^T(t)QC_2By(\eta)d\eta \le \int_{t-\tau}^{t} \left[y^T(t)QC_2BR_5^{-1}B^TC_2^TQy(t) + y^T(\eta)R_5y(\eta)\right]d\eta \\
&= \tau y^T(t)QC_2BR_5^{-1}B^TC_2^TQy(t) + \int_{t-\tau}^{t} y^T(\eta)R_5y(\eta)d\eta \\
&- \int_{t-\sigma}^{t} 2x^T(t)PC_1WZ(\xi-\tau)y(\xi-\tau)d\xi \\
&\le \int_{t-\sigma}^{t} \left[x^T(t)PC_1WZ(\xi-\tau)R_3^{-1}Z^T(\xi-\tau)W^TC_1^TPx(t) + y^T(\xi-\tau)R_3y(\xi-\tau)\right]d\xi \\
&\le \int_{t-\sigma}^{t} \left[x^T(t)PC_1WMR_3^{-1}MW^TC_1^TPx(t) + y^T(\xi-\tau)R_3y(\xi-\tau)\right]d\xi \\
&\le \sigma x^T(t)PC_1WMR_3^{-1}MW^TC_1^TPx(t) + \int_{t-\sigma}^{t} y^T(\xi-\tau)R_3y(\xi-\tau)d\xi \\
&\quad - \int_{t-\tau}^{t} 2y^T(t)QC_2VS(\eta-\sigma)x(\eta-\sigma)d\eta \\
&\quad \le \int_{t-\tau}^{t} \left[y^T(t)QC_2VS(\eta-\sigma)R_6^{-1}S^T(\eta-\sigma)V^TC_2^TQy(t)\right] \\
&\quad + x^T(\eta-\sigma)R_6x(\eta-\sigma)]d\eta \\
&\quad \le \int_{t-\tau}^{t} \left[y^T(t)QC_2VLR_6^{-1}LV^TC_2^TQy(t) + x^T(\eta-\sigma)R_6x(\eta-\sigma)\right]d\eta \\
&\quad = \tau y^T(t)QC_2VLR_6^{-1}LV^TC_2^TQy(t) + \int_{t-\tau}^{t} x^T(\eta-\sigma)R_6x(\eta-\sigma)d\eta
\end{aligned}
\tag{49.11}
$$

Substitute Eqs. (49.11) into (49.10), we get

$$\begin{aligned}\dot{V} \le & x^T(t)[2P(C_1 - A) + PC_1R_4^{-1}C_1^TP - PWMR_1^{-1}MW^TP \\ & + \sigma PC_1AR_2^{-1}A^TC_1^TP \\ & + \sigma PC_1WMR_3^{-1}MW^TC_1^TP + \sigma(R_2 + R_6)]x(t) + y^T(t) \\ & [2Q(C_2 - B) + QC_2R_1^{-1}C_2^TQ \\ & - QVLR_4^{-1}LV^TQ + \tau QC_2BR_5^{-1}B^TC_2^TQ + \tau QC_2VLR_6^{-1} \\ & LV^TC_2^TQ + \tau(R_3 + R_5)]y(t) = x^T(t)\Omega_1x(t) + y^T(t)\Omega_2y(t)\end{aligned} \tag{49.12}$$

let $C_1 = P^{-1}K, C_2 = P^{-1}N$, such that

$$\begin{aligned}\Omega_1 &= K + K^T - PA - A^TP + \sigma(R_2 + R_6) + KR_4^{-1}K^T - PWMR_1^{-1}MW^TP \\ &\quad + \sigma KAR_2^{-1}A^TK^T + \sigma KWMR_3^{-1}MW^TK^T \\ \Omega_2 &= N + N^T - QB - B^TQ + \tau(R_3 + R_5) + NR_1^{-1}N^T - QVLR_4^{-1}LV^TQ \\ &\quad + \tau NBR_5^{-1}B^TN^T + \tau NVLR_6^{-1}LV^TN^T\end{aligned}$$

Since $\dot{V}(x(t), y(t)) < 0$ for $x(t) \neq 0$ or $y(t) \neq 0$. Hence, by the standard Lyapunov–Krasovskii stability theorem that the origin of system (49.7) is global asymptotically stable. Therefore, this implies that the origin of system (49.1) is global asymptotically stable. This completes the proof.

49.4 Conclusions

We have investigated the globally asymptotic stability problem via a novel approach combining the Lyapunov stability theorem and linear matrix inequality technique, we have derived some new sufficient conditions for the globally asymptotic stability of delayed BAM neural networks.

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Chapter 50
Semantic Integration Framework Based on Domain Ontology Construction

Jike Ge, Xianqiu Xu, Yongwen Huang and Mingying You

Abstract In this paper, we proposed a semantic integration framework of heterogeneous data based on domain ontology construction. The mechanism of domain ontology construction and mapping for heterogeneous data are studied, the purposes of which are to enhance the capability of dynamic adaptability and optimization of domain ontology construction, to resolve the problems of data heterogeneity in the processing of semantic information integration, and to promote the flexibility of the semantic integration process. Next, as to the semantic query, the theory and methods of specification or dynamic expansion of semantic query based on social annotation and ontology, and the duplicate removal and aggregating optimization of semantic query results are explored, the purpose of which is to realize the usability of semantic integration system and the credibility of the query results. Finally, an experimental prototype system of semantic integration of oil and gas exploration data based on domain ontology construction is constructed, the purpose of which is to verify the feasibility and correctness of the proposed theories and methods.

Keywords Semantic integration · Ontology construction · Domain ontology

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50.1 Introduction

Due to the wide applications of different information systems, a large amount of information and knowledge is accumulated. The information and knowledge is in different formats, e.g., electronic documents, databases, and hardcopy documents, scattered in various systems such as product lifecycle management (PLM), enterprise resource management (ERP), and office automation (OA) systems. Integrating different information sources semantically is a growing research area within different application domains. However, reaching semantic integration is not an easy task. While the real world is assumed to be unique, its representation depends on the intended purpose: every representation of reality is user-specific. Thus, different applications that share interest in the same real-word phenomena may have different perceptions and therefore require different representations. Differences may arise in all facets that make up a representation: what amount of information is kept, how it is described, how it is organized, how it is coded, what constraints, processes, and rules apply, how it is presented, etc., [1, 2]. Thus, the problem of data integration emerges as a new research challenge. Data integration is becoming even more necessary given the increasing availability of data from distributed and heterogeneous sources, as experienced in the development of the internet and semantic web. Such characteristics make it difficult to search for desired information since queries might be inappropriately answered or may have incomplete results if each data source is analyzed in isolation.

Together with the concept of data integration, the term federated databases emerged during the 1990s to characterize techniques for providing integrated data access to a set of distributed, heterogeneous, and autonomous databases [3]. The work reported in Busse et al. [4] defines the classical layered architecture of federated systems based on Sheth and Larson [5], which is widely referred to by many researches. The federated layer is one of the main components currently under analysis and study. Its importance comes from its responsibility to solve problems related to semantic heterogeneity. Different approaches have been used to model this layer. They are as much diverse as complementary in some cases, and can involve different perspectives, such as the use of ontologies [6] or the use of metadata [7].

Ontologies, as considered by the computer science community, comprise elements such as classes, individuals, properties, and relationships [8], which can be used to model the semantics of the domain related to integrated data sources. Most frequently, work on ontologies aims at developing single-world ontology, i.e., an ontology that represents a given conceptualization of the real world from a given perspective. In our work, we are particularly interested in those approaches using domain ontology because they are introduced to facilitate knowledge sharing and reuse among various agents (software and humans) [9].

Following this premise, we propose a semantic integration framework of multisource heterogeneous data based on domain ontology construction, based on two main processes: semantic integration and query. Semantic integration is

carried out integrating multisource heterogeneous data schema to domain ontology schema in order to improve the understandability of data. We propose a semantic querying methodology based on social annotation, in which the use of a set of matching functions and inferences over the ontologies allowing users to find more suitable mappings according to the users' social annotation and domain ontology.

50.2 The Proposed Data Integration Framework

The architecture of the proposed semantic integration framework of multisource heterogeneous data based on domain ontology construction system is shown in Fig. 50.1. In the framework, domain ontology is constructed by integrating multisource heterogeneous data. A user's interest ontology is generated by analyzing the user's demographic characteristics, personal preferences, and user's social annotation. An automatic retrieval specification and expansion method is utilized to categorize the information queried by a user. In the proposed retrieval specification and expansion method, the terms are determined by the domain ontology and user interest ontology base.

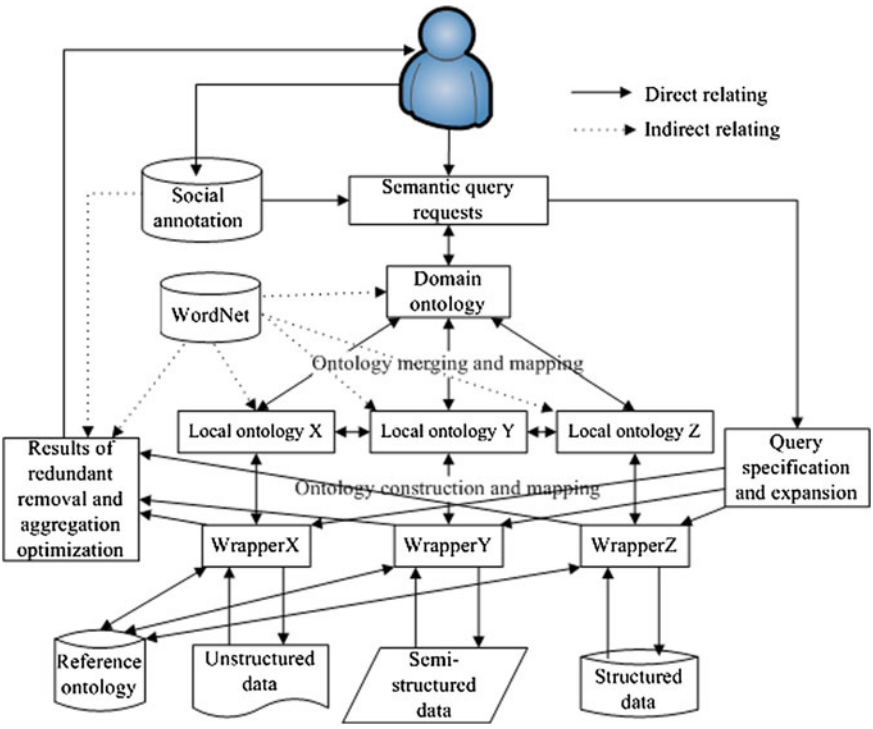

Fig. 50.1 The semantic integration framework based on domain ontology construction

50.2.1 Using Domain Ontology for Data Integration

Data integration systems (DIS) deal with two main problems: combining data located in different heterogeneous sources and providing the user with a unified view of gathered results [2]. By providing a unique, transparent and homogeneous view of heterogeneous data sources, it is possible to retrieve richer information, since different sources can have complementary data. In order to build an integrated view of data source s, some conflicts must be addressed, such as schematic and structural, and semantic ones [10].

To handle some of these conflicts, ontology provides a feasible methodology for semantic integration of the multisource heterogeneous information within the DIS. Specific domain ontology plays a key role in the data integration processing semantically. In this sense, domain ontology is constructed by integrating multisource heterogeneous information. The process of domain ontology construction includes two steps, namely, local ontology construction and merging local ontologies to domain ontology. The process of local ontology construction includes three aspects, namely from unstructured text documents, from structured relational data sources and from semi-structured data sources in XML files [11]. For structured relational data sources, the RDB2OWL mappings [12] can be regarded as documentation of the database-to-ontology relation. The RDB2OWL language reuses the OWL ontology structure as a backbone for mapping specification by placing the database link information into the annotations for ontology classes and properties. It features reuse of database table key information, user defined and table functions, as well as multiclass conceptualization that is essential for keeping the mapping compact in case of creating a conceptual partitioning of large database tables. For semi-structured data sources, XML2OWL [13] is a script to transform standard XML documents into neat OWL. The purpose of merging local ontologies to domain ontology is that building global domain ontology from some heterogeneous local ontology by using semantic distance-based ontology matching method [14].

50.2.2 The Implementation Processing of Proposed System

In our proposed system, we employ domain ontology in order to integrate multisource heterogeneous data sources. In addition to data integration, we combine social annotation with domain ontology [15] to perform semantic query expansions, retrieving approximate results that are relevant to user requirements. The operational flow of proposed system as follows.

The starting point is the query formulation in user interface. User types the query in a text box, once the query is submitted to the data integration system; it is analyzed to check possible syntactic errors and homonyms in relation to the domain ontology and user's social annotation. After the necessary corrections to

the query, if they are fit for querying ontology directly, it will implement ontology matching, if not, it will continue to the query specification and expansion module. In this module, the query is modified if both domain ontology constructs and user-defined expansion parameters indicate that semantic expansions are needed. For further information on semantic query expansion procedures.

In the next step, wrapper receives the query, creates a thread for each wrapper and distributes the query to them. Each wrapper is responsible for converting the user query into respective queries that are specific to the corresponding data source. Moreover, wrappers perform the translation of the data returned from sources to a common model, previously defined by the domain ontology. All wrappers keep two important types of XML documents containing: information on how to connect to its respective data source; and mappings for associating each ontology concept with a corresponding term in the data source. These mappings are an essential element to support query translation, since mapping rules are written depending on the schema and the query language considered by a data source. During the query translation, wrappers handle some heterogeneity problems, such as naming, lack of data, attribute, value, and identifier conflicts. After the query is translated, it is submitted to each respective data source. As soon as the results are returned from the data sources, wrappers check the mappings and the reference ontology to verify if returned answers contain terms related to user's query. In this step, specific functions offered by the reference ontology are called by the wrappers for filtering the results and discarding those coordinates that does not relate to the terms in the query.

Once all results have been received, they are redundant removal and aggregation optimization, checking for equalities and gathering them in a single tabular result. Subsequently, it can be properly formatted and presented to the user, concluding the query flow.

50.3 Case Study: Integrating Oil and Gas Exploration Data Sources

To evaluate the feasibility of proposed semantic integration framework based on domain ontology construction in a real environment, a case study was performed in the domain of oil and gas exploration.

We have constructed general prototype architecture of proposed data integration framework, it shows as Fig. 50.2. All modules, which have been developed using open source technologies, are organized in a traditional client–server structure. Users access the system through a web browser. The web server application has been built in Java Server Faces with the ICE faces extension which is an Ajax framework that allows the development of rich internet applications in Java. The concurrency of the system (as multiple users may be accessing the application at the same time) is addressed by the framework using a thread pool

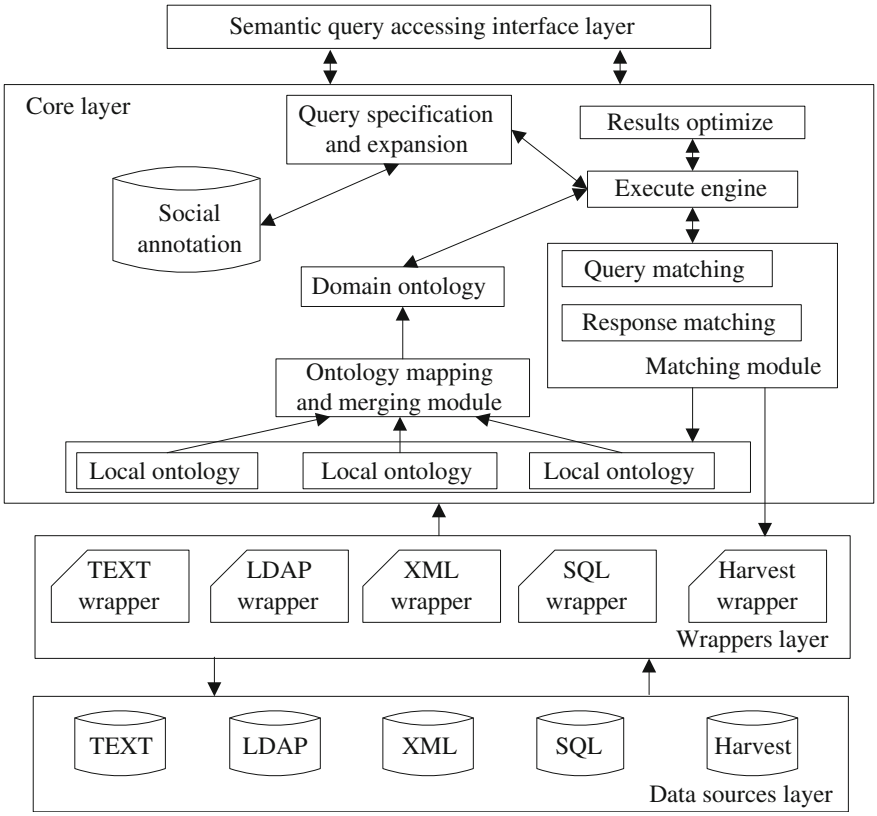

Fig. 50.2 The architecture of domain ontology construction based semantic integration

which provides bounded thread usage in large-scale applications. The core of the architecture is developed in Java, which handles the interaction between all the modules. Moreover, it manages the user's social annotation dynamically updating its state after each user action. This allows the system to take into account the behavior of the user and provide more accurate results. The Jena framework was also used to make inferences from the domain ontology written in web ontology Language.

Data sources containing the unstructured data, such as documents, the structured relational data sources (MySQL and SQL) and also semi-structured data sources in XML files.

The first step of system deployment is the construction of domain ontology, describing the semantics related to oil and gas exploration data sources. We have defined oil and gas exploration ontology with support of domain experts. The oil and gas exploration ontology was developed according to bottom-up approach and codified in OWL. Figure 50.3 shows part of this ontology.

Fig. 50.3 The part of oil and gas exploration domain ontology

To illustrate the semantic query expansion and data integration processes involving oil and gas exploration data sources, consider query Q executed by researchers, who required information on the sub-surface geological and density in Sichuan basin:

$$Q: \textit{sub-surface geological AND density AND exploration} = \textit{Sichuan basin} \tag{50.1}$$

First step is analyzing Q, so that it can be rewritten in a common vocabulary language provided by the domain ontology. In this step, the domain ontology is analyzed to detect that density term can be associated with both density of gravity exploration and density of well logging concepts. In order to handle this ambiguity, the system interacts with the user so that one option is selected.

With regard to data integration, it is necessary to define mappings between ontology concepts and the data contained in the heterogeneous sources. The wrappers, specific to each data source, analyze those mappings in order to translate

an ontology concept to the corresponding term in the data source. When a wrapper checks its mappings and they do not contain any of the terms of the query, it means that the database-specific query will not contain this term as well. In this case, the wrapper will not activate its respective database and will close the connection with local ontology.

Finally, results obtained from wrappers are sent back to results of redundant removal and aggregation optimization module, where result sets are merged. The integrated results are then presented to the user in a tabular format, including values for the original query as well as values for expanded terms.

50.4 Conclusions and Future Work

In this paper, we proposed a semantic integration framework of multisource heterogeneous data based on domain ontology construction, our framework supported integrated management of multisource information, providing a homogeneous view to access several heterogeneous data sources by constructing domain ontology. In addition, query expansions can also provide relevant retrieval results, it will support the researchers generating decision-making reports in less time. It will be our future works.

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Chapter 51
Research of Text Plagiarism Detection Process

Qin Xu, Yan Tang and Lan-su Nie

Abstract The paper analyzes and summarizes the main types and forms of the present document copying. Then according to the process of document plagiarism detection, there are many main methods and the corresponding researches used in the various stages. The paper provides an overview of the meaning of text plagiarism detection, and proposes some further work on text plagiarism detection.

Keywords Text pre-processing · Similarity between texts · Text comparison · Chinese text segment

51.1 Introduction

Over the past 20 years, with the high speed development of computer, network, and communication technology, people can get all kinds of knowledge more conveniently, which provides persons with copying opportunities however. Document copying appeared in many fields, such as academia, business, literary area among which academic works and the paper copy are the two kinds of most serious copying types. These plagiarisms not only violated the original author's copyright, also brought serious harm to academic development and economic aspects.

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In order to protect the copyright and reduce paper plagiarism, the study of paper plagiarism detection is increasingly necessary. In recent years, algorithms for English documents plagiarism detection have been proposed, mainly using digital fingerprints and word-frequency techniques. But they are not suited for Chinese documents. The main aim of this paper is document copying process. It introduces two types of the copy of the form and the commonly used detection technology.

51.2 Knowledge

51.2.1 Related Concepts

Text plagiarism is the phenomenon of copying an original material information, views, and sentences to his article directly or using the main point view of others works to his article but not marking it, which is a fraudulent practice.

Text plagiarism detection can also be called text copy detection. It is to judge a text content whether copying from one or more texts. It not only means verbatim copying, but also the original shift transformation, synonyms replace and change the way of description [1].

Paper plagiarism detection is based on text copy detection. It is to detect the format of the special information and argument information. The following content is the main methods used before and the existing research results.

Paper copy are divided into two kinds: one is thought plagiarism, that is a core subject thought plagiarism paper, main idea; the other is content copy, that is copying the words, sentences, and the program code, charts, formula and so on [2].

51.2.2 Thought Plagiarism

Thought plagiarism is the core idea of copying documents, views of ideas as well as they used. It is generally difficult to directly determine whether it is a plagiarism. Because it can not only be the whole piece of the paragraph plagiarism, and the amount of plagiarism may also be less, more hidden, so it is not simple to measure the amount of plagiarism. With the specific pattern recognition methods, it needs to compare the similarity between the suspected of plagiarism and similar documents. And then it can determine the similarity according to the set of domain value.

Zhao [3] had put forward an automatic abstract paper plagiarism detection based on detection method. The method uses computer automatically extract abstract from text or text set. It used a keywords retrieval method based on the automatic abstract technology to design realize paper plagiarism detection method and it got a good effect. Jin Bo's [4] similarity copy detection algorithm based on

textual structure is proposed for the phenomenon of written form standard for academic paper. The algorithm analyzed the academic paper structure and specific elements such as time, the title, author, unit, abstract, key words of database.

51.2.3 Content Plagiarism

The content plagiarism mainly includes the copy of words, sentences, and the program code, charts, formula and synonyms replacement. There are a variety of forms of plagiarism. As for text, it may be directly copy, a part of paragraphs and statements in reverse, replace the words, and translation of two different languages. For the program code, it can change variable names, modify the format, change the order of function, add redundancy statement or variables, and even can copy flow chart. Zhao [5] proposed a paper plagiarism judging algorithm which is based on a paragraph of obtaining statistics. It can detect the paragraph statements, the paragraph change order compression and expansion of the content.

51.2.4 Plagiarism Detection Process

Plagiarism detection process includes text preprocessing, segmentation, similarity calculation and text comparison. The text pre-processing is to convert the original text document into uniform format, and remove some unnecessary formatting information to prepare for the next. The segmentation is to divide the word of text into required word format. The similarity calculation is to calculate the similarity between the texts and get the similarity value, and to provide practical evidence to determine whether plagiarism. Text comparison is to compare the text between suspected plagiarism and source text and output the plagiarism part. The segmentation and the similarity computation are most important stages of Plagiarism detection process.

51.3 Plagiarism Detection Process Analysis

According to the domestic and international research on plagiarism detection, there is a roughly common workflow. The main flow as shown in Fig. 51.1.

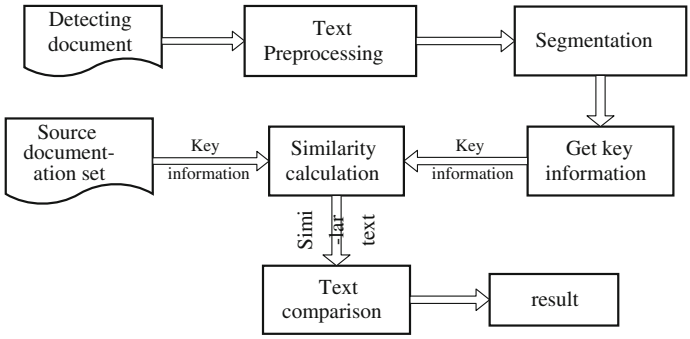

Fig. 51.1 Plagiarism detection process workflow

51.3.1 Text Pre-Processing

The text pre-processing stage is to collect all types of document data, by some processing, the original text converted into a recognizable representation of the computer, which is related to the section and clause processing, to do the foundation for the segmentation of later stages, quality of pretreatment will directly affect the effect of segmentation stage.

51.3.2 Segmentation

There are many existing segmentation methods, in essence, divided into mechanical sub-lexical, understanding sub-lexical, semantic sub-lexical and artificial intelligence sub-lexical. From the application point of view they can be divided into mechanical segmentation method based on dictionary, mechanical, statistical mechanical; rule-based and statistical segmentation method [6].

Based on these methods, there are many segmentation systems, and the more prominent existing systems [7–9] are as follow: Chinese Tokenizer, The rain marks word component, ICTCLAS, KTDictSeg, CSW Chinese word components and Mass Chinese smart word.

51.3.3 Similarity Calculation

There are many kinds of text similarity calculation, including the calculation of the relationship between words, sentences and paragraphs, etc. The most widely used algorithms are the character matching, the vector space model, the method based on word frequency statistics, the N-gram-based matching algorithm and the algorithm of the text structure and semantics-based approach.

Similarity is calculated as follows:

$$\mathrm{Sim} = \frac{|S(A) \cap S(B)|}{|S(A) \cup S(B)|} \tag{51.1}$$

A is the article to be detected; B is a database of articles. $S(A)$ and $S(B)$ denote the collection of sub-sequences in the articles of A, B. Its value is a number on [0, 1], the higher the value, the more similar about two articles.

51.3.3.1 Similarity Measure Based on the Characters that Match the Text

This measure used the distance functions and similar functions. The distance function described the degree of similarity between two text, it general made the rules on [0, 1] range, the combined total of 1.

Namely: set the similarity of text s and t as Sim(s, t), and the distance functions as Dis(s, t), then Sim(s, t) + Dis(s, t) = 1. The basic idea of the algorithm is to look the text as character series, and calculate the similarity of character of the matching between texts. The more similar the strings the greater the similarity coefficient between two texts is.

The method of plagiarism detection was used many years ago. As early as in 1994, Manber proposed Sif tool. This tool used digital fingerprint methods, compared the Hash values to measure the similarity between the files based on the string matching method. The plagiarism detection system based on the document of the string matching method proposed by Li Xu [10] had a full use of this method.

51.3.3.2 VSM Model Based on the Similarity in Vector

VSM model seams the document as the constitution of independent set of entries. All the documents and user queries can be mapped to a entry vector in text vector space, which will transform the document information matching problem into the vector space vector matching problem. The algorithm isn't be affected by the constraints of the string order and it takes the relationship of the disk, the length of the string and the difference of words into account. So it can effectively improve the accuracy of similarity calculation. In 1995, Garcia-Molina and Shivakumar SCAM (Stanford Copy Analysis Method) prototype system [11] is using for reference the information retrieval technology of vector space model in the VSM.

The SCAM of the vector space model used the cosine formula to calculate the article similarity as Sv(R, Q). The following specific company as shown:

$$\mathrm{Sv}(R, Q) = \frac{\sum_{i=1}^{n} a_i^2 * F_i(R) * F_i(Q)}{\sqrt{\sum_{i=1}^{n} a_i^2 F_i^2(R) * \sum_{i=1}^{n} a_i^2 F_i^2(Q)}} \tag{51.2}$$

where R represents the candidate document, and Q represents the document to be detected, $F(R)$ and $F(Q)$, respectively, the document Q, R and documents word frequency vector.

51.3.3.3 Method Based on Words Frequency

The method will remove the interjection, function words and stop words and so on, and then it will use a specialized storage structure to store these words. And then we will set a threshold, and compare with the source text which had been worked in database. If there are duplicate records, writing down the number until the comparison completed. Finally, we will statistic the total number of matching words. If the value greater than the threshold, they are supposed to copy. The method can extract the text characteristics of the document. And it can better grasp the global information of the text. But the accuracy rate of the method is lower. It doesn't consider the semantics of document and the structural of information. The SCAM not only used the VSM of space model which is one of technology of detective, also used a method based on word frequency statistics to measure the document similarity. Garcia-Molina and Shivakumar brought up the DSCAM model [12] (Distributed Stanford Copy Analysis Method) based on SCAM. They made up the range of detection from the single signed database to extend to the Distributed database or the function of detection text in the web [13].

51.3.3.4 Method Based on the Text Structure Similarity

The method is to construct the text structure tree according to the text structure. The root node can represent the title of the paper, abstract, key words, and the corresponding paper information. And then it construct the text content tree together the branching structure of text directory with hierarchy structure and run the text processing. Jin Bo [3] and his partners had put forward the copy of the paper on structure similarity detection algorithm. This algorithm is on the basis of academic understanding of the unique structure of the academic to analyze academic discourse structure. In order to identify the phenomenon of plagiarism, it can use hash values, digital fingerprint, word frequency statistics method to calculate the similarity between the academic. However, this algorithm is just only for the writing format specification academic plagiarism phenomenon. Wang Sen [14] had put forward the text structure tree to the method of detection, and he got good results. He uses the following formula to calculate the similarity between sentences:

$$Sim(s1, s2) = \alpha_1 \times n\mathrm{Sim}(s_1^n, s_2^n) + \alpha_2 \times o\mathrm{Sim}(s_1^o, s_2^o) \tag{51.4}$$

Among them, the si is the sentence, s_1^n is the nouns of the sentence i, and s_1^o is the other parts of the sentence. $\alpha_1 + \alpha_2 = 1$. nSim is the nouns of the similarity, oSim is the part of the similarity of other words.

51.3.3.5 Similarity Calculation Based on N-Gram

N-gram means combinations of any *n* contiguous characters in text string. We look text *T* as a linear sequence of characters, from the first character of the text, continuously moving the window of length *n* from left to right, each moving step size is a character, appears in the window of *n* character is the *n*-gram. When *n* given different values, there will be the Bigram ($n = 2$), Trigram ($n = 3$), Quadgram ($n = 4$) and so on. Zheng-tian Hong, who makes a technical of Chinese word segmentation based on statistical, which can improve *k*-grams-based algorithm [15]. The experimental results in the accuracy has been improved to some extent.

51.3.3.6 Calculation Based on the Similarity of the Semantic Aspects

Both Yu Gang's [16] based on the lexical semantic text similarity and Ma Huidong's [17] based on the extraction of keywords Chinese document copy detection are on the basis of semantic. And they excluded the limitations of the text itself and detected in terms of content. Zhao Junjie's [18] Realization of Classification-Based Paper Plagiarism Judgment System is on the basis of classification plagiarism to judgment unrelated to the contents of the first rule, and greatly improves the detection efficiency.

51.4 Text Comparison

The text comparison is the work carried out after the similarity calculation. Because similarity algorithm can only come to the overall similarity between the texts, it is a normalized in the range of (0, 1) values. It is compared with pre-set threshold to determine that it can determine whether the test text copied the documents in Chinese text plagiarism recognition system. However, we can't get us the results only this value. When the value obtained is less than a pre-set threshold, and then we can conclude that there is no suspicion of plagiarism, but if greater than the threshold, we need to navigate to the original part of plagiarism text. Then we can find the part of the "public content" by using text comparison algorithm. We also can use substring to get the results.

51.5 Summary

Although there are many kinds of Chinese document plagiarism detection systems, but the efficiency and accuracy are need to be improved. We can not only see tightly the results of these systems, but also need to artificial detect. The results of detecting formula and charts are not very ideal. And the determination methods are different from common text, and storage methods are also different. So we cannot use the general text plagiarism detection methods to judge. And it must use image processing methods to deal with in chart, so it greatly reduced the determine efficiency.

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Chapter 52
A Hot Topic Detection Approach on Chinese Microblogging

Changchun Yang, Jing Yang, Hong Ding and Hengxin Xue

Abstract This paper proposes an approach of hot topic detection on microblogging, that is, do microblogging texts clustering and heat evaluation so as to find hot topics. For the shortness and sparseness and the existence of synonyms and polysemy of the massive microblogging texts, when modeling the microblogging texts, microblogging text vectors are mapped to low-dimensional feature vector space to achieve the purpose of dimensionally reduction and denoising using Latent Semantic Indexing (LSI). For the shortcomings of traditional single-pass algorithm on topic detection, this paper proposes a two-level Hierarchical Agglomerative Clustering combined single-pass clustering method. Finally, according to text and propagation characteristics of microblogging, this paper proposes the topic heat evaluation model. Experimental studies on real world microblogging data show the method in this paper works well on massive microblogging texts and can effectively dig out hot topics.

Keywords Microblogging · LSI · Clustering · Topic detection

52.1 Introduction

As new information diffusion media, microblogging has received widespread attention for its large number of participants, fast information spread and high-impact, especially play a great role on the diffusion of popular events.

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Microblogging is very sensitive to hot topics; there will be extensive discussion on the microblogging platform almost at the same time the incidents happened. Hot topic detection on microblogging has far-reaching economic and social values. For users, they can be available to hot spot information of current society timely and conveniently. For enterprises, they can rapidly grasp the related fields development, find out business opportunities from hot topics which attractive to Users, and collect user feedback information. For the authorities or professional Medias, they can keep abreast of current social hot events and direction of public opinions so that they can effectively guide the public opinions.

Topic detection and tracking (TDT) is the technology which can collect and organize the dispersed and variable information of topics to help users find the relationship among various factors in the topic. Topic detection is an important part of TDT. It can automatically detect various topics from the information flow, classify all information to the appropriate topics and detect new topics in real-time for the newly arrived information. Topic detection can be viewed as a clustering of events; this clustering is normally in an incremental way. In the clustering process, frequently used algorithms are single-pass algorithm, incremental k-means clustering, agglomerative clustering, MLCS clustering algorithm, etc. [1].

Most topic detection researches were based on the traditional vector space model (VSM) [2], but for the shortness and sparseness and the existence of synonyms and polysemy of the massive microblogging texts, the initial established vector space will be dimensionally high and inevitably contain a lot of noise data and will have an impact on the accuracy of subsequent processing results. So we need to use a mapping or transformation method to re-express the original feature vectors so as to compress the text feature set and to build a new low-dimensional feature vector space for further processing. In this paper, a microblogging text vector is mapped to low-dimensional feature vector space using Latent Semantic Indexing (LSI) for further topic detection.

Then, for the shortcomings of traditional single-pass clustering algorithm on topic detection, we propose a two-level Hierarchical Agglomerative Clustering combined single-pass clustering method. When topics have been detected, according to the number of participators, the number of comments and retweets of all microblogging entries and the microblogging entries growth rate that a topic contains, we establish the topic heat evaluation model to screen out hot topics (Fig. 52.1).

52.2 Microblogging Text Modeling

Crawling microblogging text messages The data was crawled from Sina Weibo, the most influential and most high-profile domestic microblogging operator. In this paper, we use API provided by Sina Weibo open platform for data collection.

Preprocessing microblogging text The microblogging information needs to be structured so that computer can recognize. Text preprocessing includes word

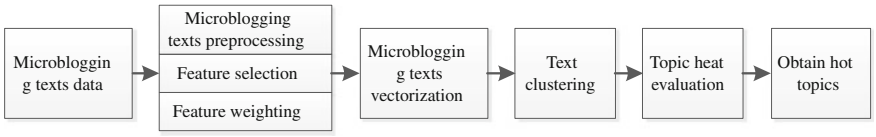

Fig. 52.1 The overall process of detecting hot topics from microblogging

segmentation and stopword filtering. In this paper, to conduct word segmentation, we use Chinese lexical analysis system ICTCLAS, which was developed by Institute of computing technology of Chinese Academy of Sciences based on Hidden Markov Model. Its functions are: Chinese word segmentation, POS tagging, named entity recognition and word recognition as well as supporting the user dictionary. In order to improve algorithm operating efficiency and topic detection accuracy, we use a set of stopwords table to filter stopwords which have no effect on understanding microblogging content after word segmentation.

Feature selection and feature weighting We'll get a set of words of different part of speech after preprocessing the microblogging texts. Words of different part of speech contribute differently to the main idea of microblogging texts, among which verbs and nouns play the most important role. So in this paper, we select verbs and nouns as features and each feature is different.

Weight of each feature of a text vector is used to measure its importance in the text. In this paper, we use the normalized TF-IDF function, the form is:

$$w_{ij} = tf_{ij} \times \log\left(\frac{N}{n_{ij}} + 0.01\right) \Big/ \sqrt{\sum_{j=1}^{M} \left[\sqrt{tf_{ij}} \times \log\left(\frac{N}{n_{ij}} + 0.01\right)\right]^2} \qquad (52.1)$$

where d_i is the ith text, t_{ij} is the jth feature of the ith text, w_{ij} is the weight of feature t_{ij}, tf_{ij} is the frequency which t_{ij} appear in text d_i, N is the current total number of texts, n_{ij} is the number of texts which contains t_{ij}, M is the total number of features in text d_i.

Constructing microblogging text model In this paper, we adopt the VSM method. The main idea of VSM is: texts are represented by vectors, each word of a text corresponds to each dimension of a vector; each word's importance in the text is represented by the value of each dimension. Then, a text d_i can be converted to a vector $\vec{d}_i$, $\vec{d}_i = \{(t_{i1}, w_{i1}), (t_{i2}, w_{i2}), \ldots, (t_{ij}, w_{ij})\}$, where t_{ij} is a feature and w_{ij} is the weight of t_{ij}. What VSM generated is a word-text matrix, where row vector represents each word's weight in each text and column vector represents each text.

For the massive microblogging texts, the total set of feature words needs to include all feature words appeared in all texts, which result in high dimension. Such a high dimension feature vector space will have a great effect on both storage and the efficiency of the algorithm. In addition, the microblogging texts are short and exist problems of synonyms and polysemy, making the traditional VSM method difficult to accurately calculate the similarity between texts.

Feature vector space based on LSI In this paper, we use LSI [3] to improve the VSM. Its main idea is to convert the original feature vector space into a latent semantic space, making the two text vectors which have no features in common originally, as well as words in a text vector internal, find their significant relevance that may exist.

The LSI method is realized by conducting singular value decomposition (SVD) to the original word-text matrix, selecting singular vectors corresponding to the first k maximum singular value to constitute a new matrix, which approximately represent the original word-text matrix.

The pending text cluster $\mathbf{A} = \{a_{ij}\}_{m\times n}$ means a text cluster consisting of m words and n texts, where each row represents a word vector; each column represents a text vector, and a_{ij} is the weight of the ith word in the jth text.

For r-rank matrix $\mathbf{A}_{m\times n}$, it can be divided as:

$$\mathbf{A}_{m\times n} = \mathbf{U}_{m\times r} \sum_{r\times r} \mathbf{V}^T_{r\times n} \tag{52.2}$$

where U and V are orthogonal matrices which represent word vector matrix and text vector matrix respectively, $\sum$ is a diagonal matrix. Leave the first k column of matrix U, V and $\sum$, we obtain a k-rank matrix $\mathbf{A}_k$ approximating to matrix A:

$$\mathbf{A}_{m\times n} = \mathbf{U}_{m\times r} \sum_{r\times r} \mathbf{V}^T_{r\times n} \approx \mathbf{U}_{m\times k} \sum_{k\times k} \mathbf{V}^T_{k\times n} \tag{52.3}$$

In this way, the word vector and text vector are mapped to the same k low-dimensional space, not only reduces the text feature space dimension, but also effectively solves the problems of synonym and polysemy in the text words.

Text similarity calculating In the k-dimensional latent semantic space, a text vector $\vec{d}_i$ of the text vector cluster $D = (\vec{d}_1, \vec{d}_2, \ldots, \vec{d}_n)$ is mapped to the converted k-rank word-text matrix space, which is equivalent to a row vector of matrix $\mathbf{V}_k$. We use cosine rule to calculate the similarity of row vectors in matrix $\mathbf{V}_k$:

$$\mathrm{sim}(d_i, d_j) = \cos(d_i, d_j) = \frac{d_i \times d_j}{|d_i| \times |d_j|} = \frac{\sum_{k=1}^{\mu} w_{ik} \times w_{jk}}{\sqrt{\sum_{k=1}^{\mu} w_{ik}^2} \times \sqrt{\sum_{k=1}^{\mu} w_{jk}^2}} \tag{52.4}$$

where $\left|\vec{d}_i\right|$, $\left|\vec{d}_j\right|$ represent the mode of text vector i, j respectively, w_{ik}, w_{jk} represent the weight of the kth feature of vector i, j respectively, μ is the total number of the features of the two vectors.

52.3 The Two-Level Hierarchical Agglomerative Clustering Combined Single-Pass Clustering Topic Detection Method

The commonly used clustering method on topic detection is single-pass clustering algorithm. Its main idea is to set up a clustering threshold, select the first text to create the first cluster, make a similarity comparison of a new input text and all existing clusters, if the similarity value of the text and existing certain cluster is higher than the clustering threshold, then classify the text to this cluster, otherwise create a new cluster for the text. Although single-pass algorithm is intuitive and efficient, the shortcomings are obvious: decision-making can only be done once for each text, and the results depend on the sequence which the text is processed, so the detection effect is poor with high misjudgement rate.

In order to reduce errors brought by the texts processing order in single-pass algorithm, improve clustering accuracy and at the same time reduce complexity of SVD on the word-text matrix, in this paper we cited the concept of "batch" proposed in literature [4], which the arrived texts is no longer clustered one by one, but batch after batch to join the clustering process, the texts number of a batch is fixed and adjustable (in this paper is set to 200).

The topic detection algorithm proposed in this paper is: inside each batch, model the microblogging texts and cluster them using hierarchical agglomerative clustering algorithm, store the micro-clusters obtained from each batch clustering; and then merge the micro-clusters based on single-pass clustering algorithm to get the final topic clusters. Certain improvements are executed in using the algorithms. Specific process is shown in Fig. 52.2:

The clustering algorithm steps of texts inside each batch are as follows:

Input: row vectors $\vec{d}_1, \vec{d}_2, \ldots, \vec{d}_n$ of matrix $\mathbf{V}_k$ converted based on LSI method (a row represents a microblogging text); Threshold of merger termination α;

Output: micro-clusters $c_1, c_2, \ldots, c_k$ that meet the merger termination condition;

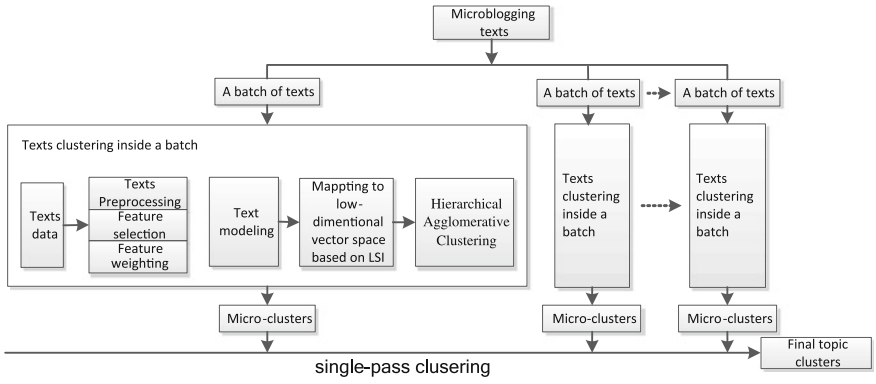

Fig. 52.2 The specific process of topic detection method proposed in this paper

Step 1: Initially consider each text vector as a micro-cluster, namely, $c_i = \left\{\vec{d}_i\right\}$ ($i = 1, 2,\ldots, n$), then calculate the similarity of each text vector and all the other text vectors, the calculation method see formula (52.4);

Step 2: Establish the similarity matrix of text vectors;

Step 3: Find the maximum similarity of two text vectors in the matrix, to determine whether it is smaller thanα, if then go to Step 6, otherwise go to Step 4;

Step 4: Merge the two text vectors $\vec{d}_i$ and $\vec{d}_j$ as $\vec{d}_q$ and merge the micro-clusters c_i, c_j, update the similarity matrix, delete rows and columns of i, and at the same time insert a new row and a new column. The new row and column are the similarity of the newly merged vector and all the other vectors;

Step 5: Repeat Step 3 and Step 4;

Step 6: Finish the algorithm and get the micro-clusters $c_1, c_2, \ldots, c_k$;

Then, clustering the micro-clusters obtained from each batch clustering based on single-pass algorithm. The topic cluster is represented using centroid vector method, i.e. the centroid vector $\vec{\mu}(c)$ of topic cluster c is represented as: $\vec{\mu}(c) = \frac{1}{N}\sum_{i=1}^{N}\vec{d}_i$ (3.1), Where N is the number of texts in the topic cluster.

The specific algorithm steps are as follows:

Input: Micro-clusters $c_1, c_2, \ldots, c_n$ obtained from each batch clustering, similarity threshold β;

Output: Final topic clusters $t_1, t_2, \ldots, t_m$;

Step 1: Compute the centroid vectors $\vec{\mu}(c_1), \vec{\mu}(c_2), \ldots, \vec{\mu}(c_m)$ of micro-clusters$c_1, c_2, \ldots, c_n$. Input a centroid vector $\vec{\mu}(c_i)$, to determine whether it is the first input vector, if then go to Step 2, otherwise go to Step 3;

Step 2: Establish a new topic cluster t_{new}, and classify the centroid vector into this new cluster;

Step 3: Compute the similarity $\text{sim}(\vec{\mu}(c_i), \vec{\mu}(t_k))$ of $\vec{\mu}(c_i)$ and existing topic clusters t_k, and get the maximum similarity value $s = \max_k(\text{sim}(\vec{\mu}(c_i), \vec{\mu}(t_k)))$ and the topic cluster t_s which has the maximum similarity with $\vec{\mu}(c_i)$;

Step: 4 To determine whether the maximum similarity s is smaller than the similarity threshold β, if then go to Step 2, otherwise go to Step 5;

Step: 5 Classify the centroid vector $\vec{\mu}(c_i)$ into the topic cluster t_s;

Step: 6 Repeat Step 1 to Step 5, until all the micro-clusters have been processed, and get the final topic clusters $t_1, t_2, \ldots, t_m$;

52.4 The Topic Heat Evaluation Model

Based on topic detection, we analyze the text and propagation characteristics of microblogging. According to the number of participators, the number of comments and retweets of all microblogging entries and the microblogging entries growth rate that a topic contains, we establish the topic heat evaluation model.

The number of participators of a topic t is represented as UN (t). The number of comments and retweets of all entries that a topic and microblogging entries growth rate of topic t are represented as (52.5,52.6,52.7) respectively.

$$\mathrm{CN}(t) = \sum_{1 \le i \le n} \mathrm{commentNum}(d_i) \tag{52.5}$$

$$\mathrm{RN}(t) = \sum_{1 \le i \le n} \mathrm{retweetNum}(d_i) \tag{52.6}$$

$$V(t) = n/(\mathrm{time}_i - \mathrm{time}_j + 1) \tag{52.7}$$

where $\mathrm{commentNum}(d_i)$, $\mathrm{retweetNum}(d_i)$ are the number of comments and retweets of one entry in the topic respectively, time_i is the earliest time a tweet published on topic t and time_j is the latest time, n is the total number of entries topic t contains.

To sum up the above, we can get the heat evaluation formula of topic t, which represented as:

$$\mathrm{HotDegree}(t) = \mathrm{UN}(t) + \mathrm{CN}(t) + \mathrm{RN}(t) + V(t) \tag{52.8}$$

According to the formula (52.8), we can get the heat of topics obtained from previous text clustering, and then sort the topics by heat we can get the hot topics.

52.5 Empirical Verification

We use TDT evaluation standards [5] to evaluate the performance of the topic detection algorithm in this paper: recall, precision, miss alarm errors, false alarm errors and detection cost $(C_{\mathrm{Det}})_{\mathrm{Norm}}$. The parameters used to calculate the these indicators are introduced in Table 52.1. A represents the number of entries detected which are related to the topic it is clustered into.

Recall

$$R = A(A + C) \tag{52.9}$$

Precision

$$P = A/(A + B) \tag{52.10}$$

Miss alarm errors

Table 52.1 Performance parameter

	Relevance	Irrelevance
Detected	A	B
Undetected	C	D

$$miss_i = C/(A + C) \tag{52.11}$$

False alarm errors

$$\mathrm{FA}_i = B/(B + D) \tag{52.12}$$

$$(C_{\mathrm{Det}})_{\mathrm{Norm}} = \frac{C_{\mathrm{Miss}} \times P_{\mathrm{Miss}} \times P_{\mathrm{target}} + C_{\mathrm{FA}} \times P_{\mathrm{FA}} \times P_{\mathrm{non-target}}}{\min(C_{\mathrm{Miss}} \cdot P_{\mathrm{target}}, C_{\mathrm{FA}} \cdot P_{\mathrm{non-target}})} \tag{52.13}$$

where $(C_{\mathrm{Det}})_{\mathrm{Norm}}$ represents the performance of the system, the smaller, the better, C_{Miss} and C_{FA} are the costs of a Miss and a False Alarm respectively, P_{Miss} and P_{FA} are the conditional probabilities of a Miss and a False Alarm respectively, and P_{target} and $P_{\mathrm{non-target}}$ are the a priori target probabilities ($P_{\mathrm{non-target}=1-\mathrm{P_{target}}}$). In this paper, C_{Miss}, C_{FA} and P_{Miss} value 1.0, 0.1 and 0.02 respectively.

52.6 Experimental Results

The experimental data were extracted through the API provided by the Sina Weibo open platform. To select data sets of ten hot topics from 1 March to 7 March 2012 in Sina Weibo. For each topic, we have collected 200 microblogging entries, and a total of 2000 microblogging entries of 10 clusters.

The experimental parameters were $\alpha = 0.15$, $\beta = 0.2$, $K = 100$. To detect topics using the algorithm proposed in this paper and compared the results with that of the traditional single-pass algorithm. The similarity threshold was set to 0.15 when using the traditional single-pass algorithm. The evaluation results of the two algorithms are shown in Tables 5.1 and 5.2 respectively.

From the evaluation results in Tables 52.2 and 52.3, we can find that by using the topic detection algorithm proposed in this paper, the performance of topic detection has been improved, the precision has been improved as well, the Miss Alarm errors and False Alarm errors have been reduced. The experimental results show that our method can detect topics from microblogging effectively.

52.7 Conclusions

In this paper, we discussed the hot topic detection technology on microblogging. When modeling the microblogging texts, based on the traditional VSM, we use LSI method so that microblogging text vectors are mapped to a lower dimensional space, which effectively realize dimensionally reduction and solute the problems of synonym and polysemy. Then, as there are shortcomings of traditional single-pass clustering algorithm, we proposed a two-level Hierarchical Agglomerative Clustering combined single-pass clustering detection algorithm on topic detection. Experimental results show that, our methods can effectively improve the quality of

Table 52.2 Evaluation results of the traditional single-pass algorithm

Initial topic clusters (10)	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	
The microblogging entries of the topic	100	100	100	100	100	100	100	100	100	100	
Topic clusters after clustering (14)	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	Others
The corresponding microblogging entries after clustering	80	78	85	76	83	87	81	79	84	90	177
A	74	71	80	70	80	82	77	74	80	84	
B	6	7	5	6	3	5	4	5	4	6	
C	26	26	20	30	20	18	23	26	20	16	
D	894	896	895	894	897	895	896	895	896	894	
R 0.774196 P 0.937691		P_{Miss}		0.225804			PFA		0.005664		
$(C_{\text{det}})_{\text{Norm}}$		0.253558									

Table 52.3 Evaluation results of the algorithm proposed in this paper

Initial topic clusters (10)	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	
The microblogging entries of the topic	100	100	100	100	100	100	100	100	100	100	
Topic clusters after clustering (12)	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	Others
The corresponding microblogging entries after clustering	88	85	90	86	89	92	88	86	91	96	109
A	86	84	90	85	89	90	88	86	90	96	
B	2	1	0	1	0	2	0	0	1	0	
C	14	16	10	15	11	10	12	14	10	4	
D	898	899	900	899	900	898	900	900	899	900	
R 0.884000 P 0.992115		PMiss		0.116000			PFA		0.000778		
$(C_{Det})_{Norm}$		0.119812									

topic detection. Finally according to the hot topic evaluation model performed at the end of the paper, we can achieve the purpose of hot topic detection. The next work will be topic tracking, in order to grasp the new posts related to a known topic.

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Chapter 53
High-Speed and High-Precision Wavelength Demodulation of Fiber Bragg Grating Sensor Network

Junjie Bai, Jianxing Li, Ying Wu and Xiaoyun Zhang

Abstract Through the technologies of wavelength division multiplex and time division multiplex, fiber Bragg grating (FBG) sensor network was built. Based on System on Programmable Chip technology and fiber comb filter, a high-speed and high-precision wavelength demodulation scheme of FBG sensor network was proposed. The optical system and hardware circuit for demodulation system were designed specifically. To improve the accuracy of demodulation system of FBG, a constant temperature channel of the demodulation system connected with a fiber comb filter, which offered reference points to calibrate the Bragg grating center wavelength. Based on 32-bit soft-core processor NoisII, the embedded system collected and processed the photoelectric signal voltage transformed to rectangular voltage pulse. The upper computer displayed dynamically the FBG wavelength demodulation process and calibrated the Bragg grating center wavelength. The experiment results of wavelength demodulation and calibration show that, the wavelength demodulation system has many advantages, such as flexibility, stabilization, easy maintenance, high-speed, high-precision, and so on. The wavelength demodulation precision is ± 2 pm.

Keywords Fiber bragg grating · Wavelength demodulation and calibration · NoisII · Fiber comb filter

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53.1 Introduction

Fiber Bragg grating (FBG) has a lot of advantages, such as small size, light weight, easy to be integrated, immunity to electromagnetic interference, sensing information with wavelength encoding, easy to build a distributed sensor network, remote monitoring, and so on [1, 2]. Tens to hundreds of FBGs can be connected in FBG sensor network. Distributed FBG sensing system can detect multi-point signals along a 100 km-long optical fiber connected with FBG sensors, which is especially suitable for the fields of civil engineering or petroleum and petrochemical industry, measuring strains, temperatures, etc. [3–5]. However, how to measure speed and precisely the picometer-level resonant wavelength shift of FBG is the key to realize the industrialization of FBG sensing technology. Based on embedded processors, such as MCU, DSP, and ARM, some wavelength demodulation systems were designed, and the unknown FBG wavelength was calibrated through the standard wavelengths of FBGs placed in a constant channel [6–8]. The speed and precision of the wavelength demodulation need to be further improved.

In the paper, based on Altera's 32-bit soft-core processor Nios II and fiber comb filter, a new wavelength demodulation and calibration system for FBG sensing network was developed, which is high-speed and high-precision.

53.2 Sensing Principle of FBG

FBG can play a role of mirror, but it must satisfy the reflection condition, Bragg condition:

$$\lambda_B = 2n_{eff}\Lambda \tag{53.1}$$

where λ_B, n_{eff}, and Λ are the center wavelength of FBG's reflected light, the effective refractive index of fiber core area, and the grating period, respectively.

According to the Bragg condition, it can be concluded that:

$$\Delta\lambda_B = 2\Delta n_{eff}\Lambda + 2n_{eff}\Delta\lambda \tag{53.2}$$

According to elasticity mechanics, the changes of FBG center wavelength, $\Delta\lambda_B$ can be expressed as:

$$\Delta\lambda_B = 2n_{eff}\Lambda\{\{1 - \frac{n_{eff}^2}{2}[p_{12} - \mu(p_{11} + p_{12})]\}\varepsilon_a + (\alpha_s + \xi_s)\Delta T\} \tag{53.3}$$

where ε_a, μ, α_s, ξ_s, and ΔT are axial strain, Poisson's ratio of fiber material, coefficient of thermal expansion of fiber material, thermo-optic parameters of fiber material, and temperature change of FBG, respectively; p_{11} and p_{12} are photoelastic coefficients of the fiber material.

Take into account the parameters of SiGe optical fiber, $\Delta\lambda_B$ can be represented as the following equation,

$$\Delta\lambda_B = 0.78\lambda_B\varepsilon_a + 6.67 \times 10^{-6}\lambda_B\Delta T \tag{53.4}$$

The expression (53.4) shows that, if only consider the change of temperature or stress, there is a linear relationship between $\Delta\lambda_B$ and ε_a, and there is a linear relationship between $\Delta\lambda_B$ and ΔT. In the light of the expression (53.4), it also can be seen that FBG is sensitive to temperature and strain at the same time. Based on the cross sensitive characteristic of FBG, there are many effective ways to measure simultaneously temperature and strain.

53.3 Wavelength Demodulation of FBG Sensor Network

53.3.1 FBG Wavelength Demodulation System

It is difficult to demodulate FBG wavelength and the cost of wavelength demodulation is high. To achieve high-precision demodulation of FBG wavelength, it involves two aspects. First, because the spectral width of Bragg wavelength is less than 0.3 nm, to improve the measurement accuracy of the amount of Bragg wavelength shift, the peak point of the FBG reflection spectrum must be identified and the movement of peak point must be tracked accurately. Second, the amount of peak-point movement measured accurately must be translated into electrical signals for measurement purpose.

Using a tunable Fabry–Perot filter (TFPF), fiber comb filter, and an optical switch to set up the optical path, the wavelength demodulation of FBG sensing network with three channels was achieved, which can monitor nearly one hundred of the external signals with high speed and high precision. The wavelength demodulation scheme is shown in Fig. 53.1. First, the broadband light source (SLED, Super LED) having a bandwidth of 50 nm centered at 1310 or 1550 nm irradiated an optical switch through 3 db directional coupler. The optical switch was controlled by program and the four channels were opened in turn. In the three optical channels connected with FBGs, a series of optical narrowband pulses were reflected, and another series of narrowband optical pluses transmit from the fiber comb filter placed inside the constant temperature channel. Then, the optical narrowband pluses of each channel transmitted into the TFPF in turn. The TFTP was controlled by triangle-wave scanning voltage. There is a linear relationship between the center wavelength transmitting form the TFTP and the scanning voltage. In the same scanning cycle, the narrowband light pulses with different center wavelengths passed through TFPT at different moment. These optical narrowband pluses can detect the Bragg wavelengths of FBG sensors. The different Bragg wavelengths made different peak points and these peak points were detected by a photo diode in turn. The voltage signal detected by photo-diodes is

filtered and amplified and finally shaped into rectangular impulse which was acquired and processed by the embedded system based on 32-bit soft-core processor NoisII. The Bragg wavelength shifts of FBG sensors were observed and plotted via demodulation program of upper computer. The switching frequency of optical switch was kept pace with the scanning-voltage frequency of TFPF.

The spectral bandwidth of SLED (Supper light-emitting diode) is 40–50 nm, and the bandwidth of the reflection spectrum of FBG is 0.07–0.6 nm. When detecting external signals, the center wavelength of FBG drifts 1–2 nm. In order to ensure that the reflection spectrums of FBG sensors do not overlap, no more than 30 FBG sensors can be connected in a same fiber. A large-scale project often require hundreds of different locations to be monitor simultaneously, which requires the development of distributed multi-channel FBG sensor system with high speed and precision. As is shown in Fig. 53.1, the wavelength demodulation system can be used extensively in large-scale multipoint monitor engineering.

53.3.2 SOPC Module Based on NIOS II

The soft-core Nios II embedded processor was introduced by Altera Corporation in 2004. Using Altera's MegaWizard interface, the designer can map a system and configure memory and peripherals. For example, the designer can choose from a variety of widths and speeds of memory as well as peripheral types. Furthermore,

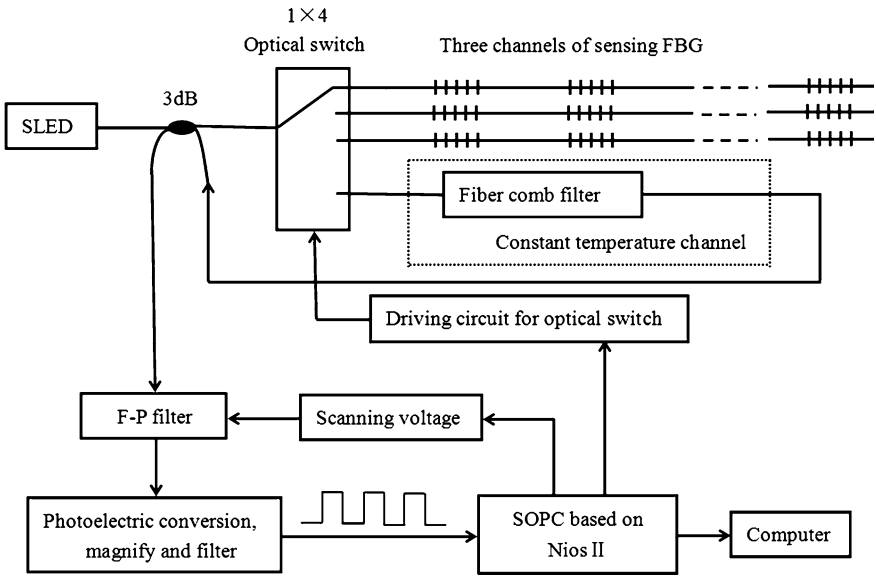

Fig. 53.1 Wavelength demodulation system for FBG sensor network

the Nios II embedded processor core can be extended in three ways, including adding conventional memory-mapped peripherals on-chip, mapping readable/writeable devices into the processor's register file, and adding user-designed function blocks directly into the processor's arithmetic logical unit.

As shown in Fig. 53.1, the System on Programmable Chip (SOPC) module based on Nios II is the core-function module, which realized data acquisition and processing, generating and controlling triangle wave scanning voltage, controlling optical switch, controlling some peripherals interfaces, and so on. Based on Altera SOPC builder tool, SOPC system is customized, and System frequency is 33 MH. The system hardware design block diagram is shown in Fig. 53.2 PIO is the parallel input/output controller. PIO_0 and PIO_1 were configured as level-trigger interfaces, which result in external interrupts when signal rising edges are detected. PIO_2 was configured as the parallel input/output interface. The SOPC module acquired and processed voltage signal shaped into rectangular impulse, which determined relative moment when the central location of rectangular impulse occurred in a scan-voltage cycle shown in Fig. 53.1.

The method of determining relative moment when the central location of rectangular impulse occurred in a scan-voltage cycle is described as follows. The high-frequency count pulse was inputted into the counter embedded in the FPGA. The photoelectric voltage signals shaped into rectangular impulse were inputted into the PIO_2. The triangle-wave scanning voltage of Fig. 53.1 was converted to square wave signal. The square wave was inputted into PIO_0 and the reverse signal of square wave was inputted into PIO_1. When the rising edge of square wave appeared, the counter started counting. When the falling edge of square wave

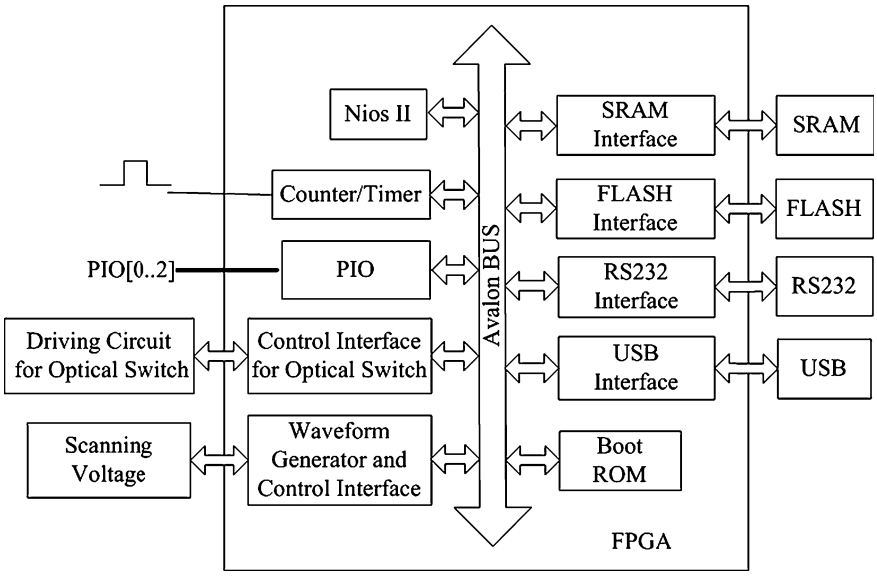

Fig. 53.2 SOPC module based on Nios II

signal appeared, the counter was zeroed. Based on query modes, the values of the counter were stored when the rising or falling edge of rectangular impulse inputted into PIO_2. When the rising edge of rectangular impulse appeared, the value of the counter was N_1. When the falling edge of rectangular impulse appears, the value of the counter was N_2. Then, the count pulse number N, which corresponds with the central location of the rectangular impulse, was $(N_1 + N_2)/2$ and was transmitted to the computer via the RS232 or USB interface. There is linear relation between the count pulse number N and the Bragg wavelength λ, which can be used to calculate the real-time Bragg wavelength of FBG [9].

53.4 Wavelength Calibration Experiment

53.4.1 Experimental Methods

Based on the above demodulation scheme, the multi-channel wavelength demodulator was developed, and the wavelength calibration experiments were done. Figure 53.3 is the experiment system structure diagram. One channel of the wavelength demodulator connected three FBGs, and a fiber comb filter was connected with another channel which was kept in constant temperature status. The wavelength demodulator transmitted central locations of the rectangular impulses to PC via RS232 interface. According to the relation between central location N_i of the rectangular impulse and center wavelength λ_i of FBG (or center wavelength λ_{i} of narrowband light impulse outputted from fiber comb filter), the unknown FBG wavelength can be calibrated. In order to verify wavelength demodulation precision, FBGs were placed in a thermostat to avoid temperature change.

53.4.2 Experimental Results

The transmission light center wavelengths of the fiber comb filter (λ_i, $i = 1$–15) were measured by a high-precision spectrometer, and were distributed in 1294.078–1309.907 nm. The wavelength demodulator detected central locations (N_i, $i = 1$–15) of the rectangular impulse signal voltage corresponding λ_i. There is an almost linear relationship between λ_i and N_i, as is shown in Fig. 53.4. N_i and λ_i

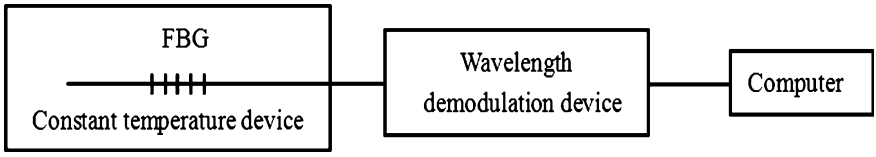

Fig. 53.3 The structural diagram of experimental system for calibration

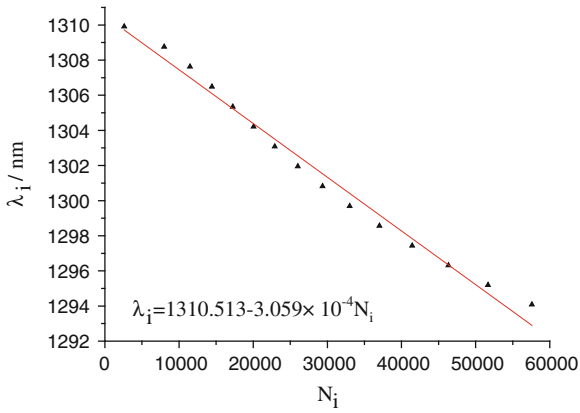

Fig. 53.4 Relation curve between λ_i and N_i

Table 53.1 Results of calibration experiment

Wavelength measured by spectrometer (nm)	Piecewise linear interpolation wavelength (nm)	Piecewise linear interpolation wavelength error (pm)	Spline interpolation wavelength (nm)	Spline interpolation wavelength error (pm)
1298.447	1298.4435	3.5	1298.4453	1.7
1305.033	1305.0316	1.4	1305.0327	0.3
1307.653	1307.6561	3.1	1307.6542	1.2

composed reference points, (N_i, λ_i), for calibration. According to different interpolation methods, the center wavelengths of FBGs were calibrated. Table 53.1 shows that, wavelength calibration precision based on spline interpolation method is ±2 pm but the algorithm is relatively complicated, and wavelength calibration precision based on piecewise linear interpolation method is ±4 pm but the algorithm is relatively simple.

53.5 Conclusion

Based on SOPC technology and fiber comb filter, the FBG wavelength demodulation system has many advantages, such as flexibility, stabilization, easy maintenance, high-speed, high-precision, and so on. It can be used extensively in large-scale bridge structural health monitoring, electric power system temperature measurement, fire alarming, and so on. The demodulation system is conductive to realize the practical and industrial applications.

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Chapter 54
A New Method for Rapid Extraction of Graduation Line

Jianxing Li, Junjie Bai and Jian Dong

Abstract In the situation of pixel size acquisition, calibration, and reading automatically graduated scale, the image of graduated line is strictly requested. In order to improve the calibration adaptability and accuracy, an automatic extraction method of graduated line, which has strong adaptability, was proposed. This method utilized Hough transform to extract the lines in image. The basic idea of K-means clustering was adopted, and the distance was taken as the basis to effectively classify the lines which belong to the same graduation line. According to the classified lines, the effective points were selected, and then the least square method was adopted to precisely fit the midline of graduated line. The experiment results testify the validity and accuracy of the method.

Keywords Graduation line · Automatic extraction · Hough transformation · K-means clustering · Least square method

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54.1 Introduction

In the situation of highly precious measurement, the microscopic graduated scale is generally used to calibrate the pixel size [1, 2]. These highly precious measurement tools have high precision and the graduated lines of them are fixed. Just to get the pixel distance between two graduated lines, the size of unit pixel can be acquired to complete the calibration. Meanwhile, this way can greatly reduce human disturbances [3]. Besides, after obtaining the calibration results with other procedure, these highly precious tools can be utilized to correct or verify. These situations involve the automatic extraction of graduated lines. Current processing method mostly requires the graduated lines in the image to be vertical, which has low adaptability. And there generally exists double edges of one graduated line, which will influence the calibration precision and final measurement results [4].

Considering the real-time performance and effectiveness, the simple Hough transformation was first used to extract all the lines in the image with graduated lines. Then, by virtue of basic thought of K-means, the distance between the line and a certain point was referenced to classify all the lines. The number of graduated lines is ordinarily more than two, and the slopes of all the lines are consistent, according to which, the non-graduated lines can be rejected. After acquiring the optimal and classified graduated lines, the edge lines were extracted, and then the middle points of these edge lines were chosen to fit the graduated lines based on least square method.

54.2 Method for Extraction of Graduation Line

54.2.1 Edge Lines Extraction of Graduation Line

Generally, the graduated lines in the image have strong contrast with the background. After Gaussian filtering on the image, the Hough transformation was utilized to extract all the lines existing in the graduated lines.

Hough transformation is a usual line extraction method [5]. It completes line extraction by changing the parameter space, in which the original x-y space is changed to k-b (slope-intercept) space. In the changed parameter space, according to the points with the most intersection points, the lines can be extracted. However, there still exists a problem which is when the lines are vertical or nearly vertical, the parameter will be infinite big. This problem can be solved by changing the parameter space again. The standard equation of line in parameter space is as follows:

$$x\cos\theta + y\sin\theta = \rho \tag{54.1}$$

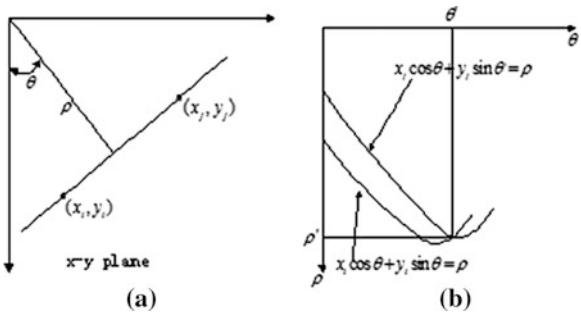

Fig. 54.1 Hough transforms principle, **a** (ρ, θ) parameterization of line **b** sine curve on $\rho\theta$ plane

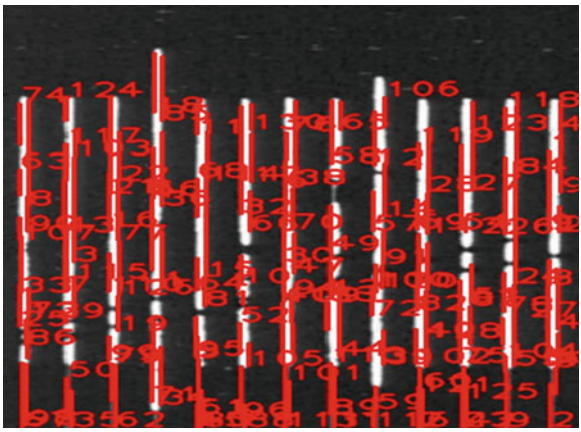

Fig. 54.2 Edge lines extraction of microscopic graduated lines

The basic principle of Hough transformation is shown in Fig. 54.1. In Fig. 54.1b, the coordinates of intersection point is the line parameters. In $\rho\theta$ plane, the intersection points whose accumulators are bigger than a certain threshold are deemed to be the points with certain lines, and the relevant coordinates are line parameters. The edge lines extraction effect of images with microscopic graduated scale, which both used in military enterprise are shown in Fig. 54.2.

54.2.2 Edge Lines Clustering Based on K-Means

K-means clustering is an unsupervised real-time algorithm proposed by Mac Queen [6]. Based on the minimizing error function, the data is classified to the preset K classes. This algorithm is generally used to extract useful information from big amount of data [7]. Before executing the K-means algorithm, the cluster number K and iteration number or convergence condition need to be previously set. Meanwhile, the K cluster centers also need to be set. The data are classified to one center according to one similarity measure criterion, and the mean vector is set

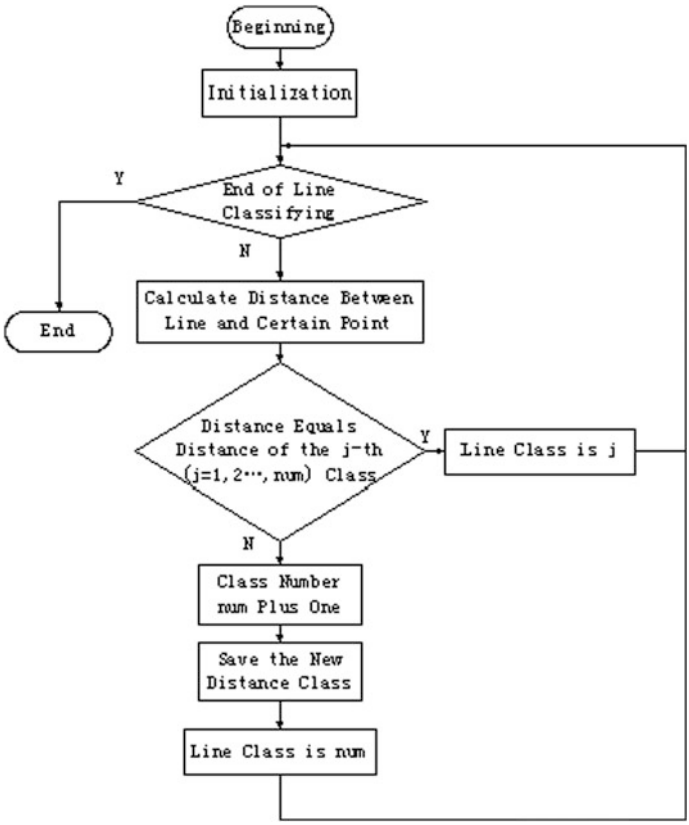

Fig. 54.3 The flow chart of lines clustering

to be the new cluster center. The procedure continues until arriving the maximum iteration number.

By virtue of the above thought and according to the features of the real sample image, the distance between point (0, 0) and the line was chosen to be the reference to classify. The basic flow chart is shown in Fig. 54.3.

After classifying, the following procedures need to be realized to obtain the final lines.

1. Counting the class number of slopes and the number of every slope.
2. Finding the slope whose number is maximum and set the slope to be k.
3. Rejecting the lines whose slope is not equal to k.

Figure 54.4 shows the classifying effect of images with microscopic graduated scale. The key to this method to classify all the lines is to choose the distance threshold between line and point according to the real situation. The pixel width of the microscopic graduated line is wide, and the classifying range is width for each line.

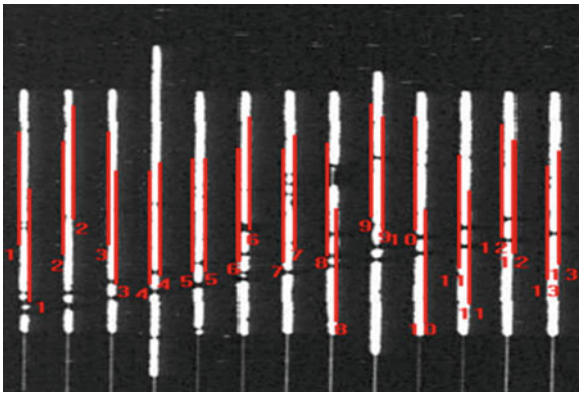

Fig. 54.4 Classified lines of microscopic graduated scale

54.2.3 Selection of Effective Midpoints Between Lines

For the situation of graduated lines with narrow pixel width, the lines classifying method can effectively classify the lines to certain classes. Then to calculate the means of endpoints that belong to the same graduated line, the means can be the reference to calculate the final lines which still has high precision. However, for the situation of graduated lines with wide pixel width, the above method will greatly lower the precision. This paper utilized a way of connecting lines and getting midpoints to effectively extract the midlines of graduated lines. The procedure of getting midpoints is shown in Fig. 54.5.

In Fig. 54.5, the rectangles represent graduated lines, and the bilateral lines represent the extracted lines. To respectively choose the four endpoints as the initial points and connect the initial points with some points in the other line, the midpoints of these points were selected as the effective points. The least square method was chosen to fit the lines according to these midpoints. The number of midpoints is selectable. The bigger the number is, the higher the precision is. The number in this paper was 80. So, 320 midpoints were chosen to fit one midline of graduated line.

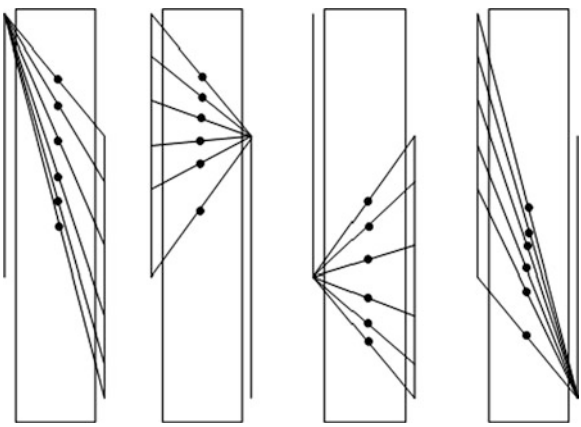

Fig. 54.5 Midpoints selection between lines

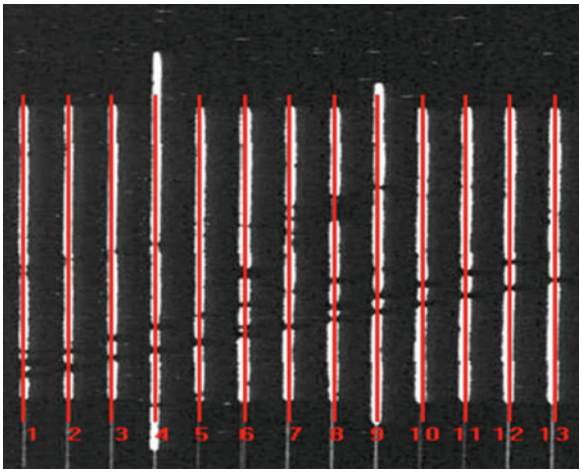

Fig. 54.6 Lines fitting effect after effective point's selection

54.2.4 The Midline Extraction of Graduation Line Based on Line Fitting

The least square method is an effective method to solve fitting problem. It solves the real problems according to get minimum sum of squares of target function [8].

$$D = \sum_{i=1}^{n} d_i^2 = \sum_{i=1}^{n} [y_i - ax_i - b]^2 \tag{54.2}$$

To seek partial derivatives, the following equations are obtained. $\begin{cases} a = \bar{y} - b\bar{x} \\ b = \dfrac{\overline{xy} - \bar{x}\bar{y}}{\overline{x^2} - \bar{x}^2} \end{cases}$

where $\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$, $\bar{y} = \frac{1}{n}\sum_{i=1}^{n} y_i$, $\overline{x^2} = \frac{1}{n}\sum_{i=1}^{n} x_i^2$, $\overline{xy} = \frac{1}{n}\sum_{i=1}^{n} x_i y_i$.

After choosing the effective points, the fitting effect based on least square method is shown in Fig. 54.6. Just because the original fitting has higher precision, second fitting can limitedly improve the precision.

54.3 Rotation Experiment of Anti-interference

To rotate the microscopic graduated scale in the image, then the lines extraction, effective point selection, and lines fitting were completed. The final extraction data are shown in Table 54.1. The angle in Table 54.1 is the angle between graduated line and the horizontal line. Line Number in the table is respective with the number in Fig. 54.6. The data in data zone in the table are pixel width.

Table 54.1 Detection data of microscopic graduated scale after rotating

Rotation angle	0°	45°	60°	75°
Line number (1,5)	219	219	219	220
Line number (2,8)	330	329	331	330
Line number (1,12)	605	605	606	606
Line number (4,11)	384	385	385	384
Line number (6,10)	220	220	219	219
Variance	0.0104	0.0111	0.0493	0.0146
Standard deviation	0.102	0.105	0.222	0.1208

The variance in the two tables is the variance of pixel width between every two lines. For example, column one in Table 54.1, the variance was calculated as this: the average pixel width of every two lines in every row is respectively $219/4 = 54.75$, $330/6 = 55$, $605/11 = 55$, $384/7 = 54.86$, $220/4 = 55$. The total average was calculated as expression (54.4).

$$(54.75 + 55 + 55 + 54.86 + 55)/5 = 54.922 \tag{54.3}$$

So the variance was calculated as expression.

$$\frac{(54.75 - 54.922)^2 + 3 \times (55 - 54.922)^2 + (54.86 - 54.922)^2}{5} = 0.0104 \tag{54.4}$$

Table 54.1 shows that, in microscopic graduated scale calibration, the standard deviation of pixel width between every two lines is smaller than 0.25. This means that the standard deviation of every pixel width will be smaller than $0.25/55 \approx 0.005$ pixel. So the calibrations of the microscopic graduated scale are higher and more stable.

54.4 Conclusion

By virtue of the basic thought of K-means clustering and according to the distances between a certain point and the lines, the effective lines clustering was completed. After clustering, a new way of connecting lines and choosing midpoints was proposed to select effective points. These effective points were chosen to fit the midline of each graduated line based on least square method. The experiment data and images show that this method has strong adaptability and accuracy even when the graduated lines are not vertical in the image. The method is applicable to improve calibration accuracy when the hardware resolution is certain.

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Chapter 55
Research of NFC Framework in MeeGo Harmattan

Wei Gong, Yan Ma, Yang Zhang and Ping Chen

Abstract This paper discusses NFC technique on MeeGo Harmattan. First of all, it introduces the definition of NFC, NFC communication modes and operating modes, NFC working principle, NFC-related specification, and NFC Forum standards. Second it presents NFC architecture on MeeGo 1.2 Harmattan, including the introduction to MeeGo Harmattan, NFC architecture, and NFC applications types. Third, it dwells on QtMobility NFC API on MeeGo 1.2 Harmattan; especially expatiate on the usage of Generic NFC classes, NFC classes used in tag access, NFC classes for Peer-to-Peer communication and Connectivity QML plugin of QtMobility which provides some QML NFC elements in detail. After that it explains how to take advantage of NFC to deliver innovative apps Apps on MeeGo Harmattan. In the end, it discusses the current problems of NFC technique on MeeGo Harmattan, and looks forward to the future development of NFC apps on MeeGo Harmattan.

Keywords NFC · MeeGo Harmattan · QtMobility · QML

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55.1 What is NFC? ss

Near field communication (NFC) is a short-range, standards-based wireless connectivity technology, based on RFID technology that uses magnetic field induction to enable communication between electronic devices in close proximity. NFC technology makes life easier and more convenient for consumers around the world by making it simpler to make transactions, exchange digital content, and connect electronic devices with a touch.

55.1.1 NFC Modes

There are two communication modes about NFC: passive mode and active mode [1]. In passive communication mode, the initiator device provides a carrier fields and the target device answers by modulating the existing field. In active communication mode, the initiator and the target devices communicate by alternately generating their own fields. A device deactivates its RF field while it is waiting for data. In this mode, both devices typically have power supplies.

NFC device can change its operating mode between reader/writer mode, peer-to-peer mode, and card emulation mode. These operating modes are based on the ISO/IEC 18092, NFC IP-1 and ISO/IEC 14443 contactless smart card standards.

55.1.2 How NFC Works

NFC provides a seamless medium for the identification protocols that validate secure data transfer. This enables users to perform intuitive, safe, contactless transactions, access digital content and connect electronic devices simply by touching or bringing devices into close proximity.

NFC operates in the standard unlicensed 13.56 MHz frequency band over a distance of up to around 20 cm. Currently, it offers data transfer rates of 106, 212, and 424 kbit/s, and higher rates are expected in the future.

For two devices to communicate using NFC one device must have an NFC reader/writer and one must have an NFC tag. The tag is essentially an integrated circuit containing data, connected to an antenna that can be read and written by the reader. There are four NFC mandated tag types: Type1, Type2, Type3, and Type4. There is very little overlap in the types of applications which those tags are likely to be used for [2].

The Reader (for example NFC enabled phones) is an active device, which continuously emits RF carrier signals, and keeps observing the received RF signals for data. A tag is a passive device incorporating a silicon memory chip connecting to external antenna. Tag does not have its own power source. Depending on the tag type the memory can be read only, rewritable, and writable once.

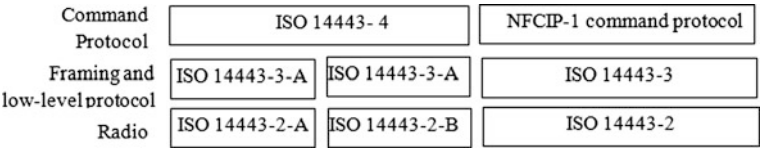

Fig. 55.1 ISO 14443 and NFCIP-1 protocol stack

55.1.3 NFC-Related Specifications

55.1.3.1 ISO 14443 and NFCIP-1

ISO 14443 is a well-known international standard originally developed for contactless chip card communication over a 13.56 MHz radio.

NFCIP-1 uses a new command protocol, which replaces the top layer of ISO 14443, and supports two communication modes that allow an NFC device to communicate with other NFC devices in a peer-to-peer manner, as well as with NFCIP-1 based NFC tags [3] which is shown in Fig. 55.1.

55.1.3.2 Other Specifications

There are other specifications such as MIFARE and FeliCa. MIFARE refers to an NFC tag type developed by NXP semiconductors; FeliCa is a proprietary NFC tag technology developed by Sony.

55.1.4 NFC Forum Standards

55.1.4.1 NDEF and RTD

NFC date exchange format (NDEF) is a common data format specified by the NFC Forum, to enable interoperability when transferring data to and from tags and between NFC devices. NDEF, which hides all the tag type-specific from the application, is a lightweight and compact binary format that can carry URLs, vCards, and NFC-specific data types [4].

NDEF is exchanged in messages. An NEDF message consists of a sequence of records, which carries a payload. The payload contents can be of type URL, MIME media, or an NFC-specific data type. For NFC-specific data types, the payload contents must be defined in an NFC Record type definition (RTD) file. NFC defines some RTDs, such as NFC Text RTD, NFC URI RTD, NFC Smart Poster RTD, NFC Generic Control RTD, and NFC Signature RTD.

55.1.4.2 LLCP

The logical link control protocol (LLCP) provides additional communication capabilities on top of the NFCIP-1/ISO 18092, to enhance the peer-to-peer mode of operation. LLCP introduces a two-way, link-level connection, allowing both peers to send and receive data using the following methods of data exchange:

- Connection-oriented transfer, where data exchanges are acknowledged;
- Connectionless transfer, where data exchanges are unacknowledged.

55.2 NFC Framework on Meego 1.2 Harmattan

55.2.1 Meego 1.2 Harmattan

MeeGo is a Linux-based open source mobile operating system. MeeGo 1.2 Harmattan by Nokia is a derivative of MeeGo and is a feature-rich software platform designed to fit Nokia's customized requirements.

MeeGo 1.2 Harmattan architecture has three layers: UI Application Framework, Application API and Core OS layers. The Application API layer includes two parts: MeeGo API and Nokia Specific API. Qt Mobility API, as a part of MeeGo API, supports cross-platform mobile application development.

55.2.2 NFC Architecture on Meego 1.2 Harmattan

Nokia is introducing NFC technology to a growing range of Symbian phones and the Nokia N9 smartphone. The Nokia N9 is running MeeGo 1.2 Harmattan platform, shipping with NFC hardware, and Qt Mobility 1.2. Based on Qt Mobility,

Nokia N9 supports the following NFC standards: NFC A technology, NFC B technology, NFC F technology (JIS 6319-A), ISO DEP protocol (ISO 14443), NFC DEP protocol (NFCIP1—ISO 18092), and the following tag types: NFC Forum Type 1 ~ NFC Forum Type 4, MIFARE Classic (Fig. 55.2).

The NFC architecture on MeeGo 1.2 Harmattan is shown in [5]. The NFC architecture supports three operating modes: reader/writer, peer-2-peer and card emulation. The NFC adaptation is provided by MeeGo core OS layer, include HAL and drivers about NFC hardwares. The NFC middleware services is based on NFC adaptation, including NFC discovery API, NFC tag extension API, NDEF API, NFC Peer-to-Peer API, and NFC content handler API.

Over the NFC services, the Connectivity API in the QtMobility project provides a set of NFC APIs for communicating with local devices. Developers can easily create NFC enabled applications using the QtMobility NFC API.

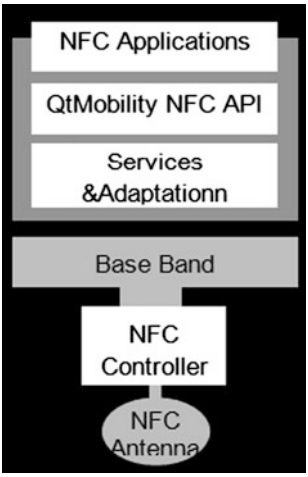

Fig. 55.2 The NFC architecture on MeeGo 1.2 Harmattan

55.2.3 NFC Application Types

There are two NFC application types on smartphone: NFC centric application and NFC enhanced application. The former works on NFC enabled phones only, the later can work on phones without NFC phones and take advantage of NFC only if available on a phone.

55.3 QtMobility NFC API on Meego1.2 Harmattan

55.3.1 Introduction to QtMobility NFC API

QtMobility NFC API provides APIs for interacting with NFC Forum Tags, including target detection and loss, registering NDEF message handlers, reading and writing NDEF messages to NFC Forum Tags, send tag specific commands [6].

QtMobility NFC API also provides APIs for interacting with NFC Forum Devices, including client and server LLCP peer-to-peer sockets.

Among all classes in QtMobility NFC API, QNearFieldManager, QNearFieldTarget, QLlcpSocket, and QLlcpServer are concerned with NFC Forum Devices; QNdefMessage, QNdefRecord, QNdefNfcTextRecord, QNdefNfcUriRecord, and QNdefFilter are used in NDEF handling; NearField, NdefFilter, NdefRecord, and NearFieldSocket are QML Elements with NFC supported.

55.3.2 The Key Classes in Qtmobility NFC API

55.3.2.1 Generic NFC Classes

The QNearFieldManager class provides access to notifications for NFC events, usually for detecting and filtering targets. Applications can connect to the targetDetected () and targetLost () signals to get notified when an NFC Forum Device or NFC Forum Tag enters or leaves proximity [7].

A QNearFieldManager instance can pre-register an application to receive NDEF messages matching a given criteria. So once a matching NDEF message is received, the application is automatically launched by the system.

The QNearFieldTarget class provides an interface for communicating with a target device, usually for querying properties, reading/writing messages, sending commands, or establishing a client socket.

55.3.2.2 NFC Classes Used in Tag Access

The QNdefMessage class provides an NFC NDEF message. A QNedfMessage is a Collection of 0 or more records. NDEF messages can be parsed from a byte array conforming to the NFC Data Exchange Format technical specification by using the from ByteArray () static function.

The QNdefFilter class encapsulates the structure of an NDEF message and is used by QNearFieldManager::registerNdefMessageHandler () to match NDEF message that have a particular structure.

The QNdefRecord class provides an NFC NDEF record, with it and its derived classes to parse the contents of NDEF messages and create new NDEF messages.

55.3.2.3 NFC Classes Used to Peer-to-Peer Communication

The QLlcpServer class provides an NFC LLCP socket based server, and makes it possible to accept incoming LLCP socket connections.

The QLlcpSocket class provides an NFC LLCP socket, typically used to read or write data.

55.3.2.4 Connectivity QML Plugin of Qtmobility

Qt Quick is recommended for developing the UI of NFC application on MeeGo phones. The Connectivity QML plugin of QtMobility is a QML plugin for the Connectivity API including Bluetooth and NFC. The NFC part of the Connectivity API provides QML elements to communicate peer-to-peer using LLCP sockets (NearFieldSocket), NDEF records of various types that encapsulate messages, a filtering mechanism on messages and the NearField element that starts the process [8].

Here are some key QML elements about NFC API:

The NdefFilter element represents a filtering constraint for NDEF message records.

The NdefRecord element represents a record in an NDEF message.

The NearField element provides access to NDEF messages stored on NFC Forum tags.

The NearFieldSocket element represents an LLCP socket.

55.4 Take Advantage of NFC to Deliver Innovative Apps on Meego Harmattan

When developing NFC-enabled applications, firstly, create a QNearFieldManager object so as to provide access to notifications for NFC events; Second, create a NdefMessageHandler method, which should have the prototype 'void targetDetected(const QNdefMessage &message, QNearFieldTarget *target)';Third call registerNdefMessageHandler() of the QNearFieldManager object to registers objects to receive notifications on the NdefMessageHandler(). So the implementation of NdefMessageHandler is the key point.

In current MeeGo Harmattan NFC application, the use cases that NFC offers include service initiation (such as smart poster), Sharing (such as exchange photos and videos between the NFC-enabled devices), connecting devices (such as the Bluetooth pairing).

55.5 The Problem and Future of NFC on Meego Harmattan

One problem of NFC on MeeGo Harmattan is its technical limitations. Using the current Qt Moblity 1.2.2 version On MeeGo Harmattan, the following features are NOT supported: Connectionless LLCP sockets (both client and server) and Tag type specific access. But With QtMobility development, this problem will be solved.

Another problem is that the NFC apps is currently too little, and there are only several NFC apps in the Nokia N9 apps store. But Nokia do not give up MeeGo Harmattan and will provides software updates, care and services support fot the Nokia N9 until at least 2015. Furthermore, according to official news from Nokia, NFC technology will be part of all future Nokia smartphone and accessories, and Meltemi, the successor of MeeGo Harmattan, will also ship with NFC. So, in the near future, there are more and more NFC applications on MeeGo Harmattan Platform that will be developed and released, NFC use case will also be more and more widely.

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Chapter 56
A Hierarchical Scheduler Design for Multiple Traffics with Reduced Feedback

Qiaoyun Sun, Haijun Zhang, Kai Sun, Shuguang Zhang and Cuiting Wu

Abstract In this paper, a novel scheduler is designed for multiple traffic classes with reduced feedback. The novel scheduler consists of two stages, i.e., at the first scheduling stage, the inter-traffic scheduler dynamically allocates the clustered bandwidth resources to each traffic class by a periodic and triggered way; at the second scheduling stage, and the intra-traffic scheduler schedules different users' packets within each traffic class simultaneously. In order to reduce the feedback, each user only reports the CQI of n subchannels that have the best normalized SNR. The proposed algorithm not only enhances the system throughput but also reduces the feedback load under the condition that the QoS requirements of RT traffic are satisfied. Simulations validate the effectiveness and good performance of the proposed scheme.

Keywords Scheduler · Multiple traffic classes · Reduced feedback

56.1 Introduction

Channel and QoS aware downlink packet scheduling policies are going to play a key role in efficiently utilizing limited radio resources and enhancing QoS experienced by users. However, most of the packet scheduling schemes developed so far, such as proportional fairness (PF) scheduling [1] and M-LWDF scheduling [2], has been designed to be well suited to a specific traffic class. They may be not

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effective for heterogeneous traffics. The existing packet scheduling algorithms for multiple traffics can be divided into two types. One is the priority queuing approaches, with which scheduler prioritizes traffic classes and allocates the remaining resources to the low priority traffics only after processing all the high priority traffics [3]. Although these algorithms can guarantee the QoS requirements of RT traffics and have low implementation complexity, they could not achieve enough multiuser diversity. Particular examples of this type include the adaptive EXP/PF algorithm [4] and UEPS algorithm [5]. However, the hard QoS constraints of RT traffics, e.g., Maximum allowable delay, may not be guaranteed as the NRT packets may have high priority over RT packets which are approaching their deadline. Therefore, a novel scheduler structure that can efficiently support multiple traffic classes should be carefully designed.

In this paper, a novel scheduler structure is proposed for multiple traffic classes with reduced CQI feedback, which improves the overall system throughput while guaranteeing the QoS requirements and fairness. The proposed scheduler is divided into two layers: inter-traffic scheduler and intra-traffic scheduler. The inter-traffic scheduler performs the resource partitioning dynamically among heterogeneous traffics by a periodic and triggered way with the objective of maximizing a room for non-real-time (NRT) traffic,. while guaranteeing the QoS requirements of real-time (RT) traffics. The intra-traffic scheduler which is indeed a single traffic scheduler chooses the users to be scheduled on the specific resource to achieve multiuser diversity. In the proposed scheme, as long as the maximum packet loss rate requirement is satisfied, RT users can be delayed so as to maximize a room for NRT users, and NRT users can get served often even when there are some RT users waiting to transmit, and more multiuser diversity can be exploited. Therefore, our proposed scheduler can achieve higher throughput while maintaining the QoS performance for RT traffics.

56.2 The Proposed Scheduler with Reduced Feedback

The base station (BS) has the status information of all queues and performs scheduling. Each mobile station feedbacks its channel quality information (CQI) to the BS. On arriving at the BS, the packets from different users and traffic classes are buffered in separate queues, which are assumed to have infinite lengths. Within one queue, packets are served in a first-in first-out (FIFO) order. Across the queues, packets are served according to the proposed packet scheduling algorithm.

56.2.1 The Structure of the Packet Scheduler

In this paper, M heterogeneous classes of traffic are considered. The M different traffic classes are prioritized according to their QoS requirements. The proposed scheduler comprises an inter-traffic scheduler and M intra-traffic schedulers. The

inter-traffic scheduler performs resource partitioning adaptively among the M traffic classes by a periodic and triggered way. After traffic class obtains suitable bandwidth resources, the M intra-traffic schedulers are used to schedule different users' packets within each traffic class simultaneously. In order to reflect the QoS requirements of each traffic class more precisely, a different scheduling metric is used for each traffic class, i.e., the M traffic classes may use the different scheduling metrics according to their traffic characteristics. Therefore, the two-level scheduler can have multiple scheduling criteria and better schedule packets in each traffic class than the one-level scheduler.

56.2.2 The Inter-Traffic Scheduler

The inter-traffic scheduler is actually a scheduler among heterogeneous traffics. The inter-traffic scheduler performs the bandwidth partitioning adaptively by a periodic and triggered way. The inter-traffic scheduler distributes bandwidth among heterogeneous traffic classes following strict class priority, from highest to lowest. By doing so, resources are allocated to high priority RT traffics first, and low priority NRT traffics should deal with the remaining.

The inter-traffic scheduler allocates the radio resources periodically to each traffic class controlled by a timer. The period may be a relatively long time which can be setup according to the length of the frame. During the long period, the allocated resources are not fixed due to the busty characteristics of the traffics. The bandwidth allocation will change when the QoS requirements of high priority RT traffics cannot be satisfied or can be satisfied excessively. The timer is initialized to zero whenever the reallocation is performed. If the timer expires, we make a large resource adjustment, i.e., we will reallocate resources for each traffic class. During the long period, if the high priority traffic classes experience good or bad satisfaction, a threshold based trigger will trigger a minor resource adjustment, i.e., only the traffic classes which experience good or bad satisfaction release some resources or obtain some resources. If the RT traffic classes have insufficient resources, the threshold based trigger will generate and the inter-traffic scheduler will remove some resources from NRT traffic to the RT traffic. Otherwise, the RT traffic will release some resources to NRT traffic. The current queue size $Q_m(t)$ in each traffic class is a measure for the backlogged traffic.

$$Q_m(t) = \sum\nolimits_{i \in \{class\_m\}} q_i(t) \tag{56.1}$$

where $q_i(t)$ is the number of bits in queue i at time t. The average channel condition $\overline{L(t)}$ is defined as the average number of bits carried per resource block (RB) which corresponds to a subframe in time and a subband in frequency and it can be represented as

$$\overline{L(t)} = \frac{1}{N_{\text{mcs}}} \sum_{j=1}^{N_{\text{mcs}}} N_{\text{bit}}(t) * N_{\text{sym}} * R * \min(M_T, M_R) \tag{56.2}$$

where N_{mcs} is the number of MCS levels, $N_{\text{bit}}(t)$ is the number of useful bits per symbol with MCS level j, N_{sym} is the number of symbols per subframe, and R is the number of subcarriers per subband.

The number of subbands $N_m(t)$ for the mth traffic class can be expressed by:

$$N_m(t) = \left\lfloor \gamma_m \frac{Q_m(t)}{\overline{L(t)}} \right\rfloor \tag{56.3}$$

where γ_m, $0 < \gamma_m < 1$, is a control factor used to control the resource allocation for heterogeneous traffic classes so that only the relatively urgent packets of high priority traffics can be served and more remaining resources will serve low priority traffics. The value of γ_m satisfying the requirements can be found through the repeated simulation.

After the RBs are distributed, the resources for each traffic class will not change until the timer expires or the trigger generates.

56.2.3 The Intra-Traffic Scheduler

The intra-traffic scheduler is a single traffic scheduler among users in a traffic class. After the inter-traffic scheduler allocates bandwidth resources to intra-traffic schedulers, an appropriate scheduling algorithm is to be designed for each intra-traffic scheduler according to the traffic characteristics and QoS requirements. Then the intra-traffic scheduler schedules the users' packets within each traffic class on their individual bandwidth resources. In this paper, the PF scheduling algorithm for NRT traffics and M-LWDF for RT traffics are adopted.

56.2.3.1 PF

For subchannel n at time t, the scheduler selects user i with a maximal priority metric, defined as

$$\mu_{i,n} = \frac{r_{i,n}(t)}{\overline{r_i(t)}} \tag{56.4}$$

and the average rate $\overline{r_i(t)}$ is updated by

$$\overline{r_i(t+1)} = \left(1 - \frac{1}{t_c}\right)\overline{r_i(t)} + \frac{1}{t_c} r_i(t) \tag{56.5}$$

where $r_{i,n}(t)$ the current rate is supported by subchannel n for user i at time t and t_c is a time constant.

56.2.3.2 M-LWDF

The M-LWDF takes the maximum delay requirement $W^i_{\max}$ into account for each user i. For subchannel n at time t, the corresponding priority metric is given as follows:

$$\mu_{i,n} = b_i W_i(t) \frac{r_{i,n}(t)}{\overline{r_i(t)}} \tag{56.6}$$

where $W_i(t)$ is the head of line (HOL) packet delay for user i. $b_i = -(\log \sigma_i)/W^i_{\max}$ with σ_i being the maximum probability of $W_i(t)$ exceeding $W^i_{\max}$, i.e., $\Pr\{W_i(t) > W^i_{\max}\} < \sigma_i$· $r_{i,n}(t)$ is the state of the subchannel n of user i at time t, i.e., the actual rate supported by subchannel n. $\overline{r_i(t)}$ is the average rate of user i.

The same traffics have the same QoS requirements, so $W^i_{\max}$ and σ_i are the same for all users owning the same traffics. Then the priority metric can be simplified as

$$\mu_{i,n} = W_i(t) \frac{r_{i,n}(t)}{\overline{r_i(t)}} \tag{56.7}$$

56.2.4 The Reduced Feedback Scheme

As we all know, the best-n feedback scheme is a promising feedback reduction scheme for OFDMA systems, where the user only reports the CQI feedback of the n strongest subchannels [6]. In order to reduce the amount of feedback to the BS and achieve fairness among the users in terms of feedback scheme, we consider a variation of the best-n scheme, namely, the normalized best-n scheme. In the feedback scheme, each user only allowed to report n CQI values of subchannels that have the best normalized SNR in a sub-traffic class. We assume that the fading channel for each MSs is a flat Rayleigh fading model. The normalized SNR of a user k is as follows:

$$\gamma_{k,i}(t) = \frac{Z_{k,i}(t)}{\bar{Z}_k} \tag{56.8}$$

where $Z_{k,i}(t)$ is the instantaneous received SNR of user k on subchannel i at slot t and $\bar{Z}_k$ is the average received SNR of user k.

56.3 Performance Evaluation

The performance of the proposed scheduling scheme with reduced feedback is compared to the proposed scheduling scheme with full feedback and the priority queuing scheme with full feedback in [3]. The performance of these schemes is evaluated in terms of the cell throughput and average packet delay.

We consider a single cell and a centralized BS in MIMO-OFDMA cellular system. Inter-cell interference is not considered. The system carrier frequency is 2 GHz and the bandwidth is 10 MHz with a subcarrier spacing $\Delta f = 15$ kHz, containing 601 subcarriers. The cell radius is 1 km and all the users are distributed uniformly in the cell. The maximum transmit power of the BS is 12 W. The BS and each user are equipped with four and two antennas respectively. The antennas are assumed with no correlation between each other.

The period of the large resource adjustment is 100 ms. The intra-traffic scheduling among users is performed every subframe whose length is 1 ms and the subframe contains 14 OFDM symbols. In order to reduce the amount of feedback information, every continuous 12 subcarriers are combined together as a subband, in which the same modulation and power allocation are used. The estimation of the channel gain and SNR of the eigenmode subchannels is based on the average on all 12 subcarriers. According to the SNR on every eigenmode subchannel, different modulation and coding schemes (MCS) of AMC are used. The mapping between MCS and the required SNR threshold is used as reference.

Four types of services are chosen, i.e., VoIP, video streaming, WWW, and BE, which are representing the four traffic classes. The priority sequence from highest to lowest is: VoIP, video streaming, WWW, and BE.

As shown in Fig. 56.1, as the user number increases, the cell throughput of these schemes increases before the upper bound of the transmission capability is reached. The proposed scheme provides a better throughput performance and can

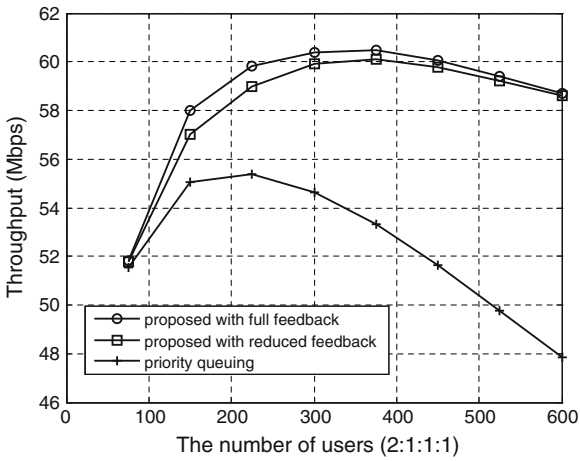

Fig. 56.1 The cell throughput versus the number of users

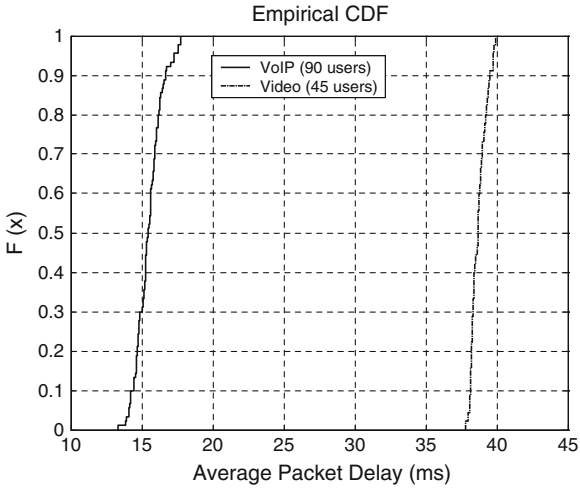

Fig. 56.2 Distribution of average packet delay

support more users. After the total system traffic load beyond the upper bound of their system capacity, the throughput will decrease as the user number increase, which is because the user fairness is guaranteed by both schemes, the more users in the system, the less chance each user can get to be served, so the throughput of every user is reduced. However, there is a sharp decline in the performance of the priority queuing scheme. This is because RT users with the worse channel condition must be still served ahead of NRT users with better channel conditions even when some RT users can still wait for a while up to their deadline. Figure 56.1 also shows that the throughput of the proposed scheme with reduced feedback is slightly lower than the full feedback case, but much higher than the priority queuing scheme. The reason is that the amount of feedback overhead is reduced significantly at the little expense of the transmission capacity, while keeping the strict fairness.

The cumulative distribution function (CDF) of average packet delay of the proposed scheme with full feedback is shown in Fig. 56.2. The two curves are for VoIP traffic with 90 users and video streaming traffic with 45 users, respectively. It can be seen that the durations of the two RT traffics' average packet delay are concentratedly distributed among certain amounts, which demonstrates the fairness among users is well kept.

56.4 Conclusions

In this paper, a two-level scheduler for multiple traffic classes with reduced feedback is proposed. The proposed scheduler tries to maximize the throughput of NRT traffics, while satisfying the QoS of RT traffics which enhances the overall system throughput. With the normalized best-*n* feedback scheme, the proposed

algorithm reduces the uplink feedback load significantly and improves the fairness among users. Simulation results demonstrate that the proposed scheduling algorithm can increase the overall system throughput significantly while guaranteeing the QoS requirements of RT traffics.

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Chapter 57
Low-Slop Hilly Land Resources Development and Utilization Based on AHP-SWOT Model

Jie Lv, Xiping Yuan, Shu Gan and Wei Li

Abstract SWOT model is an effective strategy analysis method which has remarkable structured and systematic characteristics, but this analysis method usually limited to descriptive explanation and absence of effective quantitative restriction. This paper took low-slope hilly land resources development and utilization of Yiliang county as an example, used AHP method to analyze and evaluate strengths factors, weaknesses factors, opportunities factors and threats factors of SWOT model comprehensively and drew effective strategic measure of development and utilization, at the same time, evaluated strategic measures and determining the weights. The study indicated that using AHP method to calculate the weight of SWOT elements is an effective way which makes up for the defect of the subjective. The two methods were combined effectively which make the analysis process changed from qualitative analysis to quantitative analysis. The results of the strategy analysis of low-slope hilly land resources development and utilization have reference value.

Keywords SWOT model · AHP analysis · Low-slope hilly land · Strategy analysis

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57.1 Introduction

Along with the accelerating of urbanization, industrialization and modernization of agriculture synchronously, the contradictions of land resources development and utilization are more and more acute and outstanding. The situation of cultivated land protection, basic farmland protection and construction land security are grim, the back-up land resources are nervous, and the task of land reclamation is difficult. In such circumstances, according to China's actual conditions (a large population with relatively little land, cultivated land resources are scarce, the hills area is larger), it is necessary to propel low-slope hilly land resources development and utilization. It is a major move to implement saving and optimization strategy and implement the basic national policy of using and protecting land rational. Under the new situation of industrialization and urbanization process speeding up, it is a new space exploration to guarantee development and protect resources and expand the spaces of construction land. The purpose of this is to reduce the urban and rural construction occupy high quality of cultivated land effectively and to protect land, especially the basic farmland. Meanwhile, it is an effective method to increase effective supply of the land and alleviate the contradiction between land supply and land demand.

Previous researches concerning low-slope hilly land resources development and utilization whether domestic or overseas were focus on agricultural demand level [1, 2] and short of strategy analysis of low-slope hilly land resources development and utilization. At the same time, the combination of theory research and specific planning project is scarce as well as the lack of low-slope hilly land resources development and utilization which were supported by engineering practice and urban construction mode theory research.

This paper took low-slope hilly land resources development and utilization of Yiliang county as an example, using AHP method to analysis and evaluation of the strengths factors, weaknesses factors, opportunities factors and treats factors of SWOT model comprehensively, drawing effective strategic measure of development and utilization; at the same time, evaluating strategic measures and determining the weights. Purpose of this is to guide the low-slope hilly land resources development and utilization scientifically and roundly.

57.2 Methodology

57.2.1 SWOT Analysis

SWOT analysis method, also calls situation analysis method, which was first put forward by Weihrich who came from University of San Francisco of United States in the 1980s. This method is a process which through analyzing research object's internal strengths factors and weaknesses factors, external opportunities factors

Fig. 57.1 SWOT analysis frame

and threats factors completely, then making strategic measures of problem solution [3]. SWOT analysis can deduce four countermeasures: SO strategy (depending on the internal strengths, use external opportunities), WO strategy (overcome internal weaknesses, use external strengths), ST strategy (depending on the internal strengths, avoid to external threats), WT strategy (overcome internal weaknesses, avoid to external threats). The SWOT analysis frame is shown in Fig. 57.1.

57.2.2 AHP Analysis

AHP analysis method, also calls analytic hierarchy process, which was first put forward by T. L. Saaty who was a famous American operations researcher and professor of University of Pittsburgh in the 1980s. It is a powerful system analysis and operational research method. It is quite effective to comprehensive evaluation and trend forecast of many factors, many standards and many schemes. The biggest advantage of AHP is that it can deal with combination problem of qualitative and quantitative. It also can put the decision maker's subjective judgment and policy experience into model and execute quantization processing.

57.2.3 AHP-SWOT Analysis

The advantages of SWOT analysis method are which has the remarkable characteristics of structured, systematic and easy. But SWOT analysis is a decision process which existing nun-objective defects [4]. It is hard to quantificat the merits of the known condition, it needs to introduce quantitative method to consummate it. So this paper introduced AHP method to quantizing each index of SWOT analysis results. The main steps of AHP-SWOT method: (1) explicit research

Fig. 57.2 Location of study area

scope and do SWOT analysis, apply SWOT method to identify related factors between internal conditions and external environment; (2) elements in each SWOT group were compared multiply; (3) elements among four SWOT groups were compared multiply and sorted total hierarchy; (4) use ranking results above in the strategy selection process [5, 6]. In this article, AHP-SWOT model of software yaahp0.5.3 were used to complete the main analysis.

57.3 Example Study

57.3.1 Study Area

Yiliang county is located in the central of Yunnan province (see Fig. 57.2), the longitude is between 102°58′ and 103°29′, the latitude is between 24°30′ and 25°17′, the elevation is between 1500 and 1900 meters. The county's length from north to south is 85.3 km, width from east to west is 51.5 m, and total land area is 1912.77 square kilometers. Yiliang is located in low plateau which belongs to north subtropical monsoon climate, the weather in spring and winter is dry and lack of rain, wet and more rain in summer and autumn. The average temperature for many years is 16.3 °C. Yiliang County is a typical mountainous city in Yunnan province; low-slope hilly land resources are rich and concentrated. In recent years, Yiliang County's economic strength has been enhanced, the scale of construction land expand rapidly, contradiction between human and land is very outstanding, basic power has been formed of low-slope hilly land resources development and utilization.

57.3.2 Data

The datum of low-slope hilly land resources status comes from 2011 Yiliang county statistical year book.

57.4 Result and Discussion

SWOT analysis of low-slope hilly land resources development and utilization comprehensively.

a. Strengths factors analysis

(1) resources advantage; (2) location advantages; (3) ecological environment advantage; (4) social and economic advantages.

b. Weaknesses factors analysis

(1) structures of land for construction is unreasonable and extensive; (2) reserved resources are scarce; (3) ecological environment protection faces severe challenges.

c. Opportunities factors analysis

(1) the new trend of international industrial transfer brings opportunities; (2) national macro control policies bring opportunities regularly; (3) the great western development strategy implementation bring opportunities; (4) Yunnan province as bridgehead which face to southwest China bring opportunities; (5) construction of Dianzhong economic zone bring opportunities.

d. Threats factors analysis

(1) population growth and economic development lead to the rigid demand increase of land for construction, the contradiction between supply and demand is increasing; (2) further development of urbanization and industrialization lead to the agricultural land, especially the cultivated land, protection situation is getting worse; (3) the regional development is not balanced, land use's coordination task is very difficult; (4) land ecological environment is worrying; (5) land use system and management innovation shoulder heavy responsibilities.

Low-slope hilly land resources development and utilization strategy analysis based on the method of AHP-SWOT.

Using AHP method, research contents were divided into three levels, there are the target strata, comprehensive evaluation layer and factor evaluation layer. Using software yaahp0.5.3 do level analysis to factors in the SWOT groups; using software yaahp0.5.3 do factors level analysis among the SWOT groups (see Fig. 57.3).

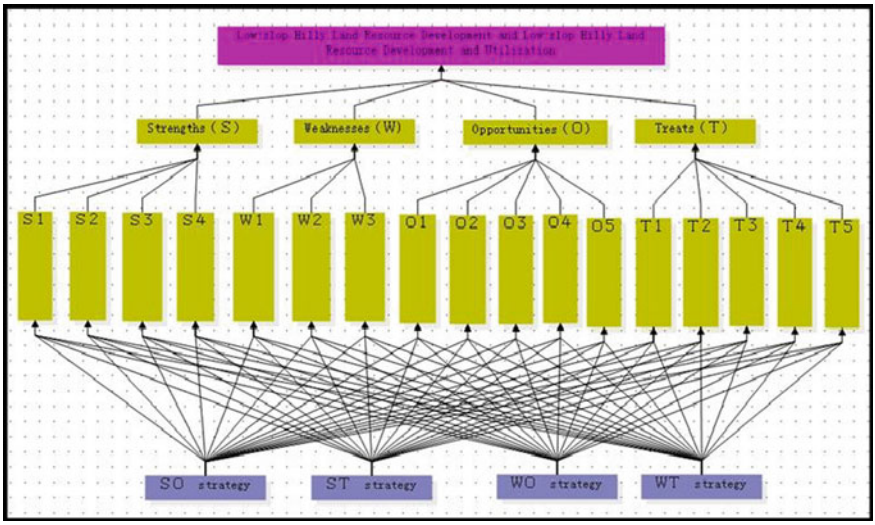

Fig. 57.3 AHP-SWOT model relationship chart

According to the exploitation strategy choices of low-slope hilly land resources of Yiliang county, the weight factors results in Table 57.1 show that: (1) the weight (0.3156) of strengths group's of low-slope hilly land resources development and utilization ranked first among all groups, resources advantage's weight

Table 57.1 Factors weight based on the AHP

Destination layer	Comprehensive evaluation layer	Weight at all levels	Factor evaluation layer	Weight
Low-slope hilly land resources development and utilization	Strengths (S)	0.3156	S1	0.1039
			S2	0.0851
			S3	0.0696
			S4	0.0570
	Weaknesses (W)	0.2012	W1	0.0855
			W2	0.0655
			W3	0.0502
	Opportunities (O)	0.2115	O1	0.0271
			O2	0.0318
			O3	0.0404
			O4	0.0494
			O5	0.0628
	Threats (T)	0.2716	T1	0.0757
			T2	0.0432
			T3	0.0620
			T4	0.0508
			T5	0.0399

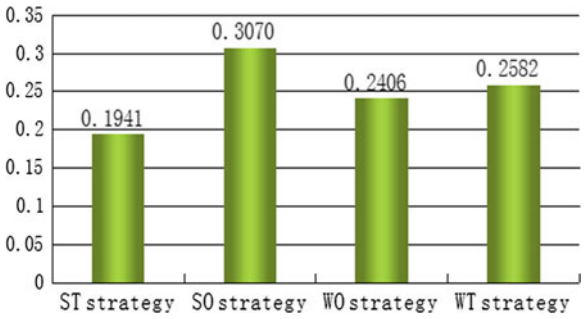

Fig. 57.4 Strategies weight based on the AHP

(0.3156) of strengths ranked first among all factors; (2) the weight (0.2716) of threats group of low-slope hilly land resources development and utilization ranked second among all groups; (3) the weight (0.2115) of opportunities group of low-slope hilly land resources development and utilization ranked third among all groups; (4) the weight (0.2012) of weaknesses group of low-slope hilly land resources development and utilization ranked fourth among all groups; (5) the sort results of each SWOT group's weight is strengths > threats > opportunities > weaknesses, low-slope hilly land resources development and utilization of Yiliang county exists certain advantages,but the threats are significant.

The Fig. 57.4 shows that: Weight ranking's orders in alternatives planes is SO strategy > WT strategy > WO strategy > ST strategy; (1) SO strategy is that extincting resources advantage of low-slope hilly land resources development and utilization and using the great opportunities of western development strategy implementation and Dianzhong economic zone construction, at meanwhile, grasping the opportunities of economic globalization and regional integration, relying on the related policy and taking the scientific development view as leading. According to the overall thinking of "industrial land is located in the tableland, town land is located in the low-slope hilly land", geographical location and traffic should be played a role, low-slope hilly land resources should be developed and utilized rationally, urban and rural construction occupied quality of cultivated land should be reduced effectively, arable land are protected especially the basic farmland; (2) WT strategy is that restraining basic farmland and high quantity cultivated land are occupied by construction land, avoiding the threat of cultivated land are occupied by construction. Improving land intensive degree, then land imbalance between supply and demand should be alleviated. For the sake of maximizing the social benefit, economic benefit and ecological benefits of land us, ecological agriculture and establishing ecological industrial park should be developed and pollution of the environment and the waste of resources should be reduced; (3) WO strategy is that restraining the sustainable decrease of the cultivated land, using the new round of land use planning opportunities. Controlling population growth, unifying the coordination of urban and rural development, coordinating the relationship between people and resources, optimizing resources allocation and developing recycling economy. Through allocating the low-slope

hilly land resources reasonably, promoting the upgrading of the industrial structure and production layout optimization; (4) SO strategy is that extincting resources advantage of low-slope hilly land resources development and utilization, avoiding land requirements' rigid growth which raised by population growth and economic development and avoiding the growing threat which raised by the contradiction between supply and demand. Under the clear guidance of the new round of overall plan of land utilization, high and new technology industries' development which covers an small area and less pollution should be accelerated in order to enhance science and technology innovation level of Yiliang county; with the purpose of saving and intensifying land utilization, the cost of land should be reduced and the low mining land use potential should be exploited fully.

57.5 Conclusion

By study, in AHP-SWOT analysis process, SWOT analysis method and AHP analysis method are relatively mature. Using AHP method to calculate the weight of SWOT elements is an effective way which makes up for the defect of the subjective. The two methods are combined effectively which make the analysis process change from qualitative analysis to quantitative analysis. The results of the strategy analysis of low-slope hilly land resources development and utilization have reference value.

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Chapter 58
Novel and Effective Multi-Secret Sharing Scheme

Shanyue Bu and Ronggeng Yang

Abstract A new multi-secret sharing (*t, n*) threshold scheme is proposed in this paper. The scheme uses the Lagrange interpolating polynomial to split and reconstruct the secrets based on Shamir secret sharing scheme, and verifies the legality of data by NTRU algorithm and one-way hashing function. Compared with other public key cryptosystems such as elliptic curve cryptography, the proposed is simpler in design, which requires less calculation and fewer storage spaces. It can detect effectively a variety of cheating and forgery behaviors, which guarantee that the reconstruction of secret is the secure and trustworthy.

Keywords Multi-secret sharing · NTRU algorithm · Threshold scheme · Verifiable

58.1 Introduction

Multi-secret sharing technique is to protect important secret or data with the distribution, storage and reconstruction of the secret or data. In 1979 cryptographist Shamir [1] proposed a secret sharing (*t, n*) threshold scheme based on Lagrange interpolating polynomial [2]. Harn proposed a verifiable multi-secret sharing scheme based on (*t, n*) threshold that through verification the cheating behavior of the dealer and the participant could be detected [3]. A new public verifiable secret sharing scheme using equalities involving bilinear map

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computations is proposed, making it easier to detect the cheating behavior of the dealer and the participant [4], a verifiable multi-threshold and multi-secret sharing scheme is proposed with each threshold value sharing multiple secrets so that processing time and storage amount could both be reduced [5], a secret shadow distribution method is introduced that combines the ID-based public key technology, which uses the participant's private key as his master shadow and also enables the simultaneous distribution of the secret shadow and the secret. The safety of the above schemes is mostly based on the difficult mathematical problems such as the solution of discrete logarithm and the factoring of large number. In Ref. [6] a secret sharing scheme based on NTRU algorithm is proposed with only one secret restorable and quite a large amount of storage.

In this paper, we propose a (t, n) threshold multi-secret sharing scheme based on NTRU algorithm and Shamir's scheme using Lagrange interpolating polynomial. The main characteristic of this scheme is that it is based on the fast and high efficient NTRU algorithm instead of the traditional cipher arithmetic of discrete logarithm and the factoring of large number [7, 8], so the processing cost of the system is reduced. It could effectively defense against the cheating behavior of the participants and varieties of attack. It guarantees security while at the same time being reasonable, simple, requiring limited storage which surpasses the similar schemes that exist today.

58.2 Multi-secret Sharing Scheme

58.2.1 Indication of Parameters

P: the assembly of all participants in a threshold secret sharing scheme. When there're n participants in a scheme, $P = \{P_1, P_2, \cdots, P_n\}$.

D: dealer in the scheme, $D \notin P$. The main duty of D is to distribute sub-secrets related to the secret information to every participant $P_i (i = 1, 2, \ldots, n)$, to provide every P_i in the scheme with public parameters needed to restore the secret and to manage the information of the participants in the scheme.

NB: electronic bulletin tablet. D could publish, change, add and delete information on *NB*. But what other participants in the scheme could do is only checking and reading information on NB, but no editorial activity such as changing the information.

Id: the set of the IDs of all participants. When there are n participants in the scheme, $id = \{id_1, id_2, \ldots, id_n\}$ D provides to every participant in the scheme P_i a single $id_i (i = 1, 2, \ldots, n)$. D publicizes each id_i on *NB*.

(h,f): The secret-key couple generated by NTRU algorithm. h is kept as a secret by D and f is put upon NB.

(H): one-way hashing function used in the scheme, either MD5 or SHA.

(S): the set of the m different pieces of secret that needed to be shared in the scheme. $S = (S_1, S_2, \cdots, S_m)$.

58.2.2 Constructing Sub-keys for Participants

According to Shamir's (t, n) threshold secret-sharing scheme [1], dealer D randomly generates t different integers and t − 1 order interpolating polynomial $a(x)$:

$$a(x) = a_0 + \sum_{j=1}^{t-1} a_j x^j \tag{58.1}$$

In which $t \leq n < N, a_i \in Z[X]/(X^N - 1), a(x)$, could be represented by vectors in NTRU. According to formula (58.2) D designates one sub-key to every participant P_i in the scheme $x_i \in Z[X]/(X^N - 1)$.

$$x_i = a(id_i) = \sum_{j=0}^{t-1} a_j * (id_i)^j \tag{58.2}$$

As to coefficients $a_j (j = 0, 1, \ldots, t-1)$ of $a(x)$, D verifies the vectors $v = (v_0, v_{1,} \ldots, v_{t-1})$ according to formula (58.3).

$$v_j = r * h + a_j (\text{mod } q) \tag{58.3}$$

D, via security channel, secretly delivers x_i to P_i and puts v on NB. After other participants in the scheme P_i receive x_i, they could verify x_i according to formula (58.4). If formula (58.4) is not satisfied, it indicates that D is cheating on P_i, and this time participants could complain to the dealer. Otherwise it indicates that D provides P_i with the authentic sub-key x_i.

$$x_i = f^* \sum_{j=0}^{t-1} v_j^* (id_i)^j (\text{mod } p) \tag{58.4}$$

58.2.3 Constructing Key Certificates

Suppose binary set (e, c) is the secret certificate of S, dealer D randomly chooses different parameters r and e, $e_j \in e (j = 1, 2, \ldots, m)$, m being the number of the secret in the scheme, r, $e_j \in Z[X]/(X^N - 1)$. According to formula (58.5), D generates for every piece of secret $S_j \in S$ a binary secret certificate (e_j, c_j)

$$c_j = r * h + e_j (\text{mod } q) \tag{58.5}$$

58.2.4 Constructing Shadow Sub-Keys

Suppose k is the set of the shadow sub-keys of S, D according to formula (58.6) generates for every secret $S_j \in S$ a shadow sub-key $k_j \in k(j = 1, 2, \ldots, m)$.

$$k_j = S_j \oplus H(a_0 * c_j) \tag{58.6}$$

D publicizes (e_j, c_j, k_j) on NB.

58.2.5 Reconstructing Multiple Secrets

We suppose that $\Gamma(|\Gamma| = t \leq n)$ is an access structure of participants in P and is monotonous, $B \in \Gamma$ is the smallest authorization subset of Γ, that is, B is the assembly of the t participants in P that are needed to reconstruct secret $S_j \in S$. Each participant in B could be a secret reconstruction and participate in secret reconstruction.

(1) Computing secret-exchanging certificates

Participant $P_i \in$ B acquires c_j from electric bulletin NB, and uses its own sub-key x_i and formula (58.7) to calculate secret-exchanging certificate A_{ij}, then P_j distributes A_{ij} to other cooperators of B.

$$A_{ij} = x_i^* c_j \tag{58.7}$$

(2) Verifying secret-exchanging certificates

After other participants in the scheme receive A_{ij} and acquire e_j from NB, they could verify A_{ij} according to formula (58.8). If (8) is not satisfied, it is believed that there are cheating behaviors among participants, it would be declared that A_{ij} is mistaken and secret reconstruction would stop. It would be demanded that P_i resend the correct A_{ij}.

$$f^* A_{ij} (\text{mod } p) = f^* \sum_{k=0}^{t-1} v_k (id_i)^{k^*} e_j (\text{mod } p) \tag{58.8}$$

(3) Reconstruction of multiple secrets

When the A_{ij} of all participants in B pass verification, k_j could then be acquired from NB and reconstruction of secret S_j could be carried out according to formula (58.9)

$$S_j = k_j \oplus H\left(\sum_{P_i \in \Gamma} A_{ij}{}^* \prod_{P_k \in \Gamma, P_k \neq P_i} \frac{-id_k}{id_i - id_k} \right) \tag{58.9}$$

58.3 Security Analysis

The security of the scheme is based upon the following three conditions:

(1) The public-key encryption system is based on NTRU algorithm, which is the mathematical problem of solving the shortest vector in the grids. This mathematical problem is very difficult and renders it impossible to solve directly the secret information based on public information.
(2) According to formulas (58.4) and (58.8), the cheating behavior between the dealer and the participant and between participant and participant during information exchange could be avoided.

Below several possible kinds of attacks are given with further analysis of the security of the scheme.

Attack 1, the safety issue of the sub-key x_i of the participants, It is impossible for the attackers to utilize the information publicized on *NB* to acquire the x_i of other participants, since the safety of x_i is based on the privacy of the dealer D secretly constructing $a(x)$. If the attacker wants to construct the same $a(x)$, he needs to solve the difficult mathematical problem of factoring large number which is not practical.

Attack 2, the negligence of the dealer, Because of negligence, when D provides a wrong sub-key x_i to other participants, fails to update x_i in time while there is a change of data in the scheme such as $a(x)$, or during the transmission of data x_i is altered with hostility, the participants could verify the validity of x_i with formula (58.4). Any non-authentic x_i could not satisfy (4) unless the attacker successfully solve the NTRU algorithm and acquire secret key such as h. But obviously this is not practical.

Attack 3, reconstructing other secrets with known secrets, since both formulas (58.6) and (58.9) utilize the one-way hashing function H, even if the attacker has acquired part of the secret S_j and k_j via legal path, he could not use $\oplus$ calculation to restore important information such as a_0. So without the help of other participants the attacker could not restore other secrets unless he successfully solves the one-way hashing function and acquire important information such as a_0. This is also obviously non-practical.

Attack 4, The cheating behavior among the participants, During the reconstruction of the secret, a binary-set secret certificate (e, c) is designed and encrypted with NTRU algorithm, so it is assured that the public (e, c) and the set of shadow sub-keys are not changeable. Dishonest participant P_i might deliberately provide the wrong secret-exchanging certificate A_{ij}, rendering other participants not being able to restore the correct secret and he himself getting the right secret. This scheme could make such behavior impossible because according to Theorem 3 and the safety of c_j, any false A_{ij} cannot lead to the right S_j with formula (58.9). Meanwhile when P_i provides the false A_{ij}, he is easy to be discovered.

58.4 Dynamic Capacity Analyses

When a new secret S_{new} needs to be added to the scheme, dealer D only needs to use formulas (58.5) and (58.6) to calculate the new $e_{\text{new}}, c_{\text{new}}, k_{\text{new}}$ and put them on NB. When certain secret S_{del} needs to be deleted from the scheme, D only needs to delete $e_{\text{new}}, c_{\text{new}}, k_{\text{new}}$ from NB while other information in the scheme remains unchanged.

When a new participant P_{new} needed to be added to the scheme, D only needs to assign to P_{new} a new id_{new}, use formulas (58.2) and (58.3) to calculate the new x_{new} and v_{new}, assign x_{new} to P_{new}, and publicize v_{new} on electric bulletin board NB, with other information in the scheme remains unchanged.

When certain participant in the scheme P_{del} needs to be deleted, D needs to delete from NB $v, \text{id}_{\text{del}}, c, k$ and etc., re-compute new secret-key couple $(h_{\text{new}}, f_{\text{new}})$, $v'_{new} = (v_1, v_{2,} \ldots, v_n)$, $c'_{\text{new}} = (c_1, c_{2,} \cdots, c_m)$ and $k'_{\text{new}} = (k_1, k_{2,} \cdots, k_m)$, and publicize $f_{\text{new}}, v'_{\text{new}}, c'_{\text{new}}, k'_{\text{new}}$ on NB. The information of other participants in the scheme such as their sub-keys needs not to be changed.

58.5 Conclusions

In this paper we propose a new multi-secret sharing scheme based on (t, n) threshold. The dealer first distributes one sub-key to each participant and provides a verifiable vector for each sub-key of the participants. The dealer also designs for every piece of secret a secret certificate and a shadow sub-key. During the secret reconstruction, each participant can utilize the information publicized on the bulletin board and calculate first the secret-exchanging certificate, which must pass the verification of other participants in order for the reconstruction to get going. Apart from the fact that the information is safe and sound, the scheme is simple and high-efficient once compared to existing schemes. And when it is needed to add a participant or a new secret, the sub-key of the participant could be reused, which results in little amount of data and good expansive capability.

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Chapter 59
Rural E-Commerce Based on Probabilistic Neural Network Model

Yuan He, Yangxu Li and Hong Xu

Abstract The purpose of this study is to examine the digital divide in western rural areas of China. According to rural E-commerce development of Western China, we constructed evaluation index system, and used methods of principal component analysis and factor analysis to pretreat survey data, then input the data into probabilistic neural network for evaluating rural E-commerce construction in Sichuan. Results reveal: First, only a small portion of rural enterprises have access to the Internet, and the penetration rate of the Internet in rural western enterprises of China is much lower than that in urban enterprises; Second, large and old enterprises are more likely to have access to the Internet; Thirdly, Internet access demonstrates very strong and positive relationships with enterprises' economic and innovative performances. The study concludes that governments should promote Internet usage among rural enterprises.

Keywords Rural ITs · Information economy · Neural network · E-commerce · Principal component analysis

59.1 Introduction

Agriculture was a clear leader in reform; however, it is now lagging behind other sectors. China's rural economy faces many serious challenges, especially in the disaster area after Wenchuan earthquake happened on 12 May, 2008. The gains of

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economic growth have not been fairly shared between urban and rural residents. Many parts of the agricultural and rural sector remain underdeveloped. Rural residents confront tremendous barriers when they enter the non-farm sector and find jobs in cities. Managing the reform rural development of disaster area needs to change the role and organization of the government. Establishing efficient governance at the local and regional levels while increasing accountability, however, remains a major challenge. By the end of 2011, there are more than 20 million rural enterprises in China, providing more than 128 million jobs, or about 27 % of China's total rural labor force, and contributing about one-third to China's gross industrial value added [1]. From 1978 to 2010, industrial output value of rural enterprise has been growing at an average rate of 18.9 %, compared to 7.4 % for state-owned enterprises (SOEs). By the end of 2009, more than 90 % of rural collective enterprises in China have been restructured (privatized) [2]. We argue that such an approach is too simplistic, and the fortunes of rural enterprises are related not only to the arrangement of property rights, but also to many other factors including their capabilities of technological innovation and management. A rural enterprise without innovation is doomed to fail in the long run.

This study examines one aspect of E-commerce innovation: access to and adoption of information technologies (ITs), particularly, the usages of the Internet in rural enterprises. The purpose of this study was to establish an evaluation system to model the usage of the Internet among rural enterprises. For this purpose, Data of 150 rural enterprises in three selected counties (county-level cities) in Sichuan province were obtained through surveys.

59.2 Probabilistic Neural Network

Probabilistic neural network (PNN) is a pattern classification algorithm which falls into the broad class of "nearest-neighbor-like" algorithms [3, 4]. When the information input to the network, the information initially transmitted to the hidden layer nodes from the input layer, and then transmitted to the output layer [5, 6]. After each layer during the corresponding characteristics function must be carried out by the transformation [7]. The characteristic function of node is:

$$f(x) = \frac{1}{1 + e^{-x}}, (-\infty < x < +\infty) \tag{59.1}$$

59.2.1 PNN Learning Algorithm

PNN learning algorithm is composed of forward propagation and back propagation, forward propagation is used for network computing to calculate on the output of a particular input, back propagation is used layer by layer to transfer error,

modify connection weights and thresholds. PNN algorithm can be summarized as follows:

Step 1 Set variables and parameters. $X_K = [x_{k_1}, x_{k_2}, \ldots, x_{k_M}]$, $(k = 1, 2, \ldots, N)$, x_k is input vector, that is training samples, N is the number of samples for training.
$W_{MI}(n) = (w_{ij})_{M \times I}$, $W_{MI}(n)$ is the nth iteration weight vector between input layer and hidden layer I.
$W_{IJ}(n) = (w_{ij})_{I \times J}$, $W_{IJ}(n)$ is the nth iteration weight vector between hidden layer I and hidden layer J.
$W_{JP}(n) = (w_{ij})_{J \times P}$, $W_{JP}(n)$ is the nth iteration weight vector between hidden layer J and output layer.
$Y_k(n) = [y_{k_1}(n), y_{k_2}(n), \ldots, y_{k_p}(n)], (k = 1, 2, \ldots, N)$, $Y_k(n)$ is the network actual output vector after the nth iteration.
$D_k(n) = [d_{k_1}(n), d_{k_2}(n), \ldots, d_{k_p}(n)], (k = 1, 2, \ldots, N)$, $D_k(n)$ is the network expectation vector after the nth iteration.

Step 2 Initialize. Smaller random non-zero value assigned to $W_{MI}(0)$, $W_{IJ}(0)$, $W_{JP}(0)$.

Step 3 Input sample data X_K, $n = 0$.

Step 4 Calculate the input signal υ and the output signal v on each neuron forward.

Step 5 Calculate error $E(n)$ from the output expectation d_k and the actual output value $Y_k(n)$ obtained on step backward, and determine whether $E(n)$ is a small positive number, then return to Step 8, otherwise return to Step 6.

Step 6 Determine whether $n + 1$ is greater than the maximum number of iterations. If $n + 1$ is less than the large number of iterations, Calculate the local gradient δ on each neuron backward, otherwise return to Step 8. The local gradient δ on each neuron is:

$$\delta_p^P = y_p(n)(1 - y_p(n))(d_p(n) - y_p(n)), (p = 1, 2, \ldots, P) \tag{59.2}$$

$$\delta_j^J = f'(u_j^J(n)) \sum_{p=1}^{P} \delta_p^P w_{jp}(n), (j = 1, 2, \ldots, J) \tag{59.3}$$

$$\delta_i^I = f'(u_i^I(n)) \sum_{j=1}^{J} \delta_j^J w_{ij}(n), (i = 1, 2, \ldots, I) \tag{59.4}$$

Step 7 Calculate the weight correction ΔW. η is learning rate. If $n = n + 1$, return to Step 4.

$$(1) \begin{cases} \Delta W_{jp}(n) = \eta \delta_p^P(n) v_j^J(n) \\ W_{jp}(n+1) = W_{jp}(n) + \Delta W_{jp}(n) \\ (j = 1, 2, \ldots, J; p = 1, 2, \ldots, P) \end{cases} \tag{59.5}$$

$$(2)\begin{cases}\Delta W_i j(n) = \eta\delta_j^J(n)v_i^I(n) \\ W_i j(n+1) = W_i j(n) + \Delta W_i j(n) \\ (i = 1, 2, \ldots, I; j = 1, 2, \ldots, J)\end{cases} \tag{59.6}$$

$$(3)\begin{cases}\Delta W_m i(n) = \eta\delta_i^I(n)v_k^m(n) \\ W_m i(n+1) = W_m i(n) + \Delta W_m i(n) \\ (m = 1, 2, \ldots, M; i = 1, 2, \ldots, I)\end{cases} \tag{59.7}$$

Step 8 If all training samples are completed, the process ends; otherwise, return to Step 3.

59.2.2 Indicator System for Evaluation Model

Before the actual operation of the model, the questionnaire data were Screened for indicator system and extracted for information. According to the national scheme of information index structure and the 2006–2010 national information planning, 15 indexes are chosen to reflect the information building in Sichuan rural areas. The 15 indexes are shown in Table 59.1.

Subjective or poor operating indicators were handled to be fuzzy or quantitative. We then used principal component analysis to further filter the scientific; the remaining indicators can be a good feature on the target groups Interpretation, making the model accuracy, simplicity and objectivity have been strengthened.

Table 59.1 Indexes and explain

Index	Explain of indexes	Index	Explain of indexes e
X1	The toll cable coverage rate	X9	The update cycle of website information related agriculture
X2	The bandwidth possessive quantity per capita	X10	The visiting rate of website related agriculture
X3	The total capacity of network resources database	X11	The transaction quantity of agricultural products online
X4	The proportion of information investment in fixed assets investment	X12	The toll communication number on telephone per capita
X5	The computer quantity per thousand household	X13	The Information consumption index
X6	The popularity rate of telephone	X14	The number of employed person on agricultural information
X7	The popularity rate of television	X15	The total output value of agricultural information services
X8	The website number related agriculture		

59.3 Data Preprocessing

59.3.1 Principal Component Analysis

Principal component analysis (PCA) is a mathematical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of uncorrelated variables called principal components. The results of a PCA are usually discussed in terms of component scores (the transformed variable values corresponding to a particular case in the data) and loadings (the weight by which each standardized original variable should be multiplied to get the component score) [9].

The following results (shown in Table 59.2) is PCA of 15 indicators extracted from 130 valid questionnaires:

The eigenvalue of principal component X_{15} is 0.02310389, close to 0 and far less than the required 0.2, we believe that the interpretation of this variable on the sample is not enough. For the explanation of X_{15} to the characteristics of the sample is not enough, the variable should be deleted to improve the accuracy of the model fitting.

Also we continue to repeat these two steps, followed by removing the two indicators (X_{14} and X_{13}), and get the eigenvectors shown in Table 59.3.

The results from Table 59.3, we can see, the eigenvalue of the first 12 principal components is the smallest of the remaining variables, the value is 0.25842740, which is not smaller than 0.2. So we believe samples can be explained by these 12 main components. The cumulative value of the first 7 principal components is 0.8056, that mean the accumulative proportion of explained variance of factor have reached $80.56 > 80$ %. We initially identified seven factors which retain the main economic information of the original data.

59.3.2 Factor Analysis

On the basis of PCA, factor analysis reduces the data dimension and strives to explain correlations among multiple outcomes as the result of one or more underlying explanations. In this study, the overall MSA (Kaiser's Measure of

Table 59.2 Eigenvalues of the correlation matrix

Index	Eigenvalue	Index	Eigenvalue	Index	Eigenvalue
X1	0.009686	X6	0.386246	X11	−0.016158
X2	0.364818	X7	0.004854	X12	0.400633
X3	0.012603	X8	0.399068	X13	−0.020718
X4	0.357825	X9	−0.016375	X14	0.370564
X5	0.016347	X10	0.383686	X15	0.016509

Table 59.3 Eigenvalues

Index	Eigenvalue	Proportion	Cumulative	Index	Eigenvalue	Proportion	Cumulative
X1	2.94206596	0.2452	0.2452	X7	0.79289114	0.0661	0.8056
X2	1.76158154	0.1468	0.3920	X8	0.66753546	0.0556	0.8613
X3	1.24551371	0.1038	0.4958	X9	0.57978212	0.0483	0.9096
X4	1.13453076	0.0945	0.5903	X10	0.50516318	0.0421	0.9517
X5	0.92775862	0.0773	0.6676	X11	0.32152934	0.0268	0.9785
X6	0.86322076	0.0719	0.7396	X12	0.25842740	0.0215	1.0000

Table 59.4 Rotated factor pattern

Index	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7
X1	−0.24959	−0.27549	0.67585	0.18635	0.32717	0.13065	0.02722
X2	0.00766	0.87274	−0.09413	0.13943	−0.06089	−0.00431	0.19791
X3	0.30548	0.18734	−0.07326	0.11503	−0.09145	0.10515	0.82819
X4	0.64137	−0.01902	−0.42871	0.04230	0.22870	−0.24685	0.05277
X5	0.04658	0.00982	−0.04124	0.02142	−0.04618	0.95301	0.04528
X6	−0.44424	0.10413	0.26478	−0.49085	0.02485	−0.23476	0.52232
X7	0.08894	0.16132	0.75779	−0.24231	−0.10446	−0.16393	−0.03051
X8	−0.05162	0.00082	0.01676	−0.06682	0.93495	−0.05359	−0.06981
X9	0.75877	−0.04735	−0.06043	0.19336	−0.20861	0.07128	0.24913
X10	0.48771	0.62149	0.27395	−0.15480	0.13200	0.01538	−0.01039
X11	0.09733	0.08653	−0.06066	0.92093	−0.05982	−0.00702	0.07863
X12	0.79552	0.37613	0.09888	0.02933	−0.07081	0.12075	0.03186

Sampling Adequacy) = 0.65855659 > 0.5, we believe it is the ideal results. The rotated analytic results are shown in Table 59.4. The following equation can be counted from the Table 59.4 (Factor2, Factor3, Factor4, Factor5, Factor6, Factor7 are omitted):

$$\begin{aligned} Factor_1 = & -0.24959X_1 + 0.00766X_2 + 0.30548X_3 + 0.64137X_4 + 0.04658X_5 \\ & - 0.44424X_6 + 0.08894X_7 - 0.05162X_8 + 0.75877X_9 + 0.48771X_{10} \\ & + 0.09733X_{11} + 0.79552X_{12} \end{aligned} \tag{59.8}$$

Based on evaluation index system established by factor analysis, we constructed the assessment prediction system of PNN.

59.4 Application of PNN

Both study samples, and prediction samples need to be normalized. Network output values correspond to discrete variables, respectively 1, 2 and 3, which represent the level of information development (1 means seldom using ITs for

E-commerce, 2 means sometimes taking the advantage of ITs for E-commerce, 3 means good use of ITs for E-commerce).

Carried out these steps, we substituted the actual data into model. The following is the process to use PNN model evaluating the information development of Rural Areas in Sichuan province:

The result shows that only three network outputs are not accordance to expected output. Those sample codes are 5, 15 and 16. The average recognition rate of PNN is 85 %. The total recognition rate of 130 samples is 97.69 %. Forecast data fit well with the actual data. Therefore, we believe that the network meets the application requirements, and the fitting and forecasting results are very satisfactory. These are implemented in the neural network toolbox of Matlab7.0; density of radial basis functions is 0.055.

59.5 Conclusions

ITs have brought both opportunities and threats to rural enterprises [3, 9]. On the one hand, rural enterprises can gain access to markets, services, and information that were hard to access before and such technologies have the potential to enable them to compete with their urban counterparts in the same market. On the other hand, they may face even more competition from enterprises elsewhere, which are using the same ITs. The study examines the digital divide in rural Sichuan, one of the developing areas in Western China. First, it reveals that only a small portion of rural enterprises have access to the Internet, and the penetration rate of the Internet in rural China is much low.

Secondly, the Internet is primarily used by rural enterprises to search and collect information regarding their suppliers, customers, and technologies, while E-commerce is not very common yet, though some rural enterprises in Western China do have started exploring the technology.

Thirdly, this study finds that the size, years of establishments and industry of enterprises are strongly associated with their Internet access. Larger and older enterprises are more likely to have access to the Internet.

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Part VI
Artificial Intelligence

Chapter 60
Optimality Conditions for Minimax Semi-Infinite Fractional Programming Involving Generalized Convexity

Xiaoyan Gao

Abstract The purpose of this paper is to consider a class of nonsmooth minimax semi-infinite fractional programming problem. Based on the concept of $H-$ tangent derivative, a new generalization of convexity, namely generalized uniform $(B_H, \rho)-$ invexity, is defined for this problem. For such semi-infinite programming problems, several sufficient optimality conditions are established and proved by utilizing the above defined new classes of functions. The results extend and improve the corresponding results in the literature.

Keywords $H-$ Tangent derivative · Generalized convexity · Minimax fractional semi-infinite programming · Optimality conditions

60.1 Introduction

The concept of generalized convexity is well known in optimization theory. To relax convexity assumptions imposed on theorems on optimality conditions for generalized mathematical programming problems, various generalized convexity notations have been introduced. Furthermore, many authors investigated the optimality conditions for minimax programming problems under the conditions of generalized convexity. In particular, Aparna Mehra [1] employed various optimality conditions and duality results under arc wise connectedness and generalized arc wise connectedness assumptions for a static minimax programming problem. Lin [2] and Wu [3] derived the sufficient optimality conditions for the generalized

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minimax fractional programming in the framework of $(F,\rho)-$ convex functions and invex functions. In [4], the Karush–Kuhn–Tucker-type sufficient optimality conditions and duality theorems for a nondifferentiable minimax fractional programming problem under the assumptions of alpha-unisex and related functions were derived. Hang-Chin Lai [5] established the necessary and sufficient optimality conditions of nondifferentiable minimax fractional programming problem with complex variables under generalized convexities. Lai and Liu [6] employed the elementary method and technique to prove the necessary and sufficient optimality conditions for nondifferentiable minimax fractional programming problem involving convexity. In [7], a unified higher order dual for a nondifferentiable minimax programming problem was formulated. Weak, strong, and strict converse duality theorems were discussed involving generalized higher order (F, α, ρ, d)-Type I functions.

Semi-infinite programming have been a subject of wide interest since they play a key role in a particular physical or social science situation, i.e., control of robots, mechanical stress of materials, and air pollution abatement etc. Recently, Qingxiang Zhang [8] obtained the necessary and sufficient optimality conditions for the nondifferentiable nonlinear semi-infinite programming involving B-arc wise connected functions. In [9, 10], the optimality conditions under various constraints qualification for semi-infinite programming problems were established.

In this paper, motivated by the above work, we first define a kind of generalize convexity about the $H-$ tangent derivative. Then, the sufficient optimality conditions are obtained for a class of minimax fractional semi-infinite programming problem involving the new generalized convexity.

60.2 Definitions and Preliminaries

Let $X \subset R^n$ be a nonempty set, $x_0 \in X, d \in R^n$ and $f : X \to R \cup \{+\infty\}$ be a function, $T^H_{epif_+}(x_0, f(x_0))$ be $H-$tangent cone of $epif_+$ with respect to $(x_0, f(x_0))$. We say that $f^H(x^0; d)$ is $H-$ tangent derivative of f at x^0 along the direction d, where $f^H(x^0; d) = \inf\{\eta | (d, \eta) \in T^H_{epif_+}(x_0, f(x_0))\}$ to define a class of new functions, we suppose that X is nonempty open subset of R^n, real valued function $f : X \to R$ is $H-$ tangent derivable at $x^0 \in X, \rho \in R$, $b : X \times X \times [0, 1] \to R_+$, $\lim\limits_{\lambda \to 0^+} b(x, x^0; \lambda) = b(x, x^0)$, $\varphi : R \to R, \eta : X \times X \to R^n, \theta : X \times X \to R^n$ where η and θ are victories application.

Define2.1 f is said to be generalized uniform $(B_H, \rho)-$ in vex function at $x^0 \in X$, if for any $x \in X$, there exists θ and ρ b, φ, η, such that

$$b(x, x^0)\varphi[f(x) - f(x^0)] \geq f^H(x^0, \eta(x, x^0)) + \rho\left\|\theta(x, x^0)\right\|^2$$

Define 2.2 f is said to be generalized uniform $(B_H, \rho)-$ pseudoinvex function at $x^0 \in X$, if for any $x \in X$, there exists b, φ, η, θ and ρ, such that

$$b(x, x^0)\varphi[f(x) - f(x^0)] < 0 \Rightarrow f^H(x^0, \eta(x, x^0)) + \rho\left\|\theta(x, x^0)\right\|^2 < 0$$

Define2.3 f is said to be generalized uniform $(B_H, \rho)-$ quasiconvex function at $x^0 \in X$, if for any $x \in X$, there exists b, φ, η, θ and ρ, such that

$$b(x, x^0)\varphi[f(x) - f(x^0)] \leq 0 \Rightarrow f^H(x^0, \eta(x, x^0)) + \rho\left\|\theta(x, x^0)\right\|^2 \leq 0$$

Remark 2.1. The function f is said to be generalized uniform $(B_H, \rho)-$ in vex function on X, if it is said to be generalized uniform $(B_H, \rho)-$ in vex function at each point $x^0 \in X$. In particular, f is said to be generalized uniform $(B_H, \rho)-$ strong in vex function or generalized uniform $x^0 \in X$ in vex function with respect to $\rho > 0$ or $\rho = 0$ respectively.

60.3 Sufficient Optimality Conditions

In this section, we consider the following minimax semi-infinite fractional programming problem: $(SIFP)$ minimize $F(x) = \sup_{y \in Y} \frac{f(x,y)}{h(x,y)}$, subject to $g(x, u) \leq 0, u \in U, x \in X$

Where X is a nonempty open subset of R^n, Y is compact subset of R^m; $f(\cdot, \cdot) : X \times Y \to R$, $h(\cdot, \cdot) : X \times Y \to R$, $f(x, \cdot), h(x, \cdot)$, are continuous on Y for every $x \in X$; $g : X \times U \to R^r$ and $U \subset R^r$ is an infinite index set; $f(x, y) \geq 0$ and $h(x, y) > 0$ for each $(x, y) \in X \times Y$. We assume that $f(x, \cdot), h(x, \cdot)$ and $g(\cdot, u)$ are $H-$ tangent derivable at $x \in X$. We put $X^0 = \{x | g(x, u) \leq 0, u \in U\}$ for the feasible set of problem (SIFP).

For each $x \in X^0$, we define $\Delta = \{j | g(x, u^j) \leq 0, x \in X^0, u^j \in U\}$, $J(x^0) = \{j | g(x^0, u^j) = 0, x \in X^0, u^j \in U\}$, $U^* = \{u^j \in U | g(x, u^j) \leq 0, x \in X^0, j \in \Delta\}$, which is a countable subset of U, $\Lambda = \{\mu^j | \mu^j \geq 0, j \in \Delta\}$, which means that $\mu^j \geq 0$, for all $j \in \Delta$, and only finitely many are strictly positive.

$$\overline{Y}(x) = \{y \in Y \left| \frac{f(x, y)}{h(x, y)} < \sup_{z \in Y} \frac{f(x, z)}{h(x, z)} \right.\},$$

$Q = \{(s, \lambda, \overline{y}) \in N \times R^s_+ \times R^{ms} | 1 \leq s \leq n + 1, \lambda = (\lambda_1, \lambda_2, \ldots, \lambda_s) \in R^s_+$, with $\sum_{i=1}^s \lambda_i = 1$, and $\overline{y} = (\overline{y}_1, \overline{y}_2, \ldots, \overline{y}_s)$ with $\overline{y}_i \in \overline{Y}(x), i = 1, \ldots, s\}$

In view of the continuity of $f(x, \cdot)$ and $h(x, \cdot)$ on Y and compactness of Y, it is clear that $\overline{Y}(x^0)$ is nonempty compact subset of Y for each $x^0 \in X^0$, and for any $\overline{y}_i \in \overline{Y}(x^0)$, we let $q^* = \frac{f(x^0, \overline{y}_i)}{h(x^0, \overline{y}_i)}$, which is always a constant.

Definition 3.1 For the problem (SIFP), a point $x^0 \in X^0$ is said to be an optimal solution, if for any $x \in X^0$ such that

$$\sup_{y\in Y}\frac{f(x^0,y)}{h(x^0,y)} \le \sup_{y\in Y}\frac{f(x,y)}{h(x,y)}$$

Theorem 3.1 *Let $x^* \in X^0$ and for any $x \in X^0$, we assume that there exists $(s^*, \lambda^*, \overline{y}) \in Q$, $q^* \in R_+, \mu_j^* \in \Lambda, j \in \Delta$ and $b_0, \phi_0, b_1, \phi_1, \eta, \theta, \rho^* \in R^{s^*}, \tau^* \in R^{(\Delta)}$, such that*

(i) For any $\overline{y}_i \in \overline{Y}(x^*), i = 1, \ldots, s^*, (f - q^*h)(\cdot, \overline{y}_i)$ is generalized uniform $(B_H, \rho_i^*)-$ invex at x^* with respect to b_0 and ϕ_0;
(ii) For any $u^j \in U^*, j \in J(x^*), g(\cdot, u^j)$ is generalized uniform $(B_H, \tau_j^*)-$ invex at x^* with respect to b_1 and ϕ_1;
(iii)

$$\sum_{i=1}^{s^*} \lambda_i^*(f - q^*h)_x^H(x^*, \overline{y}_i; \eta(x, x^*)) + \sum_{j\in\Delta} \mu_j^* g_x^H(x^*, u^j; \eta(x, x^*)) \ge 0, \forall u^j \in U^*, j \in \Delta;$$

(iv) $\sum_{j\in\Delta} \mu_j^* g(x^*, u^j) = 0, \forall u^j \in U^*, j \in \Delta;$
(v) $f(x^*, \overline{y}_i) - q^*h(x^*, \overline{y}_i) = 0,\ i = 1, \ldots, s^*;$
(vi)

$$\begin{aligned} a<0 \Rightarrow \phi_0(a)<0 \text{ and } \phi_0(0) = 0, a \le 0 \\ \Rightarrow \phi_1(a) \le 0, b_0(x, x^*) > 0, b_1(x, x^*) \ge 0; \end{aligned}$$

(vii) $\sum_{i=1}^{s^*} \lambda_i^* \rho_i^* + \sum_{j\in\Delta} \mu_j^* \tau_j^* \ge 0.$

Then x^* is an optimal solution of (SITP).

Proof Suppose that x^* is not an optimal solution of (SITP). Then there exists $\overline{x} \in X^0$, such that

$$\sup_{y\in Y}\frac{f(\overline{x},y)}{h(\overline{x},y)} < \sup_{y\in Y}\frac{f(x^*,y)}{h(x^*,y)}$$

Also $\sup_{y\in Y}\frac{f(x^*,y)}{h(x^*,y)} = \frac{f(x^*,\overline{y}_i)}{h(x^*,\overline{y}_i)} = q^*, \forall \overline{y}_i \in \overline{Y}(x^*), i = 1, \ldots, s^*.$
Further $\frac{f(\overline{x},\overline{y}_i)}{h(\overline{x},\overline{y}_i)} \le \sup_{y\in Y}\frac{f(\overline{x},y)}{h(\overline{x},y)}$
Thus, we have $\frac{f(\overline{x},\overline{y}_i)}{h(\overline{x},\overline{y}_i)} \le q^*, i = 1, \ldots, s^*.$
That is $f(\overline{x}, \overline{y}_i) - q^*h(\overline{x}, \overline{y}_i) < 0, i = 1, \ldots, s^*$
By (v), we obtain $f(\overline{x}, \overline{y}_i) - q^*h(\overline{x}, \overline{y}_i) < 0 = f(x^*, \overline{y}_i) - q^*h(x^*, \overline{y}_i), i = 1, \ldots, s^*$

From (vi), we get $b_0(\overline{x},x^*)\phi_0[(f(\overline{x},\overline{y}_i)-q^*h(\overline{x},\overline{y}_i))-(f(x^*,\overline{y}_i)-q^*h(x^*,\overline{y}_i))]<0$

Then from (i), we have $(f-q^*h)_x^H(x^*,\overline{y}_i;\eta(\overline{x},x^*))+\rho_i^*\|\theta(\overline{x},x^*)\|^2<0$

Since $\sum_{i=1}^{s^*}\lambda_i^*=1$ and $\sum_{i=1}^{s^*}\lambda_i^*=1$, we have

$$\sum_{i=1}^{s^*}\lambda_i^*(f-q^*h)_x^H(x^*,\overline{y}_i;\eta(\overline{x},x^*))+\sum_{i=1}^{s^*}\lambda_i^*\rho_i^*\|\theta(\overline{x},x^*)\|^2<0$$

Now from (iii) and (vii), we get $\sum_{j\in\Delta}\mu_j^*g_x^H(x^*,u^j;\eta(\overline{x},x^*))+\sum_{j\in\Delta}\mu_j^*\tau_j^*\|\theta(\overline{x},x^*)\|^2>0$

By (iv), we know that as $j\in\Delta\backslash J(x^*),\mu_j^*=0,$ alwaysholds for any $u^j\in U^*$.

Hence, as $j\in J(x^*),$ wealsohave

$$\sum_{j\in J(x^*)}\mu_j^*g_x^H(x^*,u^j;\eta(\overline{x},x^*))+\sum_{j\in J(x^*)}\mu_j^*\tau_j^*\|\theta(\overline{x},x^*)\|^2>0 \tag{60.1}$$

But as $j\in J(x^*)$, we know $g(\overline{x},u^j)\le 0=g(x^*,u^j),u^j\in U^*$

From (vi), we get $b_1(\overline{x},x^*)\phi_1[(g(\overline{x},u^j)-g(x^*,u^j)]\le 0,\forall u^j\in U^*$

By (ii), we have $g_x^H(x^*,u^j;\eta(\overline{x},x^*))+\tau_j^*\|\theta(\overline{x},x^*)\|^2\le 0,\forall u^j\in U^*,j\in J(x^*)$

Since $\mu_j^*\in\Lambda,j\in J(x^*)$, we get

$$\sum_{j\in J(x^*)}\mu_j^*g_x^H(x^*,u^j;\eta(\overline{x},x^*))+\sum_{j\in J(x^*)}\mu_j^*\tau_j^*\|\theta(\overline{x},x^*)\|^2\le 0,\forall u^j\in U^*$$

Finally, we have a contradiction. Thus the theorem is proved and x^* is an optimal solution of (SITP).

Theorem 3.2 *Let $x^*\in X^0$ and for any $x\in X^0$, we assume that there exist $(s^*,\lambda^*,\overline{y})\in Q$, $q^*\in R_+$, $\mu_j^*\in\Lambda,j\in\Delta$, and, such that*

(i) For any $b_0,\phi_0,b_1,\phi_1,\eta,\theta,\rho^*\in R^{s^*},\tau^*\in R^{(\Delta)}$ is generalized uniform $(B_H,\rho_i^*)-$ pseudoinvex at x^* with respect to b_0 and ϕ_0;

(ii) For any $u^j\in U^*,j\in J(x^*),g(\cdot,u^j)$ is generalized uniform $(B_H,\tau_j^*)-$ quas-iinvex at x^* with respect to b_1 and ϕ_1;

(iii)

$$\sum_{i=1}^{s^*}\lambda_i^*(f-q^*h)_x^H(x^*,\overline{y}_i;\eta(x,x^*))+\sum_{j\in\Delta}\mu_j^*g_x^H(x^*,u^j;\eta(x,x^*))\ge 0,\forall u^j\in U^*,j\in\Delta;$$

(iv) $\sum_{j\in\Delta}\mu_j^*g(x^*,u^j)=0,\forall u^j\in U^*,j\in\Delta;$

(v) $f(x^*,\overline{y}_i)-q^*h(x^*,\overline{y}_i)=0,i=1,\cdots,s^*;$

(vi)

$$a<0 \Rightarrow \phi_0(a)<0\,, a\leq 0 \Rightarrow \phi_1(a)\leq 0, b_0(x,x^*)>0 b_1(x,x^*)\geq 0;$$

(vii) $\sum\limits_{i=1}^{s^*}\lambda_i^*\rho_i^*+\sum\limits_{j\in\Delta}\mu_j^*\tau_j^*\geq 0.$

Then x^* is an optimal solution of (SIFP).

Proof Suppose that x^* is not an optimal solution of (SIFP). Then there exists $\overline{x}\in X^0$, such that $\sup\limits_{y\in Y}\frac{f(\overline{x},y)}{h(\overline{x},y)}<\sup\limits_{y\in Y}\frac{f(x^*,y)}{h(x^*,y)}$

Also $\sup\limits_{y\in Y}\frac{f(x^*,y)}{h(x^*,y)}=\frac{f(x^*,\overline{y}_i)}{h(x^*,\overline{y}_i)}=q^*, \forall\overline{y}_i\in\overline{Y}(x^*), i=1,\ldots,s^*.$

Further $\frac{f(\overline{x},\overline{y}_i)}{h(\overline{x},\overline{y}_i)}\leq\sup\limits_{y\in Y}\frac{f(\overline{x},y)}{h(\overline{x},y)}$

Thus, we have $\frac{f(\overline{x},\overline{y}_i)}{h(\overline{x},\overline{y}_i)}\leq q^*, i=1,\ldots,s^*.$

Which is equivalent to $f(\overline{x},\overline{y}_i)-q^*h(\overline{x},\overline{y}_i)<0, i=1,\ldots,s^*$

By (v), we get

$$f(\overline{x},\overline{y}_i)-q^*h(\overline{x},\overline{y}_i)<0=f(x^*,\overline{y}_i)-q^*h(x^*,\overline{y}_i), i=1,\ldots,s^*$$

From (vi), we get $b_0(\overline{x},x^*)\phi_0[(f(\overline{x},\overline{y}_i)-q^*h(\overline{x},\overline{y}_i))-(f(x^*,\overline{y}_i)-q^*h(x^*,\overline{y}_i))]<0$

Then by (i), we have $(f-q^*h)_x^H(x^*,\overline{y}_i;\eta(\overline{x},x^*))+\rho_i^*\|\theta(\overline{x},x^*)\|^2<0$

Since $\lambda_i^*\geq 0$ and $\sum_{i=1}^{s^*}\lambda_i^*=1$, we get

$$\sum_{i=1}^{s^*}\lambda_i^*(f-q^*h)_x^H(x^*,\overline{y}_i;\eta(\overline{x},x^*))+\sum_{i=1}^{s^*}\lambda_i^*\rho_i^*\|\theta(\overline{x},x^*)\|^2<0 \tag{60.2}$$

Also, as $j\in J(x^*)$, we have $g(\overline{x},u^j)\leq 0=g(x^*,u^j), \forall u^j\in U^*$

Then using (vi), we obtain

$$b_1(\overline{x},x^*)\phi_1[(g(\overline{x},u^j)-g(x^*,u^j)]\leq 0, \forall u^j\in U^*, j\in J(x^*)$$

Now by (ii), we have $g_x^H(x^*,u^j;\eta(\overline{x},x^*))+\tau_j^*\|\theta(\overline{x},x^*)\|^2\leq 0$

Since $\mu_j^*\in\Lambda, j\in J(x^*)$, it follows that

$$\sum_{j\in J(x^*)}\mu_j^*g_x^H(x^*,u^j;\eta(\overline{x},x^*))+\sum_{j\in J(x^*)}\mu_j^*\tau_j^*\|\theta(\overline{x},x^*)\|^2\leq 0$$

Also by (iv), as $j\in\Delta\backslash J(x^*)$, we have $\mu_j^*=0$ So

$$\sum_{j\in\Delta}\mu_j^*g_x^H(x^*,u^j;\eta(\overline{x},x^*))+\sum_{j\in\Delta}\mu_j^*\tau_j^*\|\theta(\overline{x},x^*)\|^2\leq 0 \tag{60.3}$$

Now, adding (60.2) and (60.3), then from (vii), we have

$$\sum_{i=1}^{s^*} \lambda_i^* (f - q^* h)_x^H (x^*, \overline{y}_i; \eta(\overline{x}, x^*)) + \sum_{j \in \Delta} \mu_j^* g_x^H (x^*, u^j; \eta(\overline{x}, x^*))$$

$$< -(\sum_{i=1}^{s^*} \lambda_i^* \rho_i^* + \sum_{j \in \Delta} \mu_j^* \tau_j^*) \|\theta(\overline{x}, x^*)\|^2 \leq 0, \forall u^j \in U^*$$

Finally, we have a contradiction. Hence $x^*$is an optimal solution of (SIFP).

60.4 Conclusions

In this paper, we have defined a new class of generalized convex functions, extending many well-known classes of generalized convex functions. Furthermore, we have achieved some sufficient optimality conditions for a class of minimax semi-infinite fractional programming problems, there should be further opportunities for exploiting this structure of the semi-infinite programming problem.

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Chapter 61
Study on Hairiness of Polyester/Cotton Blended Yarn in Rotor Spinning Via Artificial Neural Network Theory

Bo Zhao

Abstract In this study, in order to predict the cotton/polyester blended yarn hairiness of rotor spinning, an ANN model is developed. The ANN theory is an important technique of yarn virtual processing to predict the yarn hairiness. By analyzing, we can predict the hairiness of cotton/polyester blended yarn in rotor spinning. The results show that the predicted and experimental values agree well with, indicating that the neural network is an excellent method for predictors.

Keywords Rotor Spun Yarn · Cotton · Polyester · Hairiness · Artificial neural network · Prediction

61.1 Introduction

The hairiness of cotton/polyester blended yarn in rotor spinning is one of the important factors, which have great influence on the performance of yarns and the comfort of garments [1–3]. The fiber properties, the yarn structures, and the fabric properties, as a result the hairiness of cotton/polyester blended yarns show great differences. The factors of fibers, yarns, and fabrics have complicate relationships with the hairiness of cotton/polyester [4–6] blended yarn in rotor spinning. It is difficult to study the relations between them by mathematical and physical methods. With the characteristics of self-learning, self-adapting, and self-organization, an artificial neural network model expressed its [7–9] superiority on the model setting

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of complicated system. It has been widely applied in the areas of biology, business and manufacturing. It becomes more and more important in the research and production of textile industry. Over the past years, many researchers have established the ANN models to predict various textiles nonlinear problems [10–12]. However, the applications of ANN models for predicting the hairiness of cotton/polyester blended yarn in rotor spinning are very scanty. In this study, we predicted the hairiness of the cotton/polyester yarn in rotor spinning using the artificial neural network (ANN). On the basis of the results obtained, with help of ANN analysis, [13, 14] we can predict the hairiness of the cotton/polyester yarn easily and accurately. The results show that the ANN model yields more accurate and stable predictions, which indicates that the ANN theory is an effective and viable modeling method.

61.2 Experimental Procedure and Results

61.2.1 Experiment Variety

The polyester/cotton 63/37 yarn with linear density of 36.4tex was manufactured with the use of the BD200-RCE rotor spinning machine.

61.2.2 Experiment Machine Type

BD200-RCE rotor spinning machine is used in this work, the rotational speed of the machine is 30000–40000 r/min, and the rotational speed of the opening roller is 5500–6500 r/min.

61.2.3 Experiment Conditions

Test samples were conditioned in a standard atmosphere of 25 °C temperatures and 65 % relative humidity for minimum of 24 h.

61.2.4 Experiment Contents

The mechanical parameter such as the hairiness (2 mm) of cotton yarn in rotor spinning process was tested by using YG172A yarn hairiness tester.

Table 61.1 Experimental program and results

No.	Opening roller speed (r/min)	Opening roller diameter (mm)	Rotor speed (r/min)	Rotor diameter (mm)
1	5950	62	32000	62
2	6050	60	37000	65
3	5600	63	35000	62
4	5500	65	37000	63
5	5650	62	36500	65
6	5800	65	32750	63
7	5700	65	36500	66
8	5950	63	37500	64
9	6000	60	37500	65
10	5100	65	33500	65
11	5350	62	33000	60
12	5450	60	37500	60
13	5550	63	34500	60
14	5205	60	36500	63
15	5350	63	33500	64
16	5385	60	35500	62
17	5250	63	37500	60
18	5305	65	31500	63
19	5220	63	35500	60
20	5585	62	36500	63

61.2.5 Experimental Program

(Table 61.1).

61.3 Artificial Neural Network Model

An artificial neural network [15] is an analytical system that is useful for discovering relationships between variables when a prior functional specification is not possible. In an artificial network, the unit analogous to the biological neuron is referred to as process element. An ANN is a parallel running nonlinear system which simulates the human construction and encouraging behavior. It has some handing units like neuron and gets the solution through expressing the problem as the weighted value between the neurons. Because the encouraging function is usually a nonlinear function, when a lot of single neuron is not complicated, a nonlinear power system is very complicated and rich. It is composed of simple elements operating in parallel, which are inspired by biological nervous system. An artificial neural network is composed of simple elements called neuron operating parallel, which is inspired by biological neuronal systems. In nature, the network function is determined largely by weighted connection between the

processing elements. The weights of connections contain the knowledge of the network. An artificial neural network is usually adjusted or trained so that a particular input leads to a specific output. The process of training is adjusting these weight values to slide down the prediction error. Among the various kinds of algorithms for training neural networks, back propagation is the most widely used.

61.3.1 Back Propagation Neuron Network Model

The back propagation (BP) is a feed-forward connecting model, which contains an input layer, several hidden layer, and an output layer, as shown in Fig. 61.1. Neurons in the same layer do not link each other, but neurons in neighboring layer are connected by the weight. BP neural network is a front connection model and composed of input layer, output layer, and some hidden layers. The neurons in the same layer have no connection with each other, but they are connected in the neighbor layers by individual weights.

61.3.2 The Back Propagation Algorithm

Back propagation algorithm is divided into two stages. One is front propagation calculation stage at which the information is transferred from the input layer via one or several hidden layers to the output layer where the output value of each unit can be obtained at the same time. The other is the errors back propagation stage at which the calculated output values are compared with the expected values in the output layer land then the errors are sent back to adjust weights layer by layer until it is lower than the expected error.

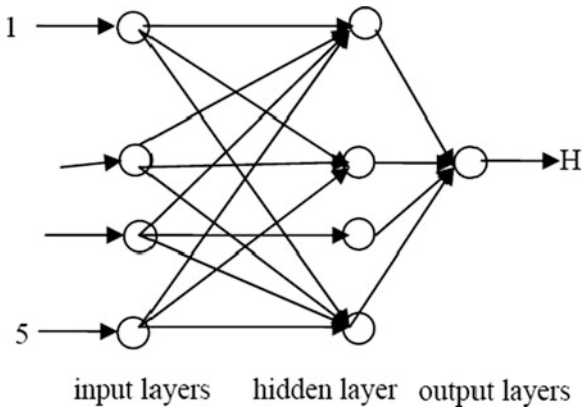

Fig. 61.1 Structure and architecture of an ANN model

61.3.3 The Practice of Back Propagation Neural Network Model

The neural network model practice is guided by BP. We use 16 groups of datum as direct practice and four groups as test and verification. The algorithm of model is momentum regulation and the reading ratio is adjusted to itself. When the BP network is being practiced, its parameters could be defined according to the structure. There are four neurons for input here, and the number of output layer is 1. The three layers are linked by the functions as following: From input layer to hide layer, the function is

$$f(x) = 1/(1 + e^{-2x}) - 1 \tag{61.1}$$

And from hide layer to output layer, the function is

$$f(x) = x \tag{61.2}$$

The learning rate was set to 0.01. The iterations were broken when the epoch reached 4000. All values were scaled between −1 and—beforehand. The program was written in Mat lab 7.0. The whole process is with the information forwards and error feedback.

61.3.4 The Training of Neuron Network Model

One of the most crucial aims of the back propagation neuron network is to minimize the error function by using the gradient steepest descent method. The error function is

$$E = \frac{1}{2}\sum_{k} (Y_{\mathrm{dk}} - Y_k)^2 \tag{61.3}$$

where Y_{dk} are the desired output, and Y_k the calculated output value of the output layer, respectively? The weights updated themselves by using error function as

$$\Delta w_{ij} = -\eta \frac{\partial E}{\partial w_{ij}} \tag{61.4}$$

Here η is the learning and determines the performance of the learning capability of network.

61.3.5 Error Measurement

In the learning network, the degree of convergence can be repressed in a mean square error (MSE), as follows (Fig. 61.2).

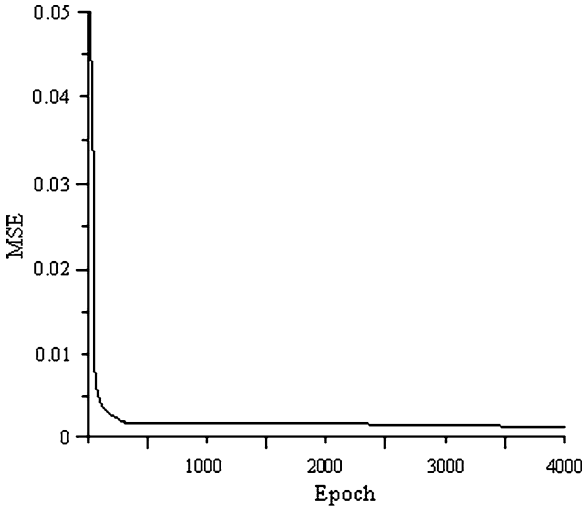

Fig. 61.2 Variation of error mean square with epoch

$$\mathrm{MSE} = \frac{1}{N}\sum_{i=1}^{N}(Y_i - X_i)^2 \tag{61.5}$$

where N is the number of objects, Y_i the neural network? Predicted values, and X_i the actual output values where n is the number of units processed by the output layer. The values of MSE lie within the range of [0, 1]. If the MSE converges to $<$0.0045, a good convergence effect is obtained, and the network learning is satisfactory. The variation of learning cycle with MSE is represented in Fig. 61.1. Here, the maximum epoch is determined as 17 and the training least mean square error is obtained as 0.001376, which is a satisfactory.

61.4 Result and Discussion

The compare of analogy value to actually experimental value in practice group, as well as the compare of predictive value to actually experimental value in test or verification group in the light of neural network, is shown in Table 61.2. The prediction result shows that neural network can predict the breaking elongation of rotor spun yarn well for the result is good. Meanwhile, the coincidence of study practice specimen is also good.

Table 61.2 Results of practice and prediction

No.	Practice output (2 mm Hairiness) (Num./10 mm)	Actual output (2 mm Hairiness) (Num./10 mm)	Error (%)
1	212.77	213.32	−0.2578
2	223.97	223.13	0.0376
3	242.02	242.98	−0.3951
4	223.01	222.89	0.0538
5	218.12	219.01	−0.4063
6	232.80	232.07	0.3146
7	224.22	223.90	0.1429
8	204.93	204.22	0.3477
9	233.19	234.01	−0.3504
10	222.72	223.31	−0.2642
11	223.46	222.74	0.3232
12	213.92	213.02	0.4225
13	233.82	233.09	0.3132
14	242.92	242.05	0.3594
15	204.00	204.98	−0.4781
16	213.18	214.07	−0.4158
17	223.82	224.01	−0.0848
18	212.89	212.05	0.3961
19	224.56	225.08	−0.2310
20	213.33	214.07	−0.3457

61.5 Summary

In this paper, we attempt to predict the cotton/polyester blended yarn hairiness of rotor spinning with ANN models. On the basis of the results obtained, with help of ANN analysis, we can predict the cotton/polyester blended yarn hairiness of rotor spinning easily and accurately, which shows the neural networks have strongly capability of self-adaptive recognition and are effective method for predictors. The results including the ANN model were found to be as good as expected, which gives good direction to solve nonlinear problems of textiles.

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Chapter 62
SEMG Multi-Class Classification Based on S4VM Algorithm

Zhuojun Xu, Yantao Tian, Zhang Li and Yang Li

Abstract A method using small amount of labeled instants and large unlabeled ones simultaneously involved in the training during the sEMG classification obtained a better effect is strongly needed. This paper introduces the S4VM proposed by Li et al. into surface EMG pattern recognition with small labeled instants and extends to multi-class classification problems, which will represent the autoregressive model characteristic value of the human hand movements of the seven types of EMG signal as the object of classification. The experimental results show that the safety semi-supervised support vector machine is suitable for the multi-pattern classification of surface EMG signal with high accuracy and good robustness.

Keywords S4VM · EMG · Multi-class · Classification

62.1 Introduction

SEMG signal as one kind of biological signal reflects human muscle movement characteristics which have the strength obtains directly and without invasive pain have been widely used in the fields of diagnostics, exercise physiology, design and development of myoelectric prostheses [1], and others. Through lots of research, people try to find the corresponding relation between the surface EMG signal and movement mode, and get the good effect by the method of neural network [2], support vector machine [3], discrete wavelet transforms [4], and decision trees [5],

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etc. However, it is a large workload to mark the EMG signals one by one, but it is relatively easier to obtain the unlabeled EMG signal. Therefore, it becomes a new issue of the surface EMG pattern recognition studies that combines a small amount of labeled instants with large amounts of unlabeled instants at the same time involved in the classification of training and get a better classification effect.

In recent years, the semi-supervised learning method (semi-supervised learning, SSL) attracted wide attention as a kind of machine learning method among supervised.

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Learning and unsupervised learning, learning instants include labeled data and unlabeled data [6]. This method uses a small amount of labeled data for training initial learning model, and then with a large amount of unlabeled date to improve the initial model performance, ultimately achieve the purpose of precise learning [7]. Joachims proposed the semi-supervised support vector machine algorithm Semi-Supervised Support Vector Machine (S3VM) [8], it can obtain a relatively sparse area through data, and divide the classification hyperplane of all labeled instants data as correctly as possible. However, it was found that some SSL method' performance even worse than simply using labeled instants' method [9, 10] sometimes. Li et al. proposed safe semi-supervised vector machine [11], which try to explore more candidate low-density separators, not randomly selecting separator but try to account for all the candidate low-density separator in order to ensure the optimal classification effect.

This paper introduces the Safe Semi-Supervised Support Vector Machine (S4VM) technology into surface EMG pattern recognition and extends to multi-class classification problems. Each training only consider one kind of labeled sample as positive examples, the remaining labeled instants as a negative example, through calculating, the test objects classified into the instants of positive example will not enter the next iteration, along with the gradual classification, the test instants involved in classification will decrease, which ensure the classification accuracy and reduce the computation load and time.

62.2 Safe Semi-Supervised Support Vector Machine (S4VM)

62.2.1 Semi-Supervised Support Vector Machine (S3VM)

In semi-supervised learning, if only considering binary classification, we are given a set of labeled data $\{x_i, |y_i\}_{i=1}^{l}$ and a set of unlabeled data $\{\hat{x}_j\}_{i=1}^{u}$, where

$y_i \in \{\pm 1\}$, x_i and $\hat{x}_j$ constitute the whole sample space, l and u are the number of labeled and unlabeled instances, respectively. The goal is to find a function f such that the following equation is minimized:

$$\min_f \frac{\|f\|_{\mathrm{H}}}{2} + C_1 \sum_{i=1}^{l} l(y_i, f(x_i)) + C_2 \sum_{j=1}^{u} l(\hat{y}_j, f(\hat{x}_j)) \tag{62.1}$$

where H is the Reducing Kernel Hilbert Space (RKHS) induced by a kernel k, $l(y, f(x)) = \max\{0, yf(x) - 1\}$ is the loss function of labeled and unlabeled instances, C_1 and C_2 are regularization parameters, they can adjusted the complexity of the model based on the experience of risk, $f(x) = w'\phi(x) + b$ is decision function, ϕ is the feature mapping induced by a kernel k. We can find through Eq. 62.3, the formulation of S3VMs is nonconvex and the optimal solution is intractable in general. And there is no more restrictions and planning about the decision boundary of low-density space in S3VM, it means we can arbitrarily choose a decision boundary according to the decision function; however, this random selection approach may cause the loss to objective function.

62.2.2 Safe Semi-Supervised Support Vector Machine (S4VM)

As the section of s3vm mentioned, there usually exist ones that multiple large-margin low-density separators decision boundary by constitute coincide well with the labeled data when given limited labeled data and abundant unlabeled data. Little further prior information for distinguishing these separators, it might be risky to select any one of them. Therefore, Li et al. proposed a new algorithm called safe semi-supervised support vector machine (S4VM), they suggest considering all these candidate separators, so as to find a decision boundary which produce the optimal classification results. They declared that S4VMs are never significantly worse than inductive SVMs; this conclusion is proved in their article [11].

S4VM algorithm will be introduced in the following. First, let $h(f, \hat{y})$ denote the functional to be minimized by the objective function of S3VMs:

$$h(f, \hat{y}) = \frac{\|f\|_{\mathrm{H}}}{2} + C_1 \sum_{i=1}^{l} l(y_i, |f(x_i)) + C_2 \sum_{j=1}^{u} l(\hat{y}_j, f(\hat{x}_j)) \tag{62.2}$$

The goal of S4VM algorithm is to find multiple large-margin low-density separators $\{f_t\}_{t=1}^{T}$ and the corresponding labeled $\{\hat{y}_t\}_{t=1}^{T}$ such that the following equation is minimized:

$$\min_{\{f_t, \hat{y}_t\}_{t=1}^{T}} \sum\nolimits_{t=1}^{T} h(f_t, \hat{y}_t) + M\Omega\left(\{\hat{y}_t\}_{t=1}^{T}\right) \tag{62.3}$$

where T the number of separators is, Ω is a penalty coefficient about the diversity of separators, and M is a large constant enforcing large diversity. $\Omega\left(\{\hat{y}_t\}_{t=1}^{T}\right)$ In Eq. 62.5 present in pairs with $\sum_{t=1}^{T} h(f_t, \hat{y}_t)$, is the sum of the diversity of each separator, so it can be written as $\Omega\left(\{\hat{y}_t\}_{t=1}^{T}\right) = \sum_{1 \le t \ne \tilde{t} \le T} I\left(\frac{\hat{y}_t' \hat{y}_t}{u} \ge 1 - \varepsilon\right)$ where I is the identity function and $\varepsilon \in [0, 1]$ is a constant.

As mentioned before, $f(x) = w'\phi(x) + b$ is decision function, ϕ is the feature mapping induced by a kernel k. So, Eq. 62.4 can be written as follows:

$$\begin{aligned} \min_{\{f_t, \hat{y}_t \in \beta\}_{t=1}^{T}} & \sum_{t=1}^{T} \left(\frac{\|w_t\|^2}{2} + C_1 \sum_{i=1}^{l} \xi_i + C_2 \sum_{j=1}^{u} \hat{\xi}_j \right) + M \sum_{1 \le t \ne \tilde{t} \le T} I\left(\frac{\hat{y}_t' \hat{y}_t}{u} \ge 1 - \varepsilon\right) \\ & \text{s.t.} \quad y_i w_t' \phi(x_i) \ge 1 - \xi_i, \ \forall i = 1, \ldots, l, \\ & \hat{y}_{t,j} w_t' \phi\left(\hat{x}_j\right) \ge 1 - \hat{\xi}_j, \ \forall j = 1, \ldots, u, \ \forall t = 1, \ldots, T, \end{aligned} \tag{62.4}$$

where $\hat{y}_{t,j}$ refers to the j th entry of $\hat{y}_t$, each algorithm which applied in S3VM also solved Eq. 62.6, we should choose the solution according to practice instance.

62.3 Classification Strategy

62.3.1 Classification Strategy

This paper applied S4VM algorithm on EMG signals classification for seven modes of different human hand movements. Relying on the reliable advantage of S4VM in the terms of classification effect, we consider a multi-classification problem into multiple two classification problems. Same amount labeled instants of each movement mode be selected in the experiments, only one class of the labeled instants is regarded as positive instants, the rest of labeled instants is regarded as negative ones, the unlabeled instant which has classified in positive class through the calculation will not enter the next iteration. With the gradual classification, the number of the unlabeled instants participate in the classification will decrease, If the classification effect is satisfactory, it just saves calculation time.

62.3.2 Label Matrix

According to our classification strategy, classification is carried out circular. Corresponding labels of labeled instants need to refresh before next iteration. In allusion to characteristic that labeled instants of each class will be the positive

instants in turn, we built a label matrix. This matrix as following, consist of positive instants matrix σ and negative instants matrix β, which consist of 1 and -1 respectively.

$$\alpha = \begin{bmatrix} 1 \\ \vdots \\ 1 \end{bmatrix}_{m\times 1}, \ \beta_i = \begin{bmatrix} -1 \\ \vdots \\ -1 \end{bmatrix}_{m\times 1} \tag{62.5}$$

where m is the number of labeled instant of each class, it can be the same for each class (in this article the number is the same), and it also can be different. The iteration aim to which class, the label for this class is +1, otherwise, is -1. We get a label matrix as follows:

$$\text{Label} = \begin{bmatrix} \alpha & \beta & \cdots & \beta \\ \beta & \alpha & \cdots & \beta \\ \vdots & \vdots & \ddots & \vdots \\ \beta & \beta & \cdots & \alpha \end{bmatrix}_{(m\times n)\times n} \tag{62.6}$$

where n is the number of class and the row vector? Is the total of labeled instants? Each time of iterations, the program will read a column of matrix as the label.

62.4 Experiment

62.4.1 Experimental Setup

Our experiment uses MQ-8 multi-channel sEMG acquisition system to collect the sEMG signal by two pair's electrode of the two channels. One pair of detection electrode is placed in close to a wrist thumb extensor muscles and index finger inherent extensor muscles position, the other pair detection electrode placed in extensor digitorum muscle, extensor carpi ulnaris position in the experiment. The movements which have given in Fig. 62.1 are extension of index finger(exif), letter "C"(aslc), extension wrist(exwr), flexion wrist(flwr), fist/hand grasp(hdgp), side flexion wrist(sfwr), and supination(wspn).

The data set of our experiment is consisting of 76 autoregressive model coefficients feature vectors of seven movement modes. Each feature vector has 6 feature coefficients in it. Concrete distribution is shown in Table 62.1.

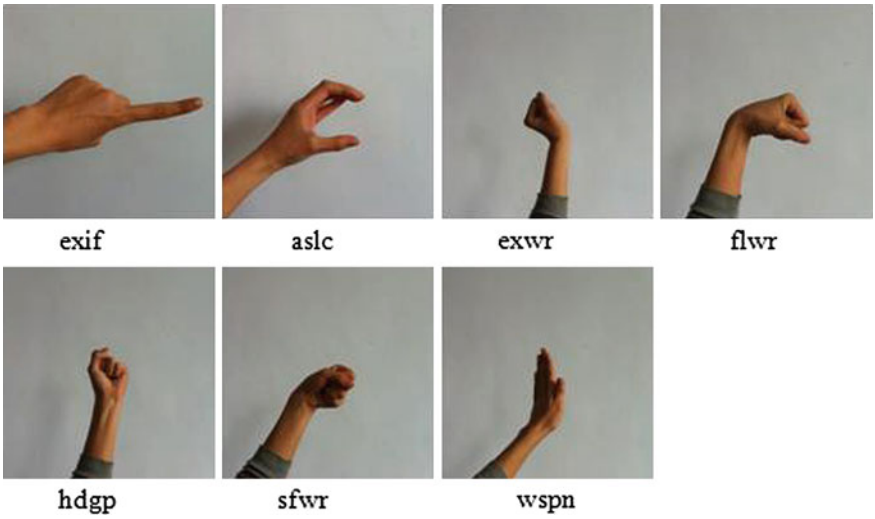

Fig. 62.1 Illustration of the hand gestures

Table 62.1 Data set

	exif	aslc	exwr	flwr	hdgp	sfwr	wspn	Total
Inst	11	9	11	13	10	11	11	76
Feat	6	6	6	6	6	6	6	

Table 62.2 Accuracy of S4VM and compared other methods (labeled instants = 7)

	exif	aslc	exwr	flwr	hdgp	sfwr	wspn	avg
SVM	69.7	90.3	78.9	84.2	86.8	83.1	81.9	82.1
S3VM	80.2	90.3	78.9	89.9	89.2	83.1	81.9	84.7
S4VM	83.1	92.7	81.9	89.9	90.8	86.8	84.1	87

62.4.2 Accuracy Experiment

We select one and two examples in each class (total 7 and 14) as labeled instants, accounting for the proportion of total is 9.2 and 18.4 % respectively, remain date used as unlabeled instants. Classification experiment is carried on S3VM, S4VM, and SVM all with the "RBF" kernel by using "libsvm" toolbox in MATLAB. The result is given in Tables 62.2 and 62.3.

The performance of SVM is worse due to this method is appropriate for the situation of adequate labeled instants. S3VM and S4VM all get a better classification effect through exploring unlabeled instants, however, due to S4VM take the global screening strategies in selecting multiple large-margin low-density separators, the classification accuracy of S4VM under a small amount labeled instants is better than other two methods.

Table 62.3 Accuracy of S4VM and compared other methods (labeled instants = 14)

	exif	aslc	exwr	flwr	hdgp	sfwr	wspn	avg
SVM	81.1	85.5	77	92.2	95.6	88.9	90.3	87.2
S3VM	86.8	94	89	96.7	100	88.9	98.8	93.4
S4VM	86.8	93.4	90.4	100	100	88.9	98.8	94

62.4.3 Robustness Experiment

We choose "RBF" and "LINEAR" as the kernels in S4VM, it can be seen in Table 62.4, though the number of labeled examples is small, the performance of S4VM is quite insensitive to the setting of the parameters. Some results in between the "RBF" and "LINEAR" are same; it proved that S4VM has good robustness (Table 62.4).

62.4.4 Amount Influence

In the previous experiments, we used a small number of labeled instants. What impact if we use more labeled instants to the classification effect? We choose 1–5 examples in each modes (total 7–35) SVM, S3VM and S4VM, SVM, and S3VM use "RBF" kernels, S4VM test twice used "RBF" and "LINEAR" respectively.

In Fig. 62.2, the line colored pink, green, blue, red, and black reflect accuracy of 1–5 examples in classification for each movement modes. Compared with SSL method, SVM is more sensitive to example increase, along with the increase of the examples classification accuracy has increased dramatically. Moreover, SSL method, especially S4VM, accuracy has increased dramatically during the proportion of labeled instants from 9.2 rising to 18.4 %, and then, with the increasing of the number of example classification accuracy change tends to be gentle. It shows that, the classification effect of S4VM is more reliable under the same condition.

Table 62.4 Accuracy of S4VM with different kernels

	exif	aslc	exwr	flwr	hdgp	sfwr	wspn	Avg
Labeled instants = 7								
RBF	83.1	92.7	81.9	89.9	90.8	86.8	84.1	87
LINEAR	80.2	92.7	80.6	86.7	90.8	86.8	85.5	86.2
Labeled instants = 14								
RBF	86.8	93.4	90.4	100	100	88.9	98.8	94
LINEAR	86.8	92.2	91.6	100	100	88.8	98.8	94

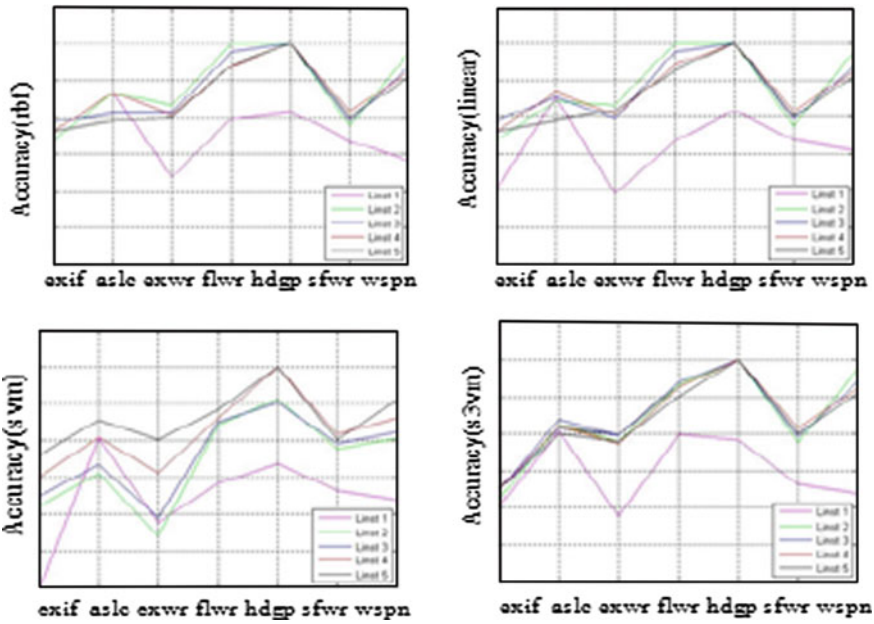

Fig. 62.2 Accuracy of S4VM compared with other methods use 1–5 examples

62.4.5 Run Time

Due to adding of the iterative process during the use of semi-supervised learning method, people may worry about which will result in wasting computation time. Take an experiment example to choose "RBF" as a main function with 2 labeled instants; we observed the run time of programs, with a result those 1.126 s for S3VM and 1.148 s for S4VM, but 4.1518 s for no iterative process SVM with a possibility of the learning difficulty increases resulting from small amounts of known instants. So it seems S4VM does not occupy a large amount of computing time.

62.5 Conclusion

We need to find an effect method combining a small amount of labeled instants and a large of amount of unlabeled instants simultaneously involving in classification training in order to get better classification effect for EMG. S4VM try to explore more candidate low-density separators without randomly selecting

separator but to account for all candidate low-density separators, which provides a guarantee for the accuracy of SSL.

This paper introduces the S4VM technology into surface EMG pattern recognition and extends to multi-class classification problems, comparing with other classification method, it is not hard to find that this method still ensure the classification accuracy under the experiment condition with small labeled instants, and also has strong robustness. The experimental results show that the safety of S4VM is suitable for surface EMG pattern classification and ensure the effect of classification under the pre-condition with only a small amount of known instants.

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Chapter 63
Attribute Reduction Based on Equivalence Classes with Multiple Decision Values in Rough Set

Dongwen Zhang, Jiqing Qiu and Xiao Li

Abstract For the attribute reduction problem of decision information systems, the concept of the equivalence class only including the condition attributes is introduced. The necessary condition of implementing attribute reduction and the attribute reduction method based on the equivalence classes with the multiple decision values are presented. After sorting the condition attributes by the cardinalities of the equivalence classes with the multiple decision value in ascending order, these ordered condition attributes are united one by one until the positive region of the united attribute subset is equal to the full region. Furthermore, if the attribute subset is independent and its indiscernibility relation is the same as the indiscernibility relation in original information system, then the subset is an attribute reduction of the information system. Finally, the experiment result demonstrates that our method is efficient.

Keywords Attribute reduction · Rough set · Equivalence class · Multiple decision values

63.1 Introduction

We have witnessed a very rapid growth of rough set theory in recent years; rough set theory has been successfully applied in such fields as knowledge discovery, decision analysis, pattern classification, fault diagnosis, etc., [1]. Attribute reduction is one of

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the key issues in rough set theory. Reference [2] proposed a discernibility matrix method, in which any two objects determine one feature subset that can distinguish them and could obtain all attribute reducts of a given data set. According to the discernibility matrix viewpoint, Ref. [3] provided a technique of attribute reduction for interval ordered information systems, set-valued ordered information systems, and incomplete ordered information systems, respectively. The idea of attribute reduction using positive region, which remains the positive region of target decision unchanged originated by Refs. [4, 5], gave an extension of this positive region reduction for hybrid attribute reduction in the framework of fuzzy rough set. In heuristic search strategies among attribute reduction methods, some attribute significance measures such as dependency function, information gain, consistency, and other measures are employed to select a feature subset. In fact, several authors [6] have applied variants entropies, combination entropy, or mutual information to measure uncertainty of an information system and construct heuristic algorithm of attribute reduction. The information entropy [7] can measure both the uncertainty of an information system and the fuzziness of a rough decision in rough set theory.

Each of these methods is a good tool to handle data redundancy problem in real life and preserves the particular properties. However, the spatial complexity in computing discernibility matrices, the time in computing information entropy are very expensive, and the theoretical proof in entropy is extremely difficult and using intelligent optimization algorithms to solve reduction problem have to answer the question of how to select the suitable model to match the reduction problem.

In this paper, we present a novel attribute reduction algorithm based on equivalence classes with multiple decision values in rough set. The proposed algorithm fits for the decision table with discrete-valued or continuous-valued attributes. We start from equivalence classes which belong to the partition formed by single condition attribute with respect to decision attributes, union the ordered condition attribute satisfied the special conditions in every iterative round and finally acquire an attribute subset which can hold the same descriptive or classification ability as the entire set of attributes.

63.2 Preliminaries

Rough set theory deals with information represented by a table called decision system, which consists of objects and attributes. This section reviews some essential definitions of rough set that are used for attribute reduction. Detailed description and formal definitions of the theory can be found in Ref. [1].

Definition 1 Let $S = (U, A_t, V, f)$ be a decision system, also called information system, where $U = \{ x_1, x_2, \ldots, x_n \}$ called universe, is a nonempty finite set of objects. $A_t = C \cup D$ is a nonempty finite set of attributes, where $C = \{ a_1, a_2, \ldots, a_m \}$ is the set of condition. Attributes describing the objects and D is a set of decision attributes that indicates the classes of objects. $V = \bigcup_{a \in A_t} V_a$ is

the union of attribute domains, where V_a is the domain of attribute $a \in A_t$. $f : U \times A_t \rightarrow V$ is an information function where $f(x,a) \in V_a$ for every $x \in U, a \in A_t$.

Definition 2 In a given decision system $S = (U, A_t, V, f)$, an indiscernibility relation with respect to $A \subseteq A_t$ is defined as $IND(A) = \{(x,y) \in U \times U | \forall a \in A[f(x,a) = f(y,a)]\}$.

In rough set, an indiscernibility relation $IND(A)$is always deemed as the knowledge in S. Obviously, an indiscernibility relation $IND(A)$ is reflexive, symmetric and transitive, and thus is an equivalence relation on U and $IND(A) = \underset{a \in A}{\cap} IND(\{a\})$. The equivalence relation $IND(A)$ induces a partition of U, which is denoted by U/A, where an element of U/A is called an equivalence class or elementary set.

Consider a partition $U/D = \{D_1, D_2, \ldots, D_k\}$ of the universe U with respect to the decision attribute D and another partition $U/A = \{U_1, U_2, \ldots, U_r\}$ defined by a set of condition attributes A. The equivalence classes induced by the partition U/A are the basic blocks to construct the Pawlak rough set approximations.

Definition 3 Given any subsets $A \subseteq C$ and $X \subseteq U$. The A-lower and A-upper approximations set of set X is defined, respectively, as follows:

$$A_{\_}(X) = \cup\{\ Y \subseteq U/A | Y \subseteq X\} \tag{63.1}$$

$$A^{-}(X) = \cup\{\ Y \subseteq U/A | Y \cap X \neq \varnothing\} \tag{63.2}$$

$A_{\_}(X)$ is the set of all objects from U which can be classified certainly as elements of X employing the set of attributes A. $A^{-}(X)$ is the set of objects of U which can be possibly classified as elements of X using the set of attributes A.

Definition 4 The A-lower approximation of X is usually called the positive region, written $POS_A(X)$, that is

$$POS_A(X) = A_{\_}(X) \tag{63.3}$$

$POS_A(X)$ indicates the union of all the equivalence classes in U/A and each element can induce a certain decision.

Definition 5 For a given decision system $S = (U, A_t, V, f)$ and the equivalence relations P, Q defined on U, if all attributes on P are necessary for Q, and then P is independent to Q.

From those related conceptions, one could conclude that attribute reduction based on the rough set theory conceptually requires keeping the relation of object discernibility. Therefore, the reduction process has to implicitly or explicitly utilize the decision information of information system.

63.3 Main Achievement

Attribute reduction is a tool to remove redundant condition attributes on condition that the classification or decision-making capacity in information systems does not change. In this paper, our attribute reduction algorithm focuses on three core issues: whether jointed condition attributes would change the condition attribute compatibility of the original decision table; on which condition jointing attributes would achieve the required reduction condition; choosing which condition attributes to joint. This paper first presents the theorem which solves the first core issue: decision value of some equivalence classes do not change after jointing condition attributes.

Definition 7 For any given subsets $A \subseteq C$ and $X \subseteq U$ if the decision values for all objects in some of equivalence classes induced by in U/A are same, these equivalence classes are called equivalence classes with certain decision value, otherwise, they are called equivalence classes with uncertain decision values.

For simplicity, we assume $D = \{d\}, V_d = \{0, 1\}$ in this paper, where d is a decision attribute which describes the decision for each object. A table with multiple decision attributes can be easily transformed into a table with a single decision attribute by considering the Cartesian product of the original decision attributes.

Theorem 1 *Suppose d is the decision attribute. A' is the subset of condition attribute set $C(A' \subseteq C)$? For each of equivalence classes in $POS_{A'}(U)$, the set $A' \cup \{a\}$ will partition it, and the partitioned equivalence classes belong to $POS_{A' \cup \{a\}}(\{d\})$ partly.*

Proof Given a decision system $S = (U, C \cup D, V, f), A \subseteq C, a \in C - A'$, According to the definition in Sect. 2, let

$$POS_{A'}(U) = U/A' = \{E_1, E_2, \ldots, E_q\}, \tag{63.4}$$

$$POS_{\{d\}}(U) = U/\{d\} = \{E_0^{'}, E_1^{'}\}, \tag{63.5}$$

$$POS_{A' \cup \{a\}}(U) = U/(A' \cup \{a\}) = \{E_1^{''}, E_2^{''}, \cdots E_r^{''}\}, \tag{63.6}$$

For any $E_j (j \in \{1, 2, \ldots, n\})$, there must exist an equivalence class $E_s^{''}, s \in \{1, 2, \cdots r\}$ in the partition $POS_{A' \cup \{a\}}(U)$ and a equivalence class $E_k^{'}(k \in \{0, 1\})$, such that $E_i'' \subset E_j$,$E_j \subset E_k'$ furthermore, $E_i'' \subset E_k'$ Hence, we have $E_i'' \subset POS_{A' \cup \{a\}}(U)$. The theorem holds.

This theorem shows that equivalence classes induced by condition attribute subset could be segmented and after merging the condition attributes the segments have the same decision value as every subset of the equivalence classes do. This theorem provides a theoretical basis for jointing condition attributes.

Theorem 2 will answer the key problem on which condition combining attributes could achieve the required reduction condition.

Theorem 2 *for a given decision system* $S = (U, C \cup D, V, f)$, *assume* $A_i, A_k \in C$,

$E_{i,q_j} \in U/A_i, E_{k,q_j} \in U/A_k, (j = 0, 1), i, k = 1, 2, \ldots m$ whose *decision value is* 0 or 1, E_{i,q_X}, E_{k,q_X} *be the uncertain equivalence class formed by condition attribute* A_i, A_k *with respect to the decision attribute respectively, when the condition* $E_{i,q_X} \cap E_{k,qX} = \varnothing$ and $i \neq k$ are satisfied, we can achieve the reduction ensuring the compatibility.

Proof Take the two uncertain equivalence classes E_{i,q_X} and E_{k,q_X} for example, $E_{i,q_X} \cap E_{k,q_X} = \varnothing$ shows that although the decision value of the uncertain equivalence classes in the partition induced by A_i condition attribute is uncertain, the decision value of these classes can be confirmed in the partition induced by A_k condition attribute. In term of theorem 1, the decision value of the equivalence classes in the partition $U/\{a_i, a_k\}$ is confirmed. So we get the reduction ensuring the compatibility. Theorem 2 is proved.

Next we propose attribute reduction algorithm based on uncertain equivalence classes in rough set. The algorithm starts from the uncertain equivalence class with lest cardinality in a single condition attribute and jointing condition attributes one by one by step until the reduction condition in theorem 2 is satisfied.

In the rough set model, attribute reduction algorithms mainly deal with categorical data. Thus, we can recode the symbol attributes with a set of consecutive nature numbers. In this paper, we focus on discussing a decision table with a set of integral numbers and apply an efficient sort algorithm for computing equivalence classes, positive regions [8].

Algorithm 1 Computing U/A algorithm

Input: a decision information system S, $U = \{ x_1, x_2, \ldots, x_n \}$, $A = \{a_1, a_2, \ldots a_h\} \subseteq C$
Output: U/A
Begin

Step 1: To every $a_i (i = 1, 2, \ldots h)$ denote, the maximum value on attribute a_i by M_i initialize every element in array Order with 1, 2… n, respectively. and all the elements in array TempOrder with 0.
Step 2: Step 2: For $i = 1$ to h do

For $k = 1$ to M_i do
{Count[k] = 0;}
For $j = 1$ to n do
{Count [$a_i(x_j)$] ++;TempOrder[j] = Order[j];}//count [$a_i(x_j)$] now contains the number of elements equal to $a_i(x_j)$
For $k = 2$ to M_i do
{Count[k] = count [$k-1$] + count[k]};
//count[k]now contains the number of elements less than or equal to k
For $k = n$ to 1 do

{Order [count [$a_i(x_j)$]] = TempOrder[j]; count [$a_i(x_j)$] –;}

Step 3: let the object sequence from step 2 be $\{ x_1^{'}, x_2^{'}, \ldots, x_n^{'}\}$; $t = 1$, $B[t] = x_1^{'}$
For $j = 2$ to n do
If $a_i(x_j^{'}) = a_i(x_{j-1}^{'})$ for all $a_i \in A(i = 1, 2, \cdots h)$, then

$$B[t] = B[t] \cup \{x_j^{'}\};$$

Else {t = t+1; $B[t] = x_j^{'}$;
End

Algorithm 2 Attribute reduction algorithm.

Input: Give a decision information system $S = (U, C \cup D, V, f), C = \{a_1, a_2, \ldots a_m\}$.

Output: Output the reduction of information system S.

Begin

Step 1: $L = \phi; M = \phi$;//L, M is variables//.
Step 2: by algorithm 1, acquire $E_{i,0}, E_{i,1}, E_{i,q_X}, POS_{a_i}(U), i = 1, 2, \ldots m$,
Step 3: Sort condition attributes in ascending order of the cardinality of $E_{i,q_X}, i = 1, 2, \cdots m$ and stored sorted attribute's ID in array sort-attar [].
Step 4: M = sort-attar [1];
Step 5:

$$j = 2$$

Step 6: While ($card(E_{M,q_X}) \neq 0$) and $j <= length(sort\_attr[])$, $K = card(E_{M,q_X})$, $L = M \cup sort\_attr[j]$; if $card(E_{L,q_X}) <$ K then $M = L; K = card(E_{L,q_X})$; $j = j$+1;
Step 7: if M is independent, turn to step 8, otherwise, For $\forall a_i \in M$, if $IND(M) <> IND(M - \{a_i\})$, then $M = M - \{a_i\}$; $IND(M) = IND(M - \{a_i\})$; turn to step 7.
Step 8: if$IND(M) = IND(C)$, so the set M is just an attribute reduction of the condition attributes set C

Otherwise $P = IND(C) - IND(M)$, for any $\bar{a} = C - M$, if $P/(M \cup \{\bar{a}\}) = \phi$, then turn to step 4, otherwise by algorithm 1, acquire $E_{a^{'},q_X}, \forall a^{'} \in M \cup \{\bar{a}\}$, and search for min ($E_{a^{'},q_X}$) denoted as $a_{\min}$. Let $M = M \cup a_{\min}$, turn to step 7

End

So the set M is just an attribute reduction of the condition attributes set C and a reduction of information system S is also obtained.

In the algorithm, we only consider the judgment $card(E_{L,q_X}) < card(E_{M,q_X})$ and do not consider the issue $card(E_{M,q_X}) \leq card(E_{L,q_X})$ precisely. In fact, when the judgment is $card(E_{M,q_X}) = card(E_{L,q_X})$, the candidate attributes are not unique and we could obtain multiple solutions.

63.4 Experimental Analysis

In this section, we will demonstrate the performance of our algorithm given in the above section. The data set from Ref. [9] is a turbine fault diagnosis example. In this example, there are 11 continuous attributes and 21 objects. We collect 15 objects, ID denoted by 2, 3, 4, 5, 6, 8, 9, 10, 12, 13, 14, 15, 17, 19, 20 as the training set, and the remaining 6 objects, ID denoted by 1, 7, 11, 16, 18, 21 as the test set. We use our algorithm on the training set for attribute reduction and verify its result.

Step 1: Calculate $E_{i,0}, E_{i,1}, E_{i,q_X}, POS_{a_i}(U), i = 1, 2, \cdots 11$, then we get Table 63.1, where a_i is the condition attribute, $j = 0, 1$ corresponds to the equivalence class whose decision value is 0 or 1, $j = X$ corresponds to the equivalence classes whose decision value is uncertain, the data in Table 63.1 corresponds to the objects' IDs and the IDs in a {} are in a equivalence class.

Step 2: Sort condition attributes in ascending order of the cardinality of $E_{i,q_X}, i = 1, 2, \ldots 11$, acquire, $Sort\_attr[] = [a_9, a_7, a_4, a_2, a_1, a_8, a_{11}, a_6, a_3, a_5, a_{10}]$

Step 3: Let M = Sort-attar [1]

Step 4: The $card(E_{M,q_X}) = 2 \neq 0$. So we start the loop. When $L = M \cup a_j = \{a_9, a_7, a_2\}$, then $card(E_{L,q_X}) = 0 < card(E_{M,q_X}) = 1$ and $N = \{a_2\}$, the loop end the $M = M \cup N = \{a_9, a_7, a_2\}$.and $\cup\{a_i | a \in M, i = 1, 2, \ldots, card(M)\} = a_9 \cup a_7 \cup a_2$. Calculate the partition $U/(a_9 \cup a_7 \cup a_2) = \{\{2\}, \{3\}, \{4\}, \{5\}, \{6\}, \{8\}, \{9\}, \{10\}\ \{12\}, \{13\}, \{14\}, \{15\}, \{17\}, \{19\}, \{20\}\}$; so we achieve a reduction:$a_9 \cup a_7 \cup a_2$

Table 63.1 The result of step 1

a_i (condition attribute)	$j = 0$ (the decision value of equivalence is 0)	$j = 1$ (the decision value of equivalence is 1)	$j = X$ (the decision value of equivalence is uncertain)
$i = 1$	{8},{10},{12},{17}	{2,4}	{3,5,6},{9,13,14,15},{19,20}
$i = 2$	{6,10},{13,17},{14},{19}		{2,3,4,5},{8,9},{12,15,20}
$i = 3$	{13,14,17},{15}	{4}	{2,3,5},{6,8,9,10,12},{19,20}
$i = 4$	{6},{8,10,15},{17},{19}	{4}	{2,3,5},{9,14},{12,13,20}
$i = 5$	{14},{19}	{4}	{2,3,5},{6,8,9,10,12,13,15,17,20}
$i = 6$	{6,10},{12},{15,17}		{2,3,4,5,13,14,19,20},{8,9}
$i = 7$	{5},{10,12,14,15,17,19}	{2},{3,4},{20}	{6,8,9,13}
$i = 8$	{6},{8,10},{15},{19}	{20}	{2,3,4,5},{9,12},{13,14,17}
$i = 9$	{6},{8},{10,14,15},{12, 17,19},{13}	{2},{4},{9,20}	{3,5}
$i = 10$		{4}	{2,3,5},{6,8,9},{10,12,13,14,15, 17,19,20}
$i = 11$	{6,19},{8},{13,14},{17}		{2,3,4,5},{9,12},{10,15,20}

After obtaining the attribute reduction of decision table, we could test the performance of the reduction $a_9 \cup a_7 \cup a_2$.

Experimental results show that the attribute reduction algorithm is simple and easy to implement. Compared with the algorithm of Ref. [6], it has a smaller number of cuts, a smaller number of rules, and the prediction results reach the required accuracy. The main work of the next step is to improve the accuracy of classification rules and eliminate the unclassified objects.

63.5 Conclusions

This paper offers a novel algorithm of attribute reduction which is suited for the information system with discrete-valued or continuous-valued attributes. The presented algorithm gives attribute reduction in continuous data itself and achieves classification prediction on dataset. In this paper, we prove the effectiveness and efficiency of the algorithm in theory and practice.

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Chapter 64
Mathematical Models of Classification and Mass Calculation

Jincai Chang, Aimin Yang and Liyu Chen

Abstract People are familiar with trees, which have a lot of unsolved mysteries. "How much do the leaves on a tree weigh?" is one of the unsolved questions that frequently rise. To figure out the answer, this paper, under some ideal hypotheses, applies biologics, mechanics, and mathematics comprehensively to build mathematical models of leaf shapes and classification, and proposes a progressive approximation method to estimate leaf mass. This paper analyzes the correlation between leaf mass and the size characteristic of a tree with the model mentioned above, and analyzes the results, comparing them with actual situations, and it proposes, accordingly, an expanding model for obtaining leaf mass.

Keywords Moment of inertia · Leaf vein · Morphological classification · Biohomologous evolution

64.1 Introduction

Mysteries of nature are always thought-provoking. One leaf will provoke countless thinking. People wonder: Why do leaves have the various shapes that they have? How does the distribution of leaves within the "volume" of a tree and its branches affect the shape? How is leaf shape (general characteristics) related to tree profile/branching structure? How much does a leaf weigh? How much do the leaves on a tree weigh?

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Ben Brand (Ph.D. in Arizona University) studied leaves on various trees. The core idea of his study is based on leaf veins which have three characteristics: leaf vein density, the distance between leaf veins, and the number of leaf vein area which is as small as peoples' capillary vessels. Accordingly, mathematical models were built for research [1].

Leaves, in a tree, should generally have similar shapes due to their continuous self-replicating heredity. However, the environment changes, and so do the leaves accordingly. Therefore, leaves in a tree display different patterns.

Similar to leaf shape, leaf mass is also one of the key factors that impact the growth of a tree. This paper estimates the leaf mass with the theory and methods of leaf vein evolution [2, 3].

64.2 Assumptions

(1) Leaves are approximately on the same flat;
(2) Trees grow normally not being sick or under other abnormal circumstances;
(3) The thickness (d) of leaves is the same;
(4) The profile of trees and branches are all ideally regular symmetry.

64.3 Leaf Classification

64.3.1 Foundational Concepts

The environment in nature changes, and so do leaves with self-replicating heredity. That is why leaves depict various patterns and shapes. Even in one tree, the leaves are different from each other due to adapting to the environment and fully exerting its own optimal effects.

At the angle of flat, the shapes of leaves are different only in size. Each leaf is basically the same when folded, which was determined by the genes of the tree and the environment it belongs to.

Accordingly, this paper focuses on the angles between leaves and the horizontal level to classify leaves of a tree.

64.3.2 Classification Standards

In the process of obtaining the angle θ, leaves will be abstracted into its vein. Rectangular coordinates system will be built considering horizontal level as Fig. 64.1.

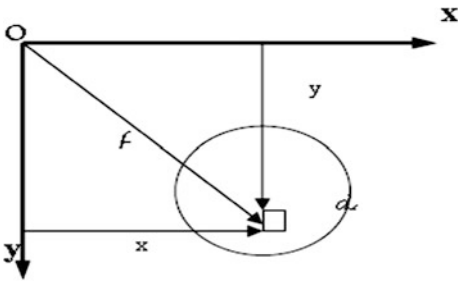

Fig. 64.1 Moment of inertia schematic

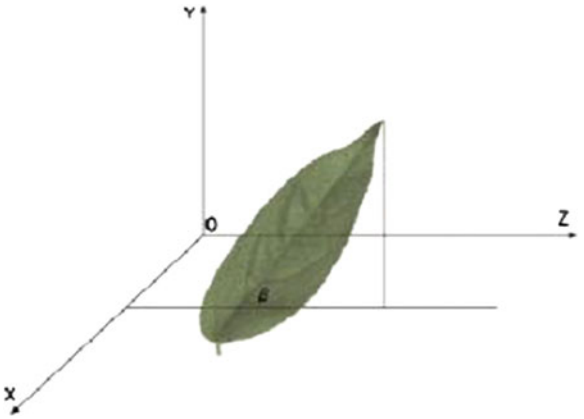

Fig. 64.2 3D plot of the leaves

By calculating the inertia axis and turn it over to locate it accurately. The bigger the surface area of any leaf on the tree, the larger its moment of inertia, the more easily it loses its stability [4]. Area factor *da* multiplying the square of its distance to Axis *x* or Axis *y* is y^2dA or x^2dA which is called the moment of inertia or cross-section of secondary wheelbase of area factor to Axis *x* or Axis *y*. The moment of inertia to Axis $y : I_y = \int_A x^2 \mathrm{d}A$.

If the angle between a leaf vein and the horizontal level is determined, the angle between the leaf and the horizontal level is correspondingly determined. See Fig. 64.2.

In the rectangular coordinates system, suppose the angle between the main leaf vein and the horizontal level is θ. When θ is fixed, levelly moving the leaf will not change its size. To obtain θ, a graphics processing is required: move the leaf to the origin so that the space linear equation of main leaf vein axis can be demonstrated as

$$z = \sqrt{x^2 + y^2} \tan\theta \tag{64.1}$$

Taking leaves as many unit areas *dA*, the space coordinate of which is () $x_i^{'}, y_j^{'}, z_k^{'}$. If levelly moved, *dA*'s space coordinate is (x_i, y_j, z_k). Suppose the distance between the main vein axis and *dA* is *D*

$$D = \frac{\sqrt{x^2 + y^2}\sin\theta - z\cos\theta}{\sqrt{\cos^2\theta + \sin^2\theta}} \tag{64.2}$$

So the moment of inertia of the main vein axis is

$$m_\theta = \sum_{i=1}^{m}\sum_{j=1}^{m}\sum_{k=1}^{m}\left(\sqrt{x_i^2 + y_j^2}\sin\theta - z_k\cos\theta\right)^2 \tag{64.3}$$

If the sum of inertia moment of any unit area to its main vein axis comes to its minimum, the main vein axis of any leaf is called the inertia axis. Derivate (3)

$$\begin{aligned} m_\theta^{'} = 2&\left[\sum_{i=1}^{m}\sum_{j=1}^{m}(x_i^2 + y_j^2) - \sum_{k=1}^{m} z_k^2\right]\sin\theta\cos\theta \\ &- 2(\cos^2\theta - \sin^2\theta)\sum_{i=1}^{m}\sum_{j=1}^{m}\sum_{k=1}^{m} z_k\sqrt{x_i^2 + y_j^2} \end{aligned} \tag{64.4}$$

Let $m_\theta^{'} = 0$, then

$$\theta = \frac{\pi}{2} - \arctan\frac{2\sum_{i=1}^{m}\sum_{j=1}^{m}\sum_{k=1}^{m} z_k\sqrt{x_i^2 + y_j^2}}{\left[\sum_{i=1}^{m}\sum_{j=1}^{m}(x_i^2 + y_j^2) - \sum_{k=1}^{m} z_k^2\right]} \tag{64.5}$$

64.4 The Relationship Between Tree Structure and Leaf Shapes

64.4.1 Minimizing Overlapping Individual Shadows

Leaves tend to minimize overlapping individual shadows, which means leaves on the same branch, no matter how they array, always keep not overlapping to maximize exposure, which is in favor of photosynthesis. In the same environment, the higher the photosynthesis efficiency is the more organic matters the leaf stores, the better the leaf grows [5]. Specifically, leaves, due to their tendency to light, change their shapes to maximize exposure to the sunshine. Adjacent leaves mosaic to each other to avoid overlapping, so that they utilize the sunshine in the best way possible. As a result, leaf shapes minimize overlapping individual shadows that are cast, so as to maximize exposure.

64.4.2 The Pattern of Leaves in the Volume of a Tree

The space between the branches is smaller than outside, so the leaves in the branches are different from that on the outside due to lack of light [6].

At the angle of biology, the photosynthesis efficiency is directly related to plants' exposure to sunshine. With the similar environmental factors (temperature, concentration of carbon dioxide, etc.), the more exposure to sunshine, the higher the photosynthesis efficiency, so leaves in the branches tend to get as more exposure to sunshine as possible. The tendency to light makes leaves turn to change into the way that they could expose more to sunshine.

Leaves on outside part of a tree may hinder light exposure of leaves in the branches. Moreover, the space between branches is smaller, so there are less leaves in the branches and the sizes of leaves here are smaller.

64.4.3 Relationship between Tree Profile and Leaf Shapes

The profile of a tree is determined by its crown which is supported by the trunk. Leaves are the final key factor that determines the profile of the tree. Based on the model of leaf distribution above, each leaf is considered as a unit area which has its own coordinate. The profile of a tree can also be abstracted into an irregular cone in the space coordinate system. For that matter, leaves distributed in different parts of a tree form its profile. Different places outermost leaves extend to finally determine the edge of the tree profile, that is to say, the coordinates of the outermost leaves determine the tree profile. In accordance with biological holographic and cell totipotency, the organs, tissues and cells are mutual related. For instance, the developing direction of the veins of a leaf is consistent with the growing direction of the tree. Based on the two angles discussed above, it can be concluded that the overall pattern of a tree is relevant to its profile and branches, which is consistent to the idea raised by Zhengtao Lv, in "An interesting observation-the correlation between the leaf shape and tree profile [7]".

64.5 Solving Models for Leaf Mass

There are two metrics about the smoothness of connection: one is parametric continuity of curves, that is parametric curves possess n order parameter continuously differentiable at the connection point, so this type of connecting is C^n or n order parameter continuity; the other is called geometric continuity, and only when the two curves segment corresponding arc length parametric have C^n order continuity at the common connection point, then this type of connecting is G^n continuity. Geometric continuity more widely used in engineering.

64.5.1 The Basic Viewpoints of Bio-Homologous Evolution

Biological organ units of homologous evolution all need ordered time and space units, namely space-time-unit [8]. The evolution of space-time-unit follows strict principle which will be perfectly demonstrated in the mathematical formula of plant leaf veins. The process of derivation is as follow:

Four principles of biological space-time-unit evolution:

(1) The central space-time-unit principle-only one of the space-time-units that life units of homologous evolution need can be the central axis, namely central space-time-unit, during numerous space-time-units.
(2) Even pairs principle-the number of space-time-units which symmetrically outward distribute from the central space-time-unit.
(3) Space-time-unit evolution principle–the number of space-time-units that the life units of homologous evolution needed is always odd.

Life evolution odd principle-the number of life evolution units in every space-time-unit can either be odd or even, but it always follows the odd evolution law which is the same to the space-time-unit evolution.

Assume that any relatively independent life needs s space-time-units in a unified space-time-unit. If a central space-time-unit is represented by "0", the number of even pairs of the space-time-units, oppositely exist, is m, which is represented by A1 A2, B1 B2, C1 C2… (s, m are natural numbers). In relevant literatures, the evolution formula of space-time-unit odd was worked out: $S = 2\,m + 1$. This formula represents both the evolution of space-time-units and the evolution of the category that life units belong. (See Fig. 64.3).

64.5.2 Evolution Law of Leaf Veins

Leaf veins are the lines of leaves where leaf vascular exists. Mathematical formulas of vein evolution reflect the deep-seated mathematical model problems of plant evolution. In accordance with the life space-time-unit odd evolution (see Fig. 64.4). Based on the four principles of biological space-time evolution, the vein evolution is assumed to have the following three principles:

(1) The axis evolution principle which means that any leave evolves around its midrib.

Fig. 64.3 Biological evolution of the category

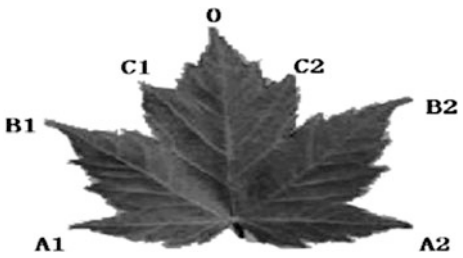

Fig. 64.4 Vein evolution of the spatial space-time maps and temporal distribution

(2) The relative evolution principle, which means that the sub-veins evolving from the two sides of any leaf make one-to-one correspondence.
(3) The equal veins evolution principle, which means that the numbers of potential sub-veins developing from the two sides of any leaf are equal.

Every leaf has an axis vein, namely, the first vein, main vein or midrib. It corresponds to the mid space-time location "0" which is represented by model 1 or 2^0m^0.

Corresponding sub-veins, named second veins, develop from the two sides of the main vein in accordance with the equal veins evolution principle. Second veins, the total of which is always even which is represented with $2m$, are m corresponding pairs which can be corresponded with $A_1A_2, B_1B_2, C_1C_2, \ldots$, the even pairs of space-time-units.

Similarly, corresponding sub-veins, third veins, develop from the two sides of the second veins. The total number of the third veins is 2^2m^2. The total number of forth veins is 2^3m^3. The total number of the fifth veins is $2^4m^4 \ldots$. And the total number of the nth veins is $2^{n-1}m^{n-1}$.

64.5.3 Surface Area Method for Mass

The mathematical model here discusses the universal law of biological evolution on the basis of following assumptions: Darwin's biological homology theory of evolution and the Biological holographic theory of Professor Yingqing Zhang. Their fundamental findings can be concluded as unified biological evolution mathematical models. While, in this part, only stems and leaves are considered. So the evolution patterns of leaf veins mentioned above apply to all the stems of plants. The difference is that the nth stems are leaves, so the total number of leaves is $N = 2^{n-1}m^{n-1}$.

In the first place, the tree will be abstracted into a regular Symmetrical ideal graph (See Fig. 64.5). The leaf mass is available:

$$M = \rho V = \rho \sum_{i=1}^{n} S_i d \tag{64.6}$$

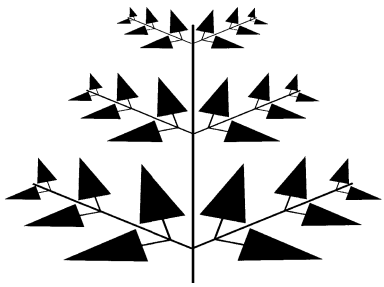

Fig. 64.5 Leaves mimic diagram 1

Fig. 64.6 Leaves mimic diagram 2

ρ: The density of leaves which is a constant. S_i: The surface area of the i th leaf on a tree. d: The thickness of leaves which is assumed the same.

It can be recognized that the key factor to obtain M is to obtain the surface area S.

For the simplified model in Fig. 64.5, assuming that the surface area ratio of two Adjacent leaves on the same branch is q, and the surface area ratio of two leaves on the same places of different adjacent branches which are in the same side of the tree is q, too. Suppose the surface areas of two adjacent leaves on the first branch are S_1 and S_2 separately (see Fig. 64.6) then

$$\frac{s_2}{s_1} = q > 1 \tag{64.7}$$

When $m = 3$ and $n = 3$, which equals to the space-time-unit even pair is 3, what the total surface area of leaves is. Here, the total number of leaves is $2^{n-1}m^{m-1} = 2^{3-1}3^{3-1} = 36$. The total surface area is known by symmetry:

$$\sum_{i=1}^{36} S_i = 2 \times 2 \times \left[\frac{S_1(1-q^3)}{1-q} + \frac{\frac{S_1}{q}(1-q^3)}{1-q} + \frac{\frac{S_1}{q^2}(1-q^3)}{1-q} \right] \tag{64.8}$$

So when the space-time-unit even pair is m considering the nth veins, the total number of leaves is

$$N = 2^{n-1} m^{n-1} \tag{64.9}$$

The total surface areas of leaves is

$$\sum_{i=1}^{n} S_i = 2 \times 2 \times \left[\frac{S_1(1-q^m)}{1-q} + \frac{\frac{S_1}{q}(1-q^m)}{1-q} + \cdots + \frac{\frac{S_1}{q^{m-1}}(1-q^m)}{1-q} \right] \tag{64.10}$$

.

Based on (64.6) and (64.10)

$$M = \rho V = \rho \sum_{i=1}^{n} S_i d = 2 \times 2\rho d \left[\frac{S_1(1-q^m)}{1-q} + \frac{\frac{S_1}{q}(1-q^m)}{1-q} + \cdots + \frac{\frac{S_1}{q^{m-1}}(1-q^m)}{1-q} \right]$$

$$= 4\left(\frac{q^m - 1}{q-1}\right)^2 \frac{\rho d S_1}{q^{m-1}} \tag{64.11}$$

In accordance with

$$\lim_{m \to +\infty} 4\left(\frac{q^m - 1}{q-1}\right)^2 \frac{\rho d S_1}{q^{m-1}} = +\infty \tag{64.12}$$

The more the branches of a tree are the larger the leaf mass, the larger the tree mass, which is corresponded with the reality.

64.6 Conclusion

This shape classification model ingeniously combines the angle of leaves and the horizontal level, and the moment of inertia, and figures out the angle of each leaf and the horizontal level. In the process of obtaining leaf mass, the model utilizes the biological Homologous evolution law which makes the solving process concise and accurate. This model is significant for the development of ecology, and can be applied to detecting the disguising system by ground vegetation. However, in reality, the profiles of trees are usually not perfectly symmetrical. Thus, the model built in this paper can be improved by remedying the coefficient for further research.

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Chapter 65
Green Supply Chain and Supplier Selection and Evaluation

Jie Xiang

Abstract In order to select the appropriate business development needs of suppliers for green supply chain vendor selection and evaluation for the study, detailed discussion of the supplier evaluation and selection, design evaluation system for selecting the framework and content, and to out the specific implementation plan is given. It is proved that the method can select suppliers for the enterprise to provide a scientific solution; vendor management of enterprises has some reference value.

Keywords Green supply chain · Suppliers · Selection · Evaluation

65.1 Introduction

In the supply chain, environmental factors considered in the first 70 years of the twentieth century were proposed, but only as logistics management was a secondary aspect of the study. Dickson [1] first made selection of suppliers with the greatest impact. In 1966, he made a series of quality, delivery and past performance of the 23 most important criteria for supplier evaluation. Eliram in 1990 while doing the selection of suppliers [2], and he stated that in addition to cost, quality, etc., quantitative criteria must also be considered to meet the management compatibility, goal congruence, and the so-called soft targets. Symtka and Clemens considered risk factors, business demand factors, cost factors, the three

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evaluation criteria; In [3] the authors proposed guidelines and the level of analysis, [4]. In 1994, Weber studied the environmental impact of some products, recommended the adoption of environmental criteria to select the appropriate raw materials, while focusing on recycling, and put forward the concept of green procurement.

Green Supply Chain concept is manufactured by the Michigan State University, [5] Research Institute for the first time in 1996 with the aim of comprehensive environmental impact and optimal use of resources to consider the manufacturing supply chain development. Reference to supply chain and the definition of green manufacturing, green supply chain can be considered in the entire supply chain of a comprehensive consideration of environmental impact and resource utilization of modern management mode, which theory of green manufacturing and supply chain management technology, involving suppliers, manufacturers, distributors and users, the aim is to make products from raw materials acquisition, processing, packaging, warehousing, transportation, use to scrap the whole process, the impact on the environment (negative effect) the smallest, most efficient resources.

Green supply chain management is the manufacturing and production enterprises in market competition for the characteristics of the twenty first century with a new management mode and method, with the aim of the supply chain, through the coordination of activities to achieve the best throughout the supply chain and business performance. Green supply chain management as a corporate culture has penetrated into all aspects of the modern enterprise.

65.2 Green Supply Chain Management System Frameworks

Green supply chain is the core of the concept of environmental awareness throughout the supply chain to environmental impact, resource utilization, and optimum economic efficiency as the goal. Currently, research on green supply chain is mainly directed against certain aspects of the supply chain of individual technologies, such as green procurement, supply chain green degree evaluation, green supply chain partner selection, and supply chain management. Green supply chain system has not yet formed a complete theoretical system. Based on this, we propose an Internet-based green supply chain management system framework, shown in Fig. 65.1. The system is composed of three parts: strategic management, production coordination system, and information management systems.

65.2.1 Strategic Management System

Green supply chain management system is the highest level of strategic management system, which is the core business and supply chain business decision nodes. Alliance, the main function is based on production needs and the evaluation

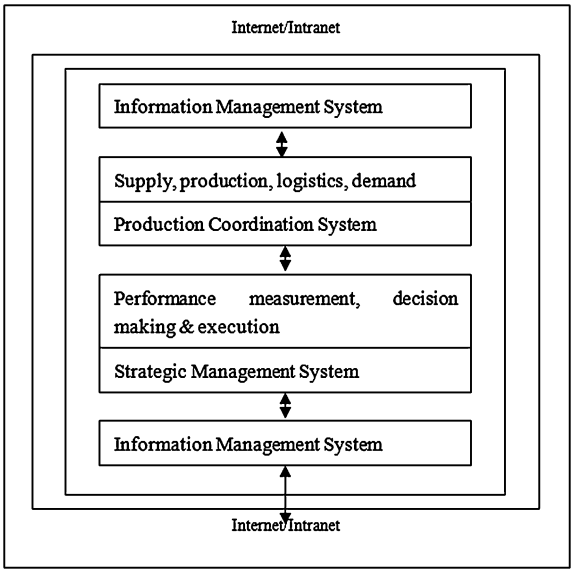

Fig. 65.1 Framework of green supply chain management system

parameters for strategic decision-making, which mainly include the following processes:

(1) Performance evaluation: evaluation for the performance of the entire supply chain. Not only the core business to evaluate the operating performance of node enterprises, but also to consider the operating performance of the node on the corporate enterprise or the upper node of the entire supply chain, especially the impact on the environment. The evaluation indicators are the total production cost, product quality, supply chain green degree, customer service standards.
(2) Decision-making: the establishment or adjustment of the supply chain strategy. Companies often having their own viable decision must take into account the core business and business decisions and ideas between nodes on the basis of the "green" thinking throughout the decision-making stage in order to develop a green supply chain strategy. Decision-making can be implemented with just the outline of a supply chain without the need to develop specific and detailed procedures for daily operations and command.
(3) The decision taken: in the supply chain core business and enterprise in the implementation of the node to develop decision-making. It should be noted that supply chain decisions can guide enterprises, but cannot force companies. If the implementation process needs to adjust or develop new decision-making, re-evaluation of supply chain performance is a must.

65.2.2 Production Coordination System

Green supply chain supply chain coordination reflects the core business and strategic partnership between node enterprises and the integration of internal and external resources and optimal utilization. Green supply chain supply chain management involves coordinating the production of the four main areas: supply, production, logistics, and needs. Supply chain coordination in green must establish a consultative mechanism to achieve increased customer service levels and lower total cost of balance. Coordination in the production system can establish a cooperative mechanism to achieve four main areas of supply chain management (supply, production, logistics, and demand) integration and optimal use of resources, both from a raw material acquisition, production, processing, logistics management, product marketing, product use, and product recovery of the full life cycle of green to the successful implementation of green supply chain management.

65.2.3 Information Management System

Information management system is the supply chain management system contact center and infrastructure. Through Internet technology there is green supply chain information sharing and delivery, so the other two parts can get the required information in a timely manner and in accordance with information to make decisions and issue commands. Information management system main function is to achieve information sharing and transfer. Typically, the core enterprise and supply chain node enterprises have their own computer systems through which work can be independent. With Internet technology, all these computer systems can be linked through the network to form a logistics and information flow, including supply chain system. In this system, you can use Internet Intranet technology, the core business and the external nodes of information exchange between enterprises, and the core enterprise information exchange, through the Internet, “standardized” technology. Intranet is a more convenient and cost effective manner to integrate various information systems enabling enterprises through the supply chain management software, internal and external information environment to be integrated into a unified platform as a whole.

65.3 Green Supply Chain Supplier Selections and Evaluation

Supply chain from suppliers, manufacturers, and component vendors, with the internal relevance. Suppliers throughout the supply chain, “the source”, supplier evaluation and selection of supply chain relationships is the basis for running.

Supplier delivery, product quality, product design and other aspects affecting the success of the manufacturer. Meanwhile, suppliers for prices and quality determines the final price and quality of consumer goods, which also determines the final product market competition, and supply chain components of the core competitiveness of a certain impact. In the green supply chain, supplier selection factors are: price, quality, delivery lead time quantity, delivery time, product type, design capability, process capability and other special factors. These factors in the actual selection process of the supply chain have shown the importance is different, mainly that the product quality, cost and delivery history of behavior of the mechanism is to choose the three most important criteria.

65.3.1 Supplier Partnerships Compared to Traditional Supplier Relationship

Generally believed that the traditional supply purchase between the primary goals are to purchase price of the product or service to a minimum. Therefore, the buyer must rise to the suppliers and price competition among suppliers through the procurement of the number assigned to the control of suppliers, while the relationship with suppliers is also only short-term contractual relationship. Can know, although this strategy reduces the purchase price, but does not help motivate suppliers to improve their value-added services, improved technology to gain a competitive edge. Supply chain environment is not conducive to the formation of the requirements under the direct, long-term, stressed there were plans and work together to achieve solutions to common problems, emphasizing mutual trust and cooperation of partnership building. Table 65.1 shows the relationship between traditional suppliers and the main differences between partnerships.

65.3.2 The Green Supply Chain Implementation of Supplier Selection

Comprehensive evaluation of vendor selection can be summarized as the following steps, shown in Fig. 65.2.

First, the analysis of market competition environment (demand, necessity). There is a demand only necessary. Established based on trust, cooperation and open exchange of long-term cooperation relationship of supply chain, we must first analyze the market competition environment. Purpose is to find which products market development for supply chain partnerships to be effective, must know what product demand, product type and characteristics of what is to confirm the needs of users to confirm whether to establish the necessary supply chain relationship, if Supply chain partnership has been established, the changes in demand for

Table 65.1 The traditional supplier relationships and comparison of partnership

Factors	Traditional relations	Partnership
1. The competitive supply market characteristics	Based on price	Technology-based cooperation
2. Supplier selection criteria	Price-based auction	Comprehensive long-term performance
3. Information transfer and management	One-way closed	Open and transparent
4. The attitude of the capacity plan	Independent	Shared responsibility in the strategic issues
5. Product delivery	Unstable	JIT, small quantities on the basis of consultations
6. Transaction processing	Non-cooperative game secrets	Based on win–win cooperation, lower costs
7. Product quality	Do not trust the quality of the inspection	Work together to achieve zero defect
8. R & D	Products on request	Participate in R & D
9. The number of suppliers	More	Fewer but
10. Pressure level	Low, if not satisfied you can find an alternative provider	High, using a variety of ways to reduce costs

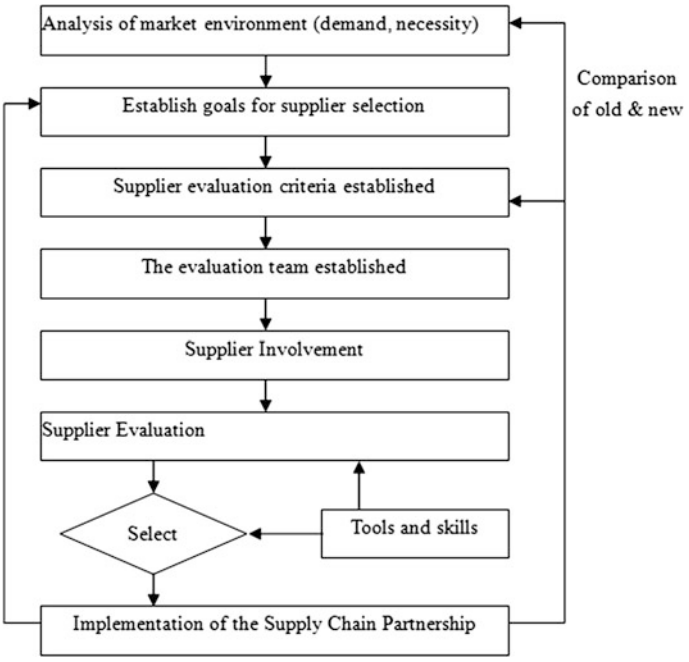

Fig. 65.2 Flow chart supplier selections

recognition based on cooperation between the supply chain the need for change, thus confirming the need for supplier evaluation and selection. Also analyzed the status of existing suppliers, analyze, summarize the problems of enterprises.

Secondly, the establishment of vendor selection target. Companies must determine how to implement the vendor evaluation process, information flow to and who is responsible, and must establish substantial, the actual target. Which is the main goal of cost reduction, supplier evaluation, selection is not only a simple evaluation, selection process, which itself is the enterprises themselves and a business to business process reengineering business processes, and well implemented, it is itself can bring a range of interests.

Finally, the establishment of supplier evaluation criteria. Supplier evaluation index system is the enterprise of suppliers and the basis for comprehensive evaluation criteria to reflect the enterprise itself and the environment posed by the complex system of indicators Grouped by different attributes, hierarchies, ordered the set. According to the system comprehensive, concise scientific, comparable stability, flexible operational principle, the establishment of integrated supply chain management vendor comprehensive evaluation index system.

65.3.3 Evaluation of Content

Supply chain management in the supplier evaluation and selection should meet comprehensive, scientific and practical, objective and fair, workable and can be strong expansion of the basic principles. For businesses, the selection and supplier development partnership aims to improve the competitiveness of its supply chain, so choose the type of evaluation of its partners; suppliers should affect the ability of cooperation and competition in all aspects to be considered as a key indicator.

According to different levels, supplier evaluation can be divided into five areas: credibility and visibility suppliers, ability to evaluate the quality of suppliers, evaluation of the technical capacity of suppliers, supplier evaluation and price evaluation of delivery capacity. Of course, there are many other indicators can be used as basis for the evaluation of suppliers, such as financial capability, geographical location, corporate culture and so on. This paper synthesizes existing research results, specifically in the enterprise visits and extensive consultation with business management advice based on the principles of evaluation index system, after repeated deliberation, finalized a five-point of the main factors for supplier selection including: corporate reputation and visibility, quality, technology, price, delivery capacity. A factor set for each level indicator and it's under evaluation contains a number of secondary indicators set to form a complete supplier evaluation index system.

65.4 Conclusions

In this paper, the green supply chain vendor selection and evaluation for the study, selection, and evaluation of the enterprise to provide a solution provider and supplier selection is given the evaluation method. More traditional in terms of supplier selection methods, the method can make the choice of suppliers to be more scientifically fair and equitable. The future work will further refine and improve the evaluation of strategic suppliers, to adapt the characteristics of supply chain management and business development practical operation.

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Chapter 66
Path-Based Floyd Algorithm in Automatic Search System

Hua Sun

Abstract The shortest path planning is a point-to-point path planning approach as a network traffic system basic function of query. From the practical point of view, Floyd algorithm is designed based on the path to automatic search system, and a description of Floyd algorithm and the shortest path algorithm is described on the city. The system can be easily graphically painted and is set to be processed on graphics, mapped quickly to any queries for the shortest distance between two locations in the city. It very intuitively can see the route on the map and effectively improve the level of public information services and accelerate the process of urban modernization.

Keywords Path planning · Floyd algorithm · Shortest path

66.1 Introduction

With economic development, cars have become a daily life of transport. GPS systems are applications that are used to solve transport facilities on the basis of vehicle location, monitoring, communication into the social problems. In the GPS system, the key issue is the automatic path search in today's increasingly large and dense transport system, the use of automatic path search system that can quickly find a starting point to end point from the shortest route [1], not only for people's daily lives but also to facilitate the work, saving time, transport costs, and improving efficiency.

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Existing research has focused on two areas: single-source shortest path and all vertices between the shortest path. The all vertices shortest path algorithm proposed by Floyd is used to calculate the shortest path between all nodes [2, 3], the Dijkstra algorithm is used to calculate a node to all other nodes of the shortest path. The Dijkstra algorithm is proven to draw the shortest path to the optimal solution, but its efficiency is a problem. With n nodes for a graph to calculate a node to the other nodes in the shortest path graph algorithm time complexity is O (n2). For medium-sized cities, geographic number may reach tens of thousands of nodes to hundreds of thousands; the time cost of the shortest path will be very great.

Optimal path planning is the first network of roads and surface features as points and lines, and then start and end in the known circumstances, finding a shortest (or a time, least cost, shortest distance) path. Dijkstra shortest path algorithm is the most commonly used method. In addition to the optimal path to solve a lot of ways, such as FLOYD algorithms, graph theory, dynamic programming, neural network method, it is the most conventional graph search method for depth and breadth of search algorithm.

Beyond this there have been on the Dijkstra algorithm and Floyd algorithm for the FD algorithm together on changes to improve storage Dijkstra algorithm [4], the principle is the trajectory of a moving target object to match the map to find the target location, and the current GPS positioning point projected onto the target, the main point of the line through the geometry algorithm.

66.2 System Design

System using Visual C++ as development tools, users in the system to obtain the starting location on the map and place of destination, the system automatically calculates the starting point to the end of the shortest path distance and path through the city [5], generates the shortest path can be directly displayed in the system to facilitate the user's query and browse. Through this system can be easily painted graphics and is set to do processing on the graphics, can be very quickly any queries to map the shortest distance between two locations and the by the city, very intuitive and can see the route on the map [6].

66.2.1 Systems Modules

The overall design of the system, including user registration system, map drawing and graphics processing module is set, path selection module (the shortest path query, path display, dynamic access to coordinates and the current time).

Function modules shown in Fig. 66.1.

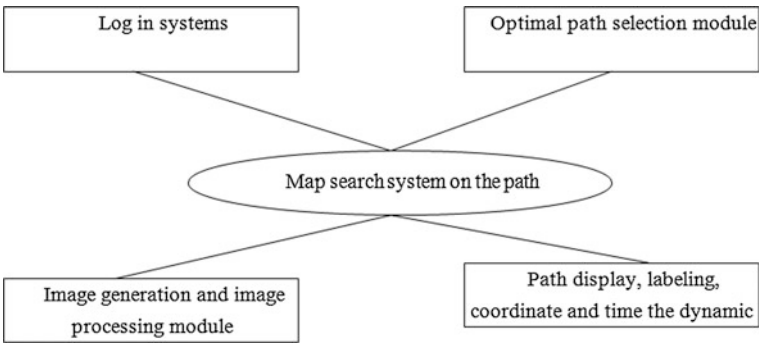
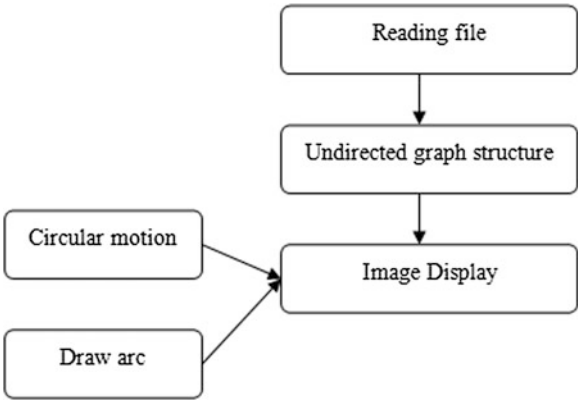


Fig. 66.1 Path search system function block diagram

Fig. 66.2 Map drawn outline set design and graphics processing module structure



66.2.2 Maps and Graphics Painted Home

Map drawn outline set design and graphics processing module structure shown in Fig. 66.2:

66.2.3 Data Processing

Map drawn flowchart is set and the graphics processing module shown in Fig. 66.3:

On behalf of the city with a small round, through the loop and the city's coordinates to draw circle. Adjacency matrix by the distance between two cities draw arc, the key to this step is to find the intersection of arcs and circles, concrete steps through the center of the circle obtained by connecting two of the intersection with the arc, then Move To (), Line To () function is drawn arc. For the query module, first of all define a static variable shouci, is a Boolean type, enter the name of the city to check with GetDlgItemText () function to obtain the input

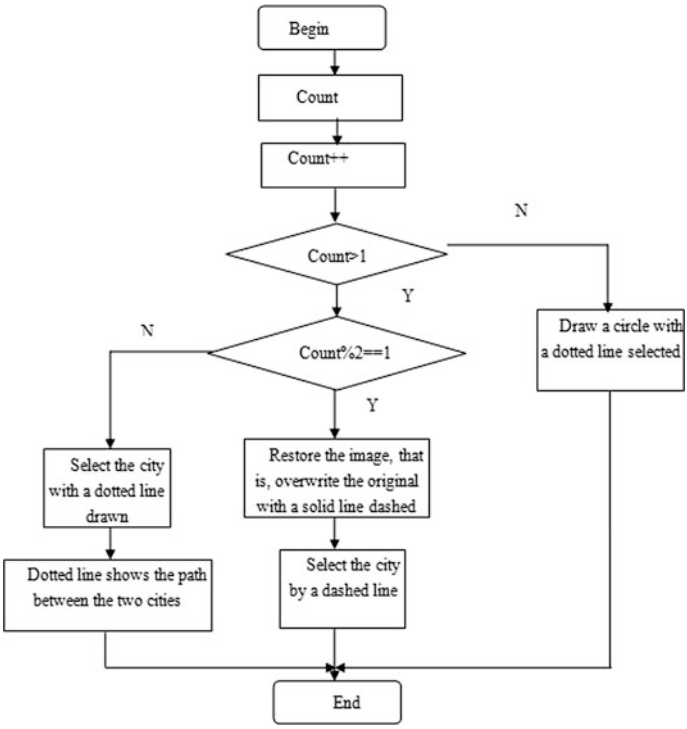


Fig. 66.3 Maps drawn flowchart set and graphics processing module

of text edit box, then the input text with LocateVex () function is obtained corresponding to the City serial number, if pathway between the two cities are two cities are among the Click to check the path, while the output means city. Query, if shouci is false, that is not the first query, the query results should revoke the original, that is the original solid line into a dotted line from the new path, then put the path to be queried by a dashed line. For mouse clicks module, mainly in terms of mouse clicks to design a mouse click is an odd number of times (>1), then first remove the original query results, the original dash re-painted solid line, and then click on the city painting into the dashed circle. Click the number is even, for the two cities by Floyd shortest path algorithm through which the line drawn dashed.

66.3 Floyd Algorithms

66.3.1 Floyd Algorithm Description

According to the paper generates an undirected graph G, an undirected graph can be initialized by the adjacency matrix of arc [g.verxnum] [g.verxnum], and the

path matrix p [g.verxnum] [g.verxnum] [g.verxnum], using Floyd algorithm can be obtained any map the shortest path between two points (Ruowu path just identified with the infinity INFINITY), the shortest path through the city along the serial number on the pa [] (the initial value of the pa [i] = −1), the distance between two points if d [i] [j] < INFINITY (there is access) will be pa [] the corresponding number in the name of the city output. Floyd algorithm is described as follows:

```
Typedef Seqlist VertexSet;
ShortestPath_Floyd (AdjMatrix g,
Weight Tyep dist [MAX_VERTEX_NUM] [MAX_VERTEX_NUM,
VertexSet path [MAX_VERTEX_NUM] [MAX_VERTEX_NUM]])
/* G is weighted directed adjacency matrix representation, path [i] [j] Vi to Vj to the current shortest path, dist [i] [j] Vi to Vj to the current shortest path length */
{
for (i = 0; i < g.vexnumn; i ++)
for (j = 0; j < g.vexnumn; j ++)
{/* Initialize path [i] [j] and dist [i] [j] */
InitList (& path [i] [j]);
dist [i] [j] = g.arcs [i] [j]. adj;
if (dist [i] [j] < INFINITY)
{
AddTail (& path [i] [j], g.vexs [i]);
AddTail (& path [i] [j], g.vexs [j]);
}
}
for (k = 0; k < g.vexnum; k ++)
for (i = 0; i < g.vexnum; i ++)
for (j = 0; j < g.vexnum; j ++)
if (dist [i] [k] + dist [k] [j] < dist [i] [j])
{
dist [i] [j] = dist [i] [k] + dist [k] [j];
path [i] [j] = JoinList (path [i] [k], path [k] [j]);
}
```

66.3.2 The Shortest Path Algorithm is Described by the City

```
void path [(MGraph G, PathMatrix P, int i, int j, int pa [])
{
//I find the serial number for the city to the starting point for the end sequence number j along the shortest path through the city the city
int k, l;
int m = i;//start serial number assigned to the city m
```

```
l = 0;
for (k = 0; k < G.vexnum; k ++)
pa [k] = −1;//pa of the initial value
while (m! = j)//not the end of the city
{
G.arcs [m] [m] = INFINITY;
for (k = 0; k < G.vexnum; k ++)
if (G.arcs [m] [k] < INFINITY & & p [m] [j] [k])//m have direct access to the k, j and k in the m to the shortest path
{
pa [l ++] = m;
G.arcs [m] [k] = G.arcs [k] [m] = INFINITY;//set the barrier to direct access
m = k;//serial number assigned to the city through m, to find
break;
}
}
pa [l] = j;
}
```

66.4 Conclusions

Modern computer technology is used to handle a variety of geographic information, optimal path selection, and the path to complete a variety of graph queries tasks. The shortest path problem in computer science and geographic information science, the basic problem has been computer science, operations research, geographic information systems, and research focus areas. The system according to road traffic information, using Visual C++ 6.0 Simulation and making the transport network, using Floyd algorithm combines the traffic map to judge the map to any two points is a path that exists to calculate the existing line of any two points between the path distance, and find out the path of all the cities, and the intuitive display, the entire system simple and easy to use. The use of the system can improve the public information service and speed up the process of urban modernization.

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Chapter 67
Modern Fashion Design Based on Virtual Reality

Zhang Yi

Abstract Virtual reality technology revolutionized the design of clothing, made in the development of virtual reality technology; from the point of view of modern fashion design tools and design concepts, we first introduced the three-dimensional garment design and virtual fitting system, and then separately showed the virtual reality environment's impact on fashion design, the impact on customer experience, the impact on clothing color design, the impact on four apparel—the aspects of virtual reality technology's profound impact on modern fashion design. Practice has proved that only the new technology and art of fashion design and performance of the organic combination are capable of fashion design to create new patterns and artistic styles.

Keywords Virtual reality technology · Fashion design · Clothing · Color

67.1 Introduction

Virtual Reality is a virtual world experience created by a computer system that uses computer graphics to create a language of virtual objects, environments, or phenomenon [1], people can make use of advanced interactive objects or equipment such environment observation, even into this virtual environment, touching one of these objects, and objects in a virtual environment or recreation. Virtual reality technology has been widely used in military, aviation, and other fields. In civilian clothing design, the technology for the garment industry has brought a revolutionary change.

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Virtual reality technology in apparel design, the first may be traced to the use of computer models design, graphic representation, mapping, until the three-dimensional (3D) mapping, but now, 3D fitting system, the fashion design system has a large number of application in fashion design, virtual reality technology, on one hand to the display of clothing designer and performance measures have a new understanding; the other hand, a virtual 3D model fitting, but also provides users with a new experience never before dressing; same time, as Internet technology continues to mature and the proliferation of computers, customers can send their bodies to the data over the network designer, the designer of data input, can be converted to a virtual 3D virtual model design, design process, designers can communicate with customers at any time, customers can see directly in the software image of their final design of clothing with color, fabric flower patterns, and other interactive information transmission [2]. The changes in fashion design and improvement of mouse clicks in a snap, and its design will be an opportunity for designers and customers will be satisfied with the work, greatly improving the work efficiency, saving design costs.

Virtual reality technology on modern fashion design is enormous, and its impact on future fashion design tools and design concepts, this chapter of clothing from the virtual reality environment design and impact, the impact on the customer experience, the impact on clothing color design on apparel costume of the four aspects, describes virtual reality technology on the significance of modern fashion design.

67.2 3D Garment Design and Virtual Fitting System

Early computer fashion design focus plane fashion design renderings and other traditional design tools, virtual reality technology, the costume design from the plane developed to a 3D space, there were many 3D clothing design system, from 1972 the earliest US garment factories are using the system developed by MARCON, the United States GERBER company officially launched in the early 1980s AM-5 system in the international garment industry has a huge impact, a variety of 3D virtual reality fashion design system has been a lot of used clothing design. PAD such as Canada's system 3D sample, the US computer design incorporation (CDI) the company's 3D-Fashion Design System, Gerber's V-stitched, France, and Lectra's e-design, and so on [3]. The 3D garment design system from the model library generated 3D human body model, using the traditional fashion design tailoring techniques to draw in the 3D model of the outline of clothing to generate 3D effect of wearing the service for designers and customers to wear in the virtual environment, and to the color of clothing, style, with clothing, wearing a display for visual effects, realistic texture to the performance of apparel fabrics and fabrics, in a different light exposure and the virtual scene in the continuous experiments, the final satisfactory design results.

Virtual fitting is an important application of virtual reality technology field, online virtual fitting system across time and space limitations, and the Fashion

Design shadow over the Internet around the world a place for each. My Virtual Model of the more famous virtual fitting the success of a website to attract several world famous clothing retail giant. Virtual fitting system with trans-regional, cross-time features, online virtual fitting can be seen as an extension of telephone shopping, people can directly see the effect of upper body clothing will be purchased. As for the developed cities of the people, work more and more busy, spare time is limited also to a virtual fitting market space. A few clicks you can buy the right clothes, and no intention of busy people who are most efficient. At present, the technology is divided into two kinds: one is European and American technology-based 3D virtual try all the models, fashion is 3D animation, the benefits can set up their own models of body proportions to conform to their own, the disadvantage is the cost too high, each garment must be hand to create 3D animation, then there is no texture, the virtual fitting room Lithuania Stilingos shopping site. Another system is the real model fitting, the model is true by definition, clothing is also true. This has the advantage of low cost, as long as each piece of clothing according to a picture on the line, there is a manifestation of clothes to maximize texture.

67.3 Virtual Reality Environment Garment Design

Clothing interactive applications of virtual reality simulation of the core technology in one of the fashion design process require fast, real clothing simulation, to help designers use computers to efficiently design and production, and these products immediately presented to the customers. This process, in fact, clothing and human body model and the collision detection process [4].

How effective and realistic on the computer to simulate the movement of clothing has always been an interactive virtual reality technology is a hot area of research. Many researchers from the simplest form of fabric shape and motion paper puts forward a number of possible models and methods in simulation speed, effectiveness and stability and have made great progress. Model commonly used clothing for the geometric simulation and physical methods of hybrid simulation. The simplest method is based on particle physics—spring model, this model works is based on the clothing and physical properties of the geometry, simulation of the deformation of clothing, and the calculation is simple. But counting only the force between adjacent particles, so with very little time to calculate deformation, resulting in a localized deformation; change of clothing is not a stable display. It is one of the basic requirements for clothing to fit, and fit of the support with the human body is closely related areas, such as: the human body is the shoulder support area around the upper body; lower body is in the hip. It may be assumed in the fitting area is fixed in the body garment on the model. In the human body during exercise, can cause traction on the clothing and oppression, which is impossible to make clothing a major change in shape. In the virtual reality system on clothing in a variety of internal forces and external forces generated by the

deformation, are considered to be a certain locality, such as gravity, air force overcast, wind, and so on. Clothing and human body model such as the role of the interaction can not be considered under the deformation occurs, which simplifies the process of fashion design external factors; only consider the adaptability of the human body model for clothing.

Designers of virtual reality technology provides a virtual 3D design environment directly, no longer consider the environmental impact of other external factors, which is different from the multimedia technology of virtual reality technology, real-time image processing technology, the most important point. Costume design for virtual reality system, designers must be able to vicariously observe and participate in the human model the environment. Users can feel present in the simulated environment of the authenticity of the object. Virtual reality technology can be constructed in the computer model of a realistic image. People can interact with the model and generate the same real world feedback to enable people to access and feel like the real world. The structure is currently nonexistent virtual reality environment, without external interference and influence of various factors, but could not exist in practice such an ideal environment, so that may minimize the unnecessary interference and influence.

67.4 Virtual Reality Technologies in the Impact of Customer Experience

Costume design is by highlighting the experience of brand style, theme, create a brand experience in the fashion design; fashion designer with the customer experience is a comprehensive in-depth exchange of bonds. In the experience of fashion design, not only on the customer's rational needs, but more emphasis on the customer as "human" perceptual requirements. Experience fashion design should emphasize the following points:

First of all, should take full account of the customer perceptions. Fashion design clothing if it puts too much attention to the function, quality, price and service, rational factors, it will ignore the Fishing perceptual knowledge; the experience of the virtual environment provides the customer design is highlighted the importance of perceptual knowledge, will bring customers more vivid products, its customers tend to create a new perceptual experience;

Second, we must emphasize the customer's identity. Fashion design experience, the means through experience with the customer's lifestyle will be linked to clothing, such as perception, feelings, thoughts, actions, and many other customers feel the touch of their consumption behavior. Beginning to consider the customer in the design of individual lifestyles and a wider range of social relations, through the clothing of the "look" designed to attract and lead customers "feel" through "feelings" caused the customer to "think" and create a customer for clothing social identity, enhance the customer design and brand identity and loyalty. Only the

design of tightly connected with the customer's lifestyle, from the customer's living environment and social environment to start, give full consideration to the customer's environment when wearing clothing designed to bring customers a more thoughtful, more pleasant experience.

67.5 The Impact of Virtual Reality Technology on the Color Design

Costume design is to wear a lot of shapes and colors around the object into account, in order to eventually achieve the purpose of coordination, coordination with the body color, fashion, people wearing the color is the basis of the desire of the human senses have a strong stimulating effect.

What kind of color is fashionable by the customer's personal behavior is not determined, nor is it out of thin air by a few designers to come up with it by social and economic changes in trends, technological advances, consumer psychology, the color of law, and many other factors and constraints.

The worldwide variety of colors, clothing colors by local, national, time, situation, and many other factors, especially the subtle parts of clothing, different fabric textures, different patterns, not only can show the shape and color of things, can also be demonstrated in the course wearing the perspective of human variation, reflecting the colors of the clothing style of influence.

The costume design, in addition to master the changes of color in, the traditional color is an important source of inspiration for designers. Fashion design is the esthetic needs of the times, the traditional clothing rubbing and in modern design, is to give the traditional color of the new sense of the times, they formed a fashion color. US apparel clothing by color, style, texture, pattern matching and other elements of the annex and fax form, they are organic whole, in which color the most active and most eye catching, the most sensitive. Color is the first between people and media, clothing, color of clothing the soul, so that for any designer, in order to make his clothes full of vigor and vitality of the times, we must master the traditional color, color in grasp to design a garment of the soul.

Designers of virtual reality technology can provide a more realistic background space, in this space, designers can fully experience the diversity of color, test a variety of colors of the product style. At the same time, designers can change at any time the design style and the corresponding color, the texture of the selected material patterns corresponding to the color, style, and fashion design change at any time to experience a variety of colors from different angles, the design style of realistic effects, to find best color match. Virtual reality technology provides a complete set within the system open clothing style library, the human body model libraries, library and design library and other fabrics to give designers more color design material, but also an ever-changing color space to the designers.

67.6 Virtual Reality Technologies on the Impact of Garment Decoration

Decorative techniques from the clothing, the decorative trim and 3D decoration are divided into two planes. Decorative form positioning clothing styles. Clothing image clothing style is a kind of gives the overall impression of symbolic meaning, works in the clothing style reflected the content and form of various elements, which means a work or work group characteristics and personality. Different style of clothing is often used as decoration in the form of different styles to strengthen this position in the minds of consumers. Fabric style, clothing style structure, independent of the clothing accessories and attachments with relative independence, these are 3D style of clothing decorated form.

In the virtual reality environment, in addition to 3D garment design system can generate 3D effect of clothing fabric, but also can directly observe the process of clothing in fashion design influence vividly displayed on the screen effect of wearing apparel and accessories with the results.

Modern fashion design, clothing must fully consider the overall effect on the influence of garments past, designers tend to emphasize the role of spatial composition, many designers to design the space as the space plane constituted neglect of its environment and overall beauty, and there is no attention to the important role of clothing. Original costume design is by 2D to 3D changes in the way to appear cutting the proportion of flat cut, dress only in the 3D imaging technology for mature students, was only valued by the people, to become a complete human body modeling fashion design, dress in different locations in space and space will show a different artistic effects, with the development of virtual reality technology, 3D decoration and more important in fashion design, it is to diversity and practicality, and unmatched in the clothing decorative landscaping features is becoming the new darling of fashion design, drawing people's attention. Clothing is an organic whole, making use of 3D garment design a means of decoration can be more expressive, and virtual reality technology to create this design means more room for development.

67.7 Conclusions

As people's esthetic standards, the requirements are of the growing number of fashion design, clothing is the ultimate effect of wearing, the clothing the only test of success. The traditional design of industrial clothing is mostly done on the 2D and 3D stress of modern fashion design, personalization, and fashion. The emergence of virtual reality technology impact on the fashion design more and more obvious, because the visual virtual reality system, 3D interaction, allows designers and consumers continue to get more interactive process design methods and design philosophy. The virtual reality environment's impact of fashion design, the impact

on the customer experience, the impact on clothing color design, the impact on four apparel are the aspects of virtual reality technology's profound impact on modern fashion design. Practice shows that virtual reality in sports clothing designer, is a kind of profound impact on design tools and design tools, but only to new technology and fashion design and performance art of organic combination, can create new patterns and fashion design style.

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Chapter 68
The Application of Fuzzy Self-Tuning PID Controller in SEHS

Sun Lan

Abstract The existing hybrid fuzzy PID controller does not perform using electric hydraulic servo system application (SEHS). Therefore, when the system parameters change it will require a new adjustment of PID controller variable. Therefore, a hybrid fuzzy and fuzzy self-tuning PID control was put forward. This control scheme was divided into two parts, the fuzzy controller and fuzzy self-tuning PID controller. Fuzzy controller is used to control the output of the system of the values of the system away from target value. We proved the performance of the control scheme through the experiment of the motor speed control SEHS. The experimental results show that the proposed hybrid fuzzy PID controller and fuzzy self-tuning effect is better than that of a hybrid fuzzy and PID controller.

Keywords Fuzzy self-tuning PID controller · Servo electro-hydraulic system · Motor speed control

68.1 Introduction

Application of hydraulic pressure drive reflects the ability of the heavy equipment of the hydraulic loop to pass more power, which is easy to control. It has many outstanding qualities, such as response from lubrication and heat transfer performance precision, relatively large torque fluid, large torque-to-inertia high yield ratio, circulation, relatively high stiffness, and smaller positioning error. Despite the high cost of hydraulic components and power plant, power loss due to the

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leakage, rigid, nonlinear response, and easy to make a mistake of low power operation tend to limit the use of hydraulic pressure drive constitutes a subset of the whole industry drive and is widely used in transportation and manufacturing [1, 2].

Electric hydraulic servo system (SEHS), other, maybe it is the most important system, because it requires the advantages of both the output power of traditional hydraulic system and the rapid response of the power system. However, there are also many challenges to SEHS design. For example, they are highly nonlinear phenomena, such as fluid of compressibility, flow/pressure relationship and dead-band due to internal leakage and hysteresis, there are many uncertain factors, due to the hydraulic system of linear. So, it seems quite difficult for high accuracy servo control using the linear control method [3].

68.2 Controller Designs

There are various types of control systems used in classical control, modern control, and intelligent control system, each of which has been researched and implemented in many industrial fields. The control system method has its advantages and disadvantages. Therefore, the trend is to realize hybrid systems by more than one type of control technology.

68.2.1 PID Controller

The PID control method has been widely used in the industry during the past several decades because of its simplicity. The implementation of PID control, as shown in (1), requires finding suitable values for the gain parameters K_P, K_I, and K_D. To tune these parameters, the model is linearized around different equilibrium points,

$$u(k) = K_p e(k) + K_l \sum_{i=0}^{k} e(i) + K_D[e(k) - e(k-1)] \tag{68.1}$$

where $e(k)$ is the error signal.

68.2.2 Fuzzy Controller

Fuzzy logic control (FLC) has the advantage that it does not require an accurate mathematical model of the process.

Figure 68.4 shows a schematic diagram of a fuzzy control system. Input variables go through the fuzzification interface and are converted into linguistic variables. Then, a database and rule base holding the decision-making logic are used to infer the fuzzy output. Finally, a defuzzification method converts the fuzzy output into a signal to be sent out.

First, the two input variables must be defined in terms of linguistics. The error (e) in velocity is expressed by a number in the interval from −10 to 10. There are five linguistic terms of the error in velocity: negative big (NB), negative (N), zero (Z), positive (P), and positive big (PB). Similarly, the fuzzy set of the error change of the velocity or acceleration (Δe) is presented as {NB, N, Z, P, PB} over the interval from −10 to 10 V. Finally, the fuzzy set of the output signal is presented as {Z, PS, PM, P, PB} over the interval from −5 to 5 V (Figs. 68.1 and 68.2).

The knowledge base for a fuzzy controller consists of a rule base and membership functions. It is reasonable to present these linguistic terms by triangular-shape membership functions, as shown in Fig. 68.3. A fuzzy control knowledge base must be developed that uses the linguistic description of the input variable. In this paper, an expert's experience and knowledge method is used to build a rule base [4]. The rule base consists of a set of linguistic IF–THEN rules containing two antecedences and one consequence, as expressed in the following form:

$$R_{i,j,k} : \text{IF} \quad e = A_i \quad \text{and} \quad \triangle e = B_j \quad \text{THEN} \quad u = C_k \tag{68.2}$$

where $1 \leq i \leq 5$, $1 \leq j \leq 5$, and $1 \leq k \leq 5$, The total number of IF–THEN rules is 25 and is represented in matrix form, called a fuzzy rule matrix.

The decision-making output can be obtained using a max–min fuzzy inference where the crisp output is calculated by the center of gravity (COG) method.

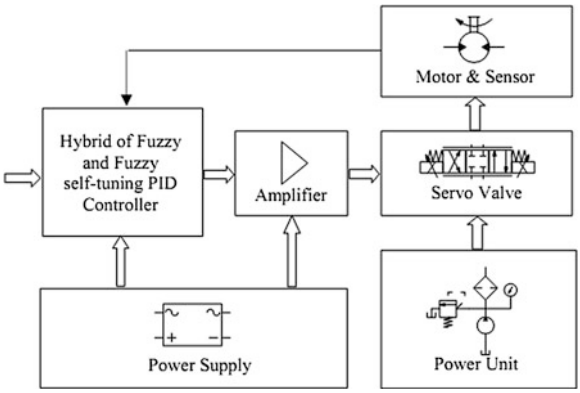

Fig. 68.1 Block diagram of using a hybrid fuzzy and fuzzy self-tuning PID controls the SEHS

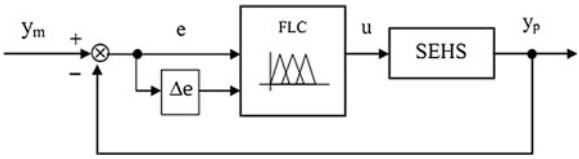

Fig. 68.2 Block diagram of a FLC

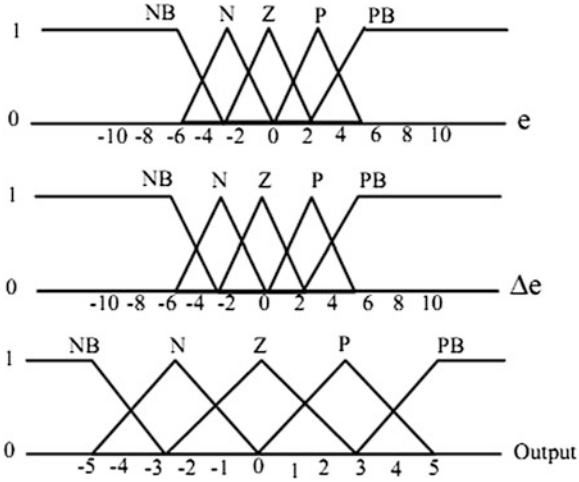

Fig. 68.3 Fuzzy sets of a FLC

68.2.3 Hybrid of Fuzzy and PID Controller

While the traditional PID controller is sensitive to changes, and the fuzzy controller control system parameters don't need precise information system variables to be effective. However, PID controller can better control and reduce the steady-state error of the system. Therefore, a hybrid system is as shown in Fig. 68.4, the development of the advantage of the two, using PID control and fuzzy controller.

Figure 68.4 shows a switch between fuzzy controller and PID controller, in the position of switch will depend on the actual value and the error between the set point values. If the error in the speed of higher than the threshold value of mixed system e0, fuzzy controller, it has a rapidly rising time and a small amount of overshoot, the system to correct speed is set point. When speed below the threshold e0 or close to the set point change, the hybrid system PID control, and has good accuracy rate set near [5, 6].

68.2.4 Fuzzy Self-tuning PID Controller

Fuzzy self-tuning PID controller means that the tree parameters K_P, K_I, and K_D of PID controller are tuned by using fuzzy tuner [4]. The coefficients of the

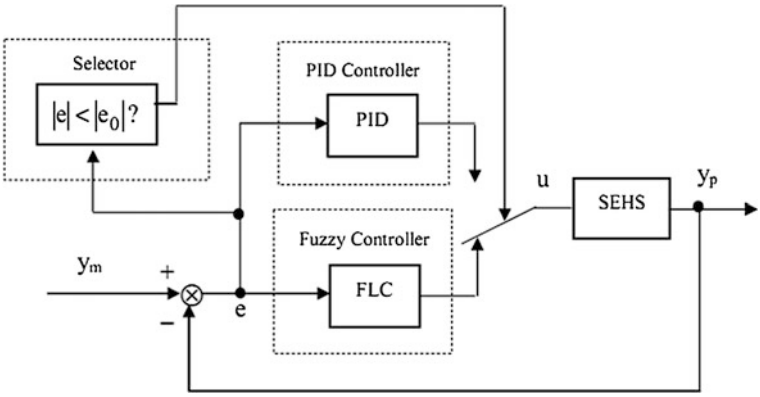

Fig. 68.4 Block diagram of a hybrid fuzzy PID

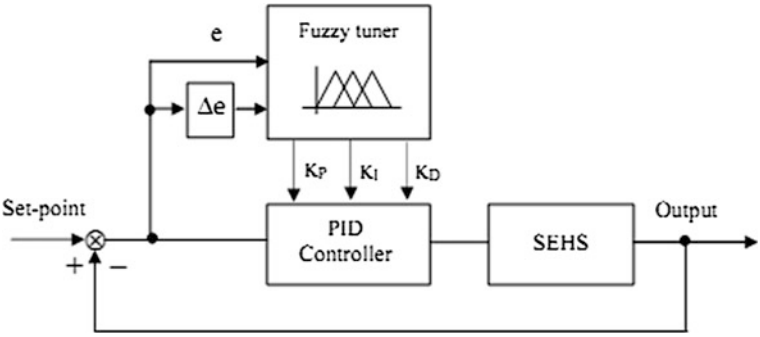

Fig. 68.5 Block diagram of a fuzzy self-tuning PID controller

conventional PID controller are not often property tuned for the nonlinear plant with unpredictable parameter variations. Hence, it is necessary to automatically tune the PID parameters. The structure of the fuzzy self-tuning PID controller is shown in Fig. 68.5 where e is the error between desired velocity set point and the output, eΔ is the derivation of error. The PID parameters are tuned by using fuzzy tuner, which provide a nonlinear mapping from e and eΔ of error to PID parameters.

Regarding to the fuzzy structure, there are two inputs to fuzzy inference: e and eΔ, and there outputs for each PID controller parameter K'_P, K'_I, and K'_D respectively. Mamdani model is applied as structure of fuzzy inference with some modification to obtain the optimum value for K_P, K_I, and K_D. Suppose the variable ranges of the parameters of PID controller are $[K_{Pmin}, K_{Pmax}]$, $[K_{Imin}, K_{Imax}]$, and $[K_{Dmin}, K_{Dmax}]$ respectively. The range of each parameters was determined based on the experimental on PID controls the SEHS. The range of each parameters are, $K_P \in [0.5, 1.5]$, $K_I \in [0.1, 1]$, and $K_D \in [0.001, 0.01]$. Therefore, they can be calibrated over the interval [0,1] as follows:

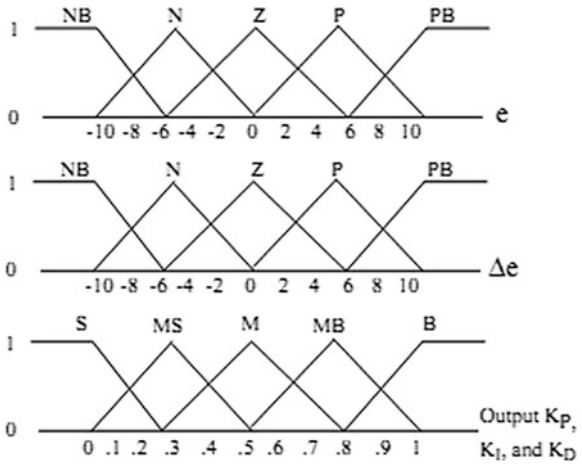

Fig. 68.6 Fuzzy sets of fuzzy tuner

$$K'_P = \frac{K_P - K_{P\min}}{K_{P\max} - K_{P\min}} = \frac{K_P - 0.5}{1.5 - 0.5}, K_P = K'_P + 0.5 \tag{68.3}$$

$$K'_I = \frac{K_I - K_{I\min}}{K_{I\max} - K_{I\min}} = \frac{K_I - 0.1}{1.0 - 0.1}, K_I = 0.9K'_I + 0.1 \tag{68.4}$$

$$K'_D = \frac{K_D - K_{D\min}}{K_{D\max} - K_{D\min}} = \frac{K_D - 0.001}{0.01 - 0.001}, K_D = 0.009K'_D + 0.001 \tag{68.5}$$

The membership functions of these inputs fuzzy sets are shown in Fig. 68.6. The linguistic variable levels are assigned as: negative big (NB), negative (N), zero (Z), positive (P), and positive big (PB). Similarly, the fuzzy set of the error change of the velocity or acceleration (Δe) is presented as {NB, N, Z, P, PB}. Fig. 68.7.

68.3 Experimental Results

The effectiveness of the proposed hybrid of fuzzy and fuzzy-tune PID controller is evaluated experimentally with the SEHS and is compared with that of the hybrid fuzzy PID controller which uses the nominal values of the gains obtained by experiment. The control algorithms described in section IV of topics A, B, C, D, and E were hybridized and applied to the SEHS using LabVIEW program as the development platform and shown in Fig. 68.8.

The proposed hybrid of fuzzy and fuzzy self-tuning PID controller is evaluated experimentally with the motor speed control of SEHS and is compared with that of the conventional of a hybrid of fuzzy and PID controller. For the first experiment to observe the response of the SEHS control output of both the controllers, it is as shown in Figs. 68.9 and 68.10, respectively.

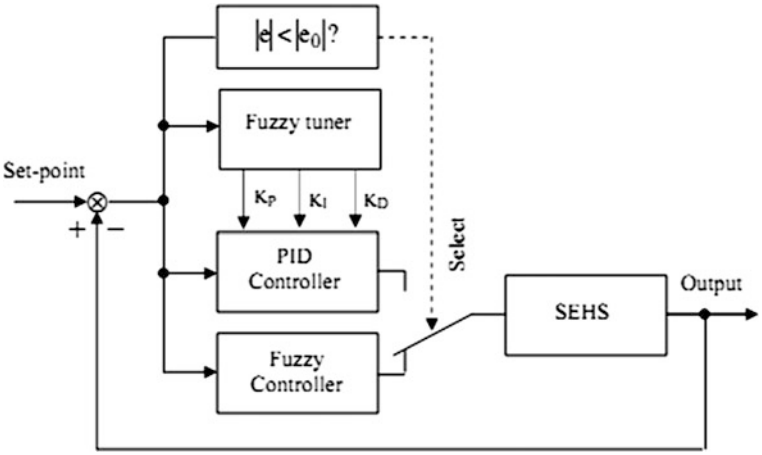

Fig. 68.7 Block diagram of a hybrid of fuzzy and fuzzy self-tuning PID

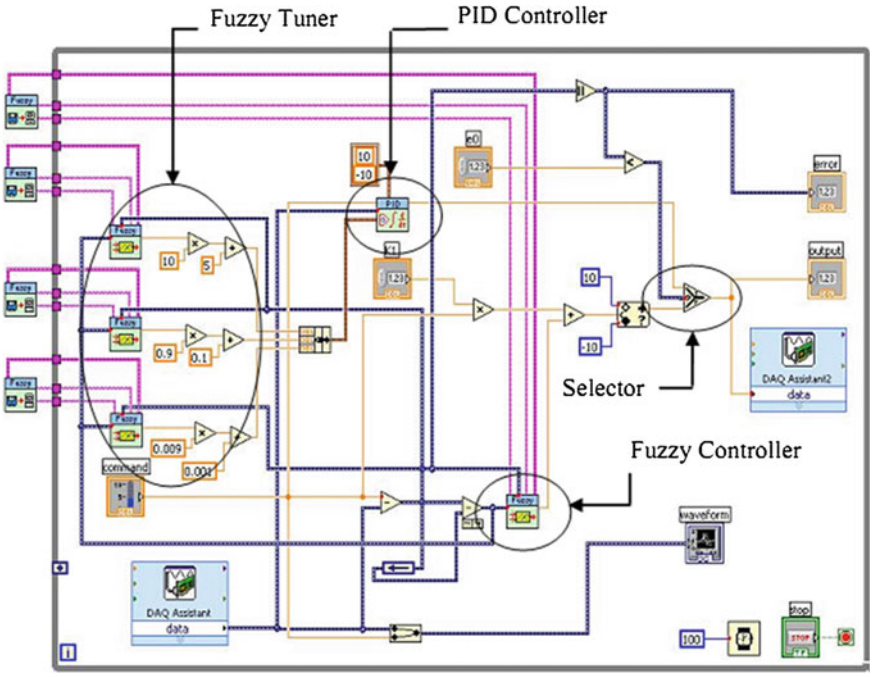

Fig. 68.8 The control algorithms are developed by LabVIEW program

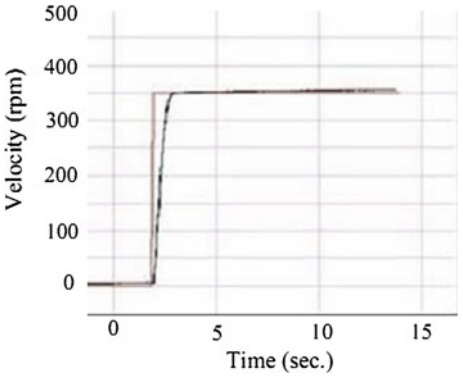

Fig. 68.9 Output responses of a conventional controller

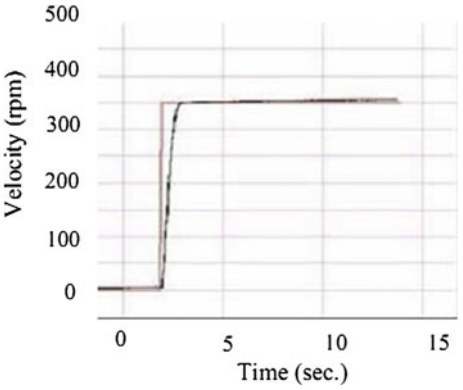

Fig. 68.10 Output responses of a proposed controller

68.4 Conclusion

The purpose of this study is to put forward the hybrid fuzzy and fuzzy self-tuning PID controller SEHS motor speed control. This control scheme was divided into two parts, the fuzzy controller and fuzzy self-tuning PID controller. Fuzzy controller is used to control the output of the system of the values of the system away from target value.

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Part VII
Mathematics and Computation

Chapter 69
Research of University Financial Risk Early Warning Mechanism Based on Hierarchical Fuzzy Method

Jun Zheng, Benluo Xiao, Guangbiao Sun and Xiaosi Xu

Abstract Despite the haze of financial crisis was dispersing gradually; the side impact on the world economy is not dispersing as well. In the period of financial crisis, with the rapid development of higher educational cause and the growing scale of the college entrance, many colleges have been on debt in running schools on a massive scale, the new posture of the financial management have come into sight, the financial risk begins to take shape. If our colleges want to survive, develop, and expand, we must on our guard effectively dissolve the financial risk. At present, it is the biggest theoretical and practical mechanism in colleges and universities. Based on Fuzzy-AHP method, evaluation college financial warning mechanism, setting the quantitative indicators, analyzing and evaluating whether it is reasonable for the use of the college funding or not, and the level of the financial management and the real financial situation, revealing the hidden problems in advance, they can forecast the potential financial risk and the joint liability risk, and also provide a way of identifying risks to the financial management in colleges and universities.

Keywords Fuzzy-AHP · High school financial risk · Early-warning mechanism · Evaluation

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69.1 Introduction

At present, in the background of the international financial crisis is still extending and going further and the world economy goes downhill, our colleges and universities develop extraordinary and on debt in running schools on a large scale, the rapid expansion of colleges and universities and the fierce competition of the market, they all lead to greater financial risk for the colleges and universities such as financing. In a long time, in terms of financial management especially in risk management, our colleges and universities still have some weak links that beyond ignore [1]. The issue is more prominent and urgent for the expansive colleges and universities. How to understand and grasp the financial risk in the process of University financial operation timely, accurately, reliably; and also study on financial risk in universities and the countermeasures; we should from the effects of financial crises on the financial risks of universities start with the transmission mechanism, and then construct the financial risk early-warning mechanisms, they are the important prerequisite in the positive and effective responses to the financial crisis [2]. No cross, no crown. We firmly believe that it will be the sunny "spring" to survive the cold "winter".

69.2 Establishing a Wide Range of Financial Early-Warning Index System

69.2.1 Combine the Qualitative with the Quantitative Index Analysis

The most critical is to select the high sensitivity key warning index in higher colleges financial risk early-warning index system, so that early-warning index system to reflect the situation comprehensive, truly of financial risk faced by colleges and universities [3]. Through quantitative analysis and qualitative analysis solvency in indicator of the method of combining debt paying ability, with the risk liability ratio judge college fund, the greater the risk of index level to meet or exceed the total assets of income the performance index of financial risk of financial risk early-warning on the asset-liability ratio. As shown in Table 69.1.

Table 69.1 The comparison of advantages and disadvantages between qualitative and quantitative evaluation methods

Items	Advantages	Disadvantages
Qualitative evaluation method	Easy to understand and implement Easy to reach a consensus	Great input Strong subjective Time consuming
Quantitative evaluation method	High accuracy	Heavy workload Complex calculation Strong professional

Early-warning indicators and quantitative analysis is mainly design, a set of school funds through financial risk index evaluation solvency system, to evaluate the financial liability ratio of financial risk early warning. According to the character of financial activities in higher school, the system generally can be divided into five categories: solvency ability. Taking into account the main source of financial risk is liability, so the system is to give priority to solvency ability index, operational performance indicators supplement, profitability indicators, development potential, and internal control is added. In the selection of specific targets, indicators should complement but not to repeat, and reflect the college's financial situation as comprehensive as possible [4].

69.2.2 To Make the Critical Value

In determining the financial risk pre-warning index, its critical value must be clear. Because of the geographical location of universities, their own operations and future development of the camp of the orientation is different, the critical value of the measurement is also different. Generally speaking, the average of the industry in recent 3 years (or the highest and the lowest in nearly 3 years) as a critical value, have become the warning index of the watershed. Once the college financial indexes reach critical value, it shows that the risk in the financial management of colleges and universities need the attention. However the warning critical value is not absolute standard, college can combine with the actual development of itself and make an appropriate increase or reduce on the basis of reference value [5].

69.2.3 The Establishment of Data Analysis Model

Recently, the model of data analysis model includes: Single variable warning, Multivariate linear discriminant analysis, Multivariate probit regression analysis, Multivariate logistic regression analysis, Time series analysis, and so on. The colleges and universities should carry out the modeling options according to the actual situation, and the commonly used model is multivariate linear discriminant analysis model. This model is to build multivariate linear discriminant equations to improve the accuracy of the prediction by the means of statistic. One of the most representatives is Z value (Z-score) model which is found by Professor Altman in American New York University [6].

The model is used for the value (Z value) which is weighed through summary of the five kinds of financial index as a criterion to predict the possible occurrence of the financial crisis. The formula is:

$$Z = b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 = \sum b_iX_i \tag{69.1}$$

In the formula, Z value is the total discrimination branch, bi is the weighs, which is the value degree of independent variable Xi through the identify of multiple regression analysis; Xi is five ratios which is viewed as the variability of the model, of these, X_1-working capital/total assets; X_2-retained earnings/total assets; X_3-EBIT/total assets; X_4-owner's equity market value/total debt; X_5-income/total assets [7].

Professor Altman established the discriminant model based on the comprehensive analysis of the relationship of these variabilities and the view of the correctness of the variability warning:

$$Z = 0.717X_1 + 0.847X_2 + 3.11X_3 + 0.42X_4 + 0.998X_5 \tag{69.2}$$

Z is the discriminant function.

Research showed that: the Z value is inversely proportional to the possibility of financial crisis. The smaller is Z value, the bigger is the possibility of financial crisis; the bigger is Z value, the smaller is the possibility of financial crisis. And Z value is more than 2.9 means the financial condition (Horizontal axis value (3); when Z value is lower than 1.2, the financial is worried (Horizontal axis value (1); when Z value is between 1.2 and 2.9 which belong to the "grey area", the financial is instable (Horizontal axis value 2). The Z-score of the discriminant function diagram is as follows in Fig. 69.1.

69.3 The Analysis of the Evaluation Results

69.3.1 Fuzzy Evaluation Method

The fuzzy evaluation method is used for multi-objective decision, one of the basic methods of fuzzy system analysis. Under the fuzzy environment, the fuzzy evaluation method taking account of various factors influence, will not quantitative factors quantified, comprehensive decision-making judgment. The fuzzy evaluation method can effectively deal with the fuzzy which met in the evaluation process, as

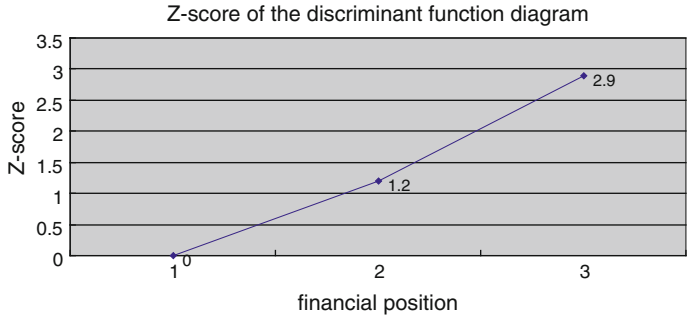

Fig. 69.1 The Z-score of the discriminant function diagram

well as by the subjective preferences of the people themselves. So we can use level fuzzy analysis evaluation to the financial risk prewarning system. As shown in Fig. 69.2.

Analytical hierarchy fuzzy analysis evaluation to the financial risk early warning system, the second rule layer using analytic hierarchy process, for the third layer because involves many factors, the complex relationship, the fuzzy evaluation method for the calculation of risk value. The specific calculation process is described below [8].

The first step: Division of fuzzy evaluation factors, establish the risk assessment of each factors fuzzy evaluation factors set U, $U = \{U_l, U_2, \ldots, U_n\}$, n is for the number of evaluation factors.

The second step: Specify the evaluation factors set, use its can select the review of the corresponding level we construct fuzzy evaluation set, $V = \{v_1, v_2, \ldots, v_i\}$. $i = 1, 2, t, t$ is the number of upper factors. During the risk evolution, v is the reviews collection of the risk level, which means the risk level from low to high reviews, including "very low", "low", "low", "medium", "high", "high", "very high" etc.

The third step: Set weight of comments collection, Comments in the fuzzy set V of the influence of the comments judge thing is different, set the collection of weight comments for W, $W = \{w_1, W_2, \ldots, W_i) \in F(V)$, of which the first I Wi said V the weight of a comment and meet the Wi quartile 0 and $\sum W = 1$ the two attributes.

The forth step: establish the fuzzy relation matrix R, According to experts given to each of the factors of the comments, structural fuzzy mapping f: U_i-$f(U_i) = (r_1, r_2, \ldots r_m) \in f(V)$, mapping f said factors of Ui reviews focus on all comments the support degree. Through the above process available to V Ui nationalities Vector of degrees.

$$R = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ r_{m1} & r_{m2} & \cdots & r_{mn} \end{bmatrix} \tag{69.3}$$

The fifth step: Computing hierarchy fuzzy evaluation results, the fuzzy evaluation results are W combined with R_1. Writing: E = WRT.

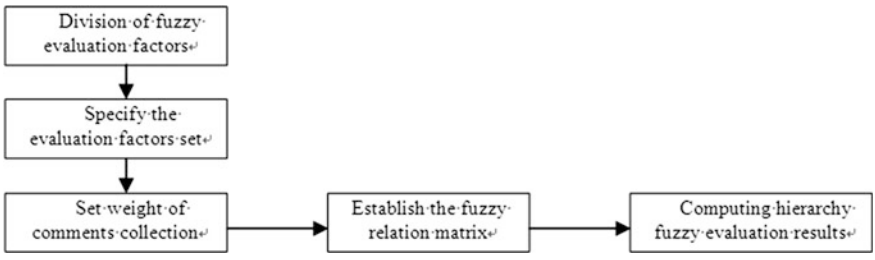

Fig. 69.2 Fuzzy evaluation method flow chart

Synthetic operation can be the maximum—the most small train = -(one Sunday afternoon, ∨) calculation method is compared with Wi Rij take the maximum, again from the results take a minimum, weighted average type enables delta = (•, ⊕) calculation method is multiplied with $W_i R_{ij}$ again we will get results together sum is adopted in this paper, the weighted average type. Finally the E each factor normalization, the last of the risk assessment results, including E is representative of the last of the comprehensive evaluation results nationalities.

$$R^T = \begin{bmatrix} r_{11} & r_{21} & \cdots & r_{n1} \\ r_{12} & r_{22} & \cdots & r_{n2} \\ \vdots & \vdots & \vdots & \vdots \\ r_{1m} & r_{2m} & \cdots & r_{nm} \end{bmatrix} \tag{69.4}$$

69.3.2 Construction Delivery Class Structure

Through a description of financial risk early-warning system in colleges and universities, and detailed knowledge of the system, now University financial risk early-warning system for hierarchical refinement, structure handed class structure. According to selected colleges and universities financial risk index, constructed three handed class times: first floor (target) x: long-term financial risk in universities; the second layer (standard) y: financial risks, operational risks, investment risks; the third layer (program) z: the early warning indicators. The following Table 69.2 is on the University's Division of financial risk early-warning system of pass class.

69.3.3 Calculate Criteria Risk Weights

Relationship between second-tier criteria relative to the target layer is clear, ideal for traditional analytic calculation. First of all on the second floor of various factors in relation to the target layer for 22-comparative judgment, constructed G-C judgement matrix looks like this:

$$G\_C = \begin{bmatrix} 1 & 0.5 & 1.5 \\ 2 & 1 & 4 \\ 0.6667 & 0.25 & 1 \end{bmatrix} \tag{69.5}$$

Find vector w = (0.7892, 1.7323, 0.4785) r, normalization, are criteria "financing", "operational capacity", and "investment" for the target layer sort of weight vector w = (0.263 l, 0.5774, 0.1595) t. CR = 0 consistency ratio. 0089 < 0.1, G-C satisfied with the consistency of judgement matrix set up, so there's no need to amend judgment matrix, you can calculate risk-weighting factor values of third-level programs.

Table 69.2 Colleges financial crisis risk early-warning indicators

Destination layer	Criterion layer	Index layer	Index meaning
Financial crisis early-warning index system	Solvency ability	Liquidity ratio	Ratio of current assets to current liabilities
		Asset-liability ratio	Liabilities as a percentage of total assets
		Cash liabilities ratio	The ratio of net cash flows from operating activities and total liabilities.
		Interest-bearing liabilities ratio	Interest-bearing debt ratio = (short-term borrowings + a maturity of long-term borrowings + long-term borrowings + interest payable)/ total liabilities x one hundred percent
		Long-term liabilities to the total debt ratio	The ratio of long-term liabilities to the total liabilities
		Debt pay rate	Debt pay rate = Total debt within a certain period that can be used to pay off the debt x 100 %
		Available for turnaround month	Available for turnover months = (at the end of the annual total expenditure of the bank deposits + year-end cash + year-end cash loans received + end of bond investments + end of notes receivable—Borrowings at the end of—end of tax payable)/the total annul spending/twelve
	Indicators of operating performance	Income and expenditure ratio	Income and expenditure ratio = the total University income in a certain period/the total University spending in a certain period
		Students tuition income and expenditure ratio	Students tuition income and expenditure ratio = number of tuition fee income/expenditure
		Public expenditure ratio	Public expenditure ratio = public expenditure/business spending
		The growth rate of fixed assets	The growth rate of fixed assets = (total fixed assets-fixed assets in the previous year)/fixed assets in the previous year
		The ratio of ability to raise revenue	The ratio of ability to raise revenue = raised revenue/total revenue
		Receivable and temporary payment of the proportion of total year-end current assets	Receivable and temporary payment of the proportion of total year-end current assets = accounts receivable and temporary payment/(school total assets—fixed assets—intangible assets)

(continued)

Table 69.2 (continued)

Destination layer	Criterion layer	Index layer	Index meaning
	The profitability	The rate of return on equity	EVA/shareholder's rights in the end year*100 %
		The rate of Return on Assets	EVA/average total assets *100 %
		The rate of EVA	EVA/undertaking revenue *100 %
	The potential development	The growth rate of net profit	The rate of net profit increase in the year to the total net profit in the last year
		The increase rate of sales	The rate of the increasing revenue in the year over the total income in the last year
		The growth rate of net assets	The rate of the increasing net assets in the year over the net asset in the last year
	The ability of internal control	Internal Auditors and their independence	Qualitative indicators/expert rating
		The internal control system and its organization	Qualitative indicators/expert rating

Table 69.3 College financial comprehensive weight risk table

Index	Z-Y relative weight	Y-X relative weight	The synthesis weights (Wi)
Z1	0.55	0.5	0.27
Z2	0.25		0.13
Z3	0.08		0.04
Z4	0.12		0.06
Z5	0.4	0.3	0.12
Z6	0.4		0.12
Z7	0.2		0.06
Z8	0.25	0.2	0.05
Z9	0.13		0.03
Z10	0.62		0.12

69.3.4 Calculation Program Risk Weights

Because of many factors of the scheme, and the complex relationship with rule layer, so the method of fuzzy evaluation method for risk assessment. First structure of fuzzy evaluation factors set $U = \{U_1, U_2, U_3, U_4, U_5\}$, rebuild comments set V_i, probability comments $V_i = \{V_1, V_2, V_3, \ldots V_i,\}$. The index weight synthesis can be calculated by the following formula: all the indexes in the general objective of comprehensive weight of each index = relative to rule layer of the index of relative × rule layer relatively general objective weight of the index, and therefore have to index weight as shown in Table 69.3.

69.4 Conclusion

This construction is based on fuzzy comprehensive evaluation of the construction of the college financial crisis warning model, mainly in two aspects have been improved and explored. On one hand, the cash flow and the economy added (EVA) and the other latest factors have been taken into consideration, and establish the financial crisis by early-warning indictors system that the qualitative and quantitative phase combination; on the other hand analysis, the evaluation results by constructing the financial crisis early-warning system matrix model, we can see all indexes in University financial system in the pros and cons status and status through the diagram, so that the colleges and universities can improve these indexes directly. But because of the fuzzy evaluation of the defect itself, as factors such as fuzzy financial choices, with subjective human factors such as weight distribution, to a certain extent it will affect the accuracy of evaluation, the model also needs constant revision and improvement. In addition, the applicability of the model is subject to further testing in the empirical analysis. In conclusion, in face of the financial crisis and the increasingly fierce competition, for the sake of survival and development, the colleges and universities should require the

financial management department be sensitive to the financial risk in colleges and universities, make the decision in time, and cut down the loss of financial risk to ensure the sustained rapid healthy development of universities, to promote the social harmony and stability.

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Chapter 70
Hilbert Algebras in Negative Implicative BCK-Algebras

Qiu-na Zhang, Nan Ji and Li-nan Shi

Abstract The notion of BCK-algebras was formulated first in 1966 by Iséki, Japanese, and Mathematician. This notion is originated from two different ways. One of the motivations is based on set theory; another motivation is from classical and nonclassical propositional calculi. There are many classes of BCK-algebras, for example, subalgebras, bounded BCK-algebras, positive implicative BCK-algebra, implicative BCK-algebra, commutative BCK-algebra, BCK-algebras with condition (S), Griss (and semi-Brouwerian) algebras, quasicommutative BCK-algebras, direct product of BCK-algebras, and so on. The notion of positive implicative BCK-algebras was introduced by Iséki in 1975. In previous studies, scholars gave the definition of the positive implicative BCK-algebras, and its characterizations, and the relationship between other BCK-algebra, before this article I give a notion an ideal of Hilbert Algebras in BCK-algebras, as well as some propositions, so, here I will give a notion of Hilbert algebras in negative implicative BCK-algebras, and some propositions.

Keywords BCK-algebra · Hilbert algebras · Negative implicative BCK-algebra

70.1 Introduction

A BCK-algebra is an important class of logical algebras and was extensively investigated by several researchers [1–4]. The notion of BCK-algebras was formulated in 1966 by Iséki, Japanese, and Mathematician [5, 6]. This notion is

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originated from two different ways. One of the motivations is based on set theory [7–9]. In set theory, there are three most elementary and fundamental operations among various operations including the general analytical operation introduced by Kantorovic and Livenson to make a new set from old sets. Another motivation is from classical and nonclassical propositional calculi [10–12]. There are some systems which contain the only implication functor among the logical functors [13]. There are many classes of BCK-algebras, for example, subalgebras, bounded BCK-algebras, positive implicative BCK-algebra, implicative BCK-algebra, commutative BCK-algebra, BCK-algebras with condition (S), Griss (and semi-Brouwerian) algebras, quasi-commutative BCK-algebras, direct product of BCK-algebras, and so on. They gave a theorem of estimating the number of subalgebras in finite BCK-algebras, and gave a way extending BCK-algebras, and also provided characterizations of commutative, positive, implicative BCK-algebras. Here, I will give a new class of BCK-algebra, which is called Hilbert Algebras in negative implicative BCK-algebras and some propositions.

Definition 1.1 Let X be a subset with a binary operation $*$ and a constant 0. Then $(X; *, 0)$ is called a BCK-algebra if it satisfies the following conditions

BCI-1 $((x * y) * (x * z)) * (z * y) = 0$,
BCI-2 $(x * (x * y)) * y = 0$,
BCI-3 $x * x = 0$,
BCI-4 $x * y = 0$ and $y * x = 0$ imply $x = y$,
BCK-5 $0 * x = 0$

In X we can define a binary operation $\leq$ by $x \leq y$ if and only if $x * y = 0$. Then $(X; *, 0)$ Is called a BCK-algebra if it satisfies the following conditions:

BCI- $1'$ $(x * y) * (x * z) \leq z * y$
BCI- $2'$ $x * (x * y) \leq y$
BCI- $3'$ $x \leq x$
BCI- $4'$ $x \leq y$ and $y \leq x$ imply $x = y$.
BCK- $5'$ $0 \leq x$
BCI- $6'$ $x \leq y$ if and only if $x * y = 0$

For any BCK-algebra $(X; *, 0)$,* and $\leq$ are
Called a BCK-operation and BCK-ordering on X respectively

Theorem 1.1 In a BCK-algebra $(X; *, 0)$, we have the following properties:

(1) $x \leq y$ Implies $z * y \leq z * x$
(2) $x \leq y$ And $y \leq z$ imply $x \leq z$

Theorem 1.2 let $(X; *, 0)$ be a BCK-algebra, then for all x, y, z in X, the following hold:

(1) $x * y \leq z$ Implies $x * z \leq y$
(2) $(x * z) * (y * z) \leq x * y$

(3) $x \leq y$ Implies $x * z \leq y * z$
(4) $x * y \leq x$
(5) $x * 0 = x$

Definition 1.2 A BCK-algebra $(X; *, 0)$ is called to be negative implicative if it satisfies$(z * x) * (z * y) = z * (x * y)$ For all x, y, z in X

Definition 1.3 Suppose H is a nonempty set, $\rightarrow$ is a binary operation on H, $1 \in H$. Then $(H, \rightarrow, 1)$ is Hilbert algebras if it satisfies the following conditions for any x, y, z in H:

$$H_1\ x \rightarrow (y \rightarrow x) = 1;$$
$$H_2\ (x \rightarrow (y \rightarrow z)) \rightarrow ((x \rightarrow y) \rightarrow (x \rightarrow z)) = 1$$
$$H_3 \text{ if } x \rightarrow y = 1 \text{ and } y \rightarrow x = 1, \text{ then } x = y$$

Lemma 1.1 Suppose $(H, \rightarrow, 1)$ is a Hilbert algebras, the following conditions are satisfied for any x, y, z in H:

$$H_4\ x \rightarrow (y \rightarrow z) = (x \rightarrow y) \rightarrow (x \rightarrow z);$$
$$H_5\ x \rightarrow (y \rightarrow z) = y \rightarrow (x \rightarrow z);$$
$$H_6\ (x \rightarrow y) \rightarrow ((y \rightarrow z) \rightarrow (x \rightarrow z)) = 1;$$
$$H_7 x \rightarrow ((x \rightarrow y) \rightarrow y) = 1;$$
$$H_8 x \rightarrow x = 1;$$
$$H_9 1 \rightarrow x = 1.$$

We can find the proof in [1] and [2].

Given a Hilbert algebras $(H, \rightarrow, 1)$, we can define a binary operations*and two binary relations $\prec, \prec'$ on H.

$$x * y = y \rightarrow x, x \prec y \Leftrightarrow x \rightarrow y = 1, x \prec' y \Leftrightarrow x * y = 1 \tag{70.1}$$

Then we know $x \prec' y$ in $(H, *, 1)$ if and only if $y \prec x$ in $(H, \rightarrow, 1)$.*and $\rightarrow$ are two opposite binary operations on H,$\prec$ and $\prec'$ are two opposite order relations on H.

Lemma 1.2 [2] $(H, \rightarrow, 1)$ is a Hilbert algebras if and only if $(H, *, 1)$ is a positive implicative BCK-algebras.

We can find the proof in [2].

70.2 Definition and Propositions

Definition 2.1 A Hilbert algebras $(H, \rightarrow, 1)$ is called to be negative implicative if it satisfies

$(y \to z) \to (x \to z) = (y \to x) \to z$ For all x, y, z in H

Theorem 2.2 In any Hilbert algebras in negative implicative BCK-algebra $(X, \to, 1)$ we have $(z \to x) \to y = (y \to x) \to z$ for all x, y, z in X.

Proof By BCK- 2′ we have $(z \to x) \to z \leq z$, $(y \to x) \to x \leq y$
By theorem 1.4 of [3] we get

$$(y \to x) \to ((z \to x) \to x) = (z \to x) \to y \leq (y \to x) \to z \tag{70.2}$$

$$(z \to x) \to ((y \to x) \to x) \leq (z \to x) \to y \tag{70.3}$$

Obviously $(z \to x) \to y = (y \to x) \to z$ the proof is completed.

Theorem 2.3 Let $(X, \to, 1)$ be a Hilbert algebra in negative implicative BCK-algebra, then the following conditions are equivalent to each other:

(a) X Is negative implicative,
(b) $y \to x = (x \to y) \to x$,
(c) $y \to x = (x \to (x \to y)) \to x$,
(d) $(y \to x) \to x = x$,
(e) $(x \to y) \to ((y \to x) \to x) = (x \to y) \to x$.

Proof (a)⇒(b) By definition 1.2, we have
$y \to x = (x \to x) \to (y \to x) = (x \to y) \to x$, Which is (b).
(b) ⇒ (c)

$$((x \to y) \to x) \to ((x \to (x \to y))) \to x = (x \to (x \to y)) \to (x \to y) = 1$$

$$(((x \to (x \to y))) \to x) \to ((x \to y) \to x) = (x \to y) \to (x \to (x \to y)) = 1,$$

Then $(x \to (x \to y)) \to x = (x \to y) \to x$

By (b) we obtain $y \to x = (x \to (x \to y)) \to x$. (c) Holds
(c) ⇒ (d) Substituting $y \to x$ for y in (c) we get
$(y \to x) \to x = (x \to (x \to (y \to x))) \to x = (x \to 1) \to x = 1 \to x = x$,
which is (d).
(d) ⇒ (e) Right → -multiplying both side of (d) by $x \to y$, we have
$(x \to y) \to ((y \to x) \to x) = (x \to y) \to x$, thus (e) holds.
(e) ⇒ (b) Concerning (e) we get

$$(x \to y) \to ((y \to x) \to x) = (x \to y) \to x \leq y \to x$$

If we substitute $(y \to x) \to x$ for x, and substitute $x \to y$ for y, then we obtain

$$\begin{aligned} (y \to x) &= (((y \to x) \to x) \to (x \to y)) \to ((y \to x) \to x) \\ &\leq (((y \to x) \to x) \to (x \to y)) \to x \leq (x \to y) \to x \end{aligned} \tag{70.4}$$

Table 70.1 *Proofs* Let $X = (0, a, b, 1)$ and $*$ on X be given

$*$	0	a	b	1
0	0	0	0	0
a	a	0	a	0
b	b	b	0	0
1	1	1	1	0

Thus $y \to x = (x \to y) \to x$, which is (b).
(b) $\Rightarrow$ (a) Suppose (b) holds. Then

$$\begin{aligned} &((y \to x) \to z) \to ((y \to z) \to (x \to z)) \\ &= ((y \to x) \to z) \to ((y \to z) \to ((z \to x) \to z)) \\ &= ((y \to x) \to z) \to ((z \to x) \to y) \end{aligned} \tag{70.5}$$

By theorem 2.2 $(z \to x) \to y = (y \to x) \to z$,
Thus $((y \to x) \to z) \to ((z \to x) \to y) = 1$,
Then $((y \to x) \to z) \to ((y \to z) \to (x \to z)) = 1$
Similarly, $((y \to z) \to (x \to z)) \to ((y \to x) \to z)$

$$= ((y \to z) \to ((z \to x) \to z)) \to ((y \to x) \to z)$$

$$= ((z \to x) \to y) \to ((y \to x) \to z)$$

Thus we obtain $(y \to z) \to (x \to z) = (y \to x) \to z$, (a) holds. This finished the proof.

Corollary 1 A positive implicative BCK-algebra is not a negative implicative BCK-algebra Table 70.1.

Then $(X; *, 0)$ is a positive implicative BCK-algebra, but is not a negative implicative BCK-algebra.as

$$(a * 0) * (a * b) = a * a = 0, a * (0 * b) = a * 0 = a, (a * 0) * (a * b) \neq a * (0 * b)$$

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Chapter 71
Study on Optimization of Innovative City Evaluation Index System Based on Mathematical Model

Shujuan Yuan and Li Li

Abstract Innovative city is the product of the city knowledge-based development. This article puts forward the concept model of innovative city to establish evaluation index system of innovative city by introducing the mathematical model of the factor analysis method. Dialysis effects of each link on evaluation results by analyzing the evaluation process of innovative city. Absorbing advantages of various evaluation schemes to draw the most reliable evaluation results, so that the objectivity and fairness of the evaluation can be ensured. Therefore, it can guide policy formulation or adjustment of reality and plays a role of promoting and improving reality.

Keywords Innovative city · Mathematical model · Index system · Factor analysis method

71.1 Theory Research of Innovative City

Innovative city [1] is an important mode in current development of regional innovation; it is also a hot issue both of academic circles and government concerns. Dozens of domestic cities have put forward the strategic goal of building innovative city. Promoting the city of regional research center to innovative city is the future direction of the development of city transformation. The essence of constructing innovative city is the complex city construction system based on the core elements of innovation. The core connotation of innovative city is supported

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by internal factors (main body of innovation, innovation resources, innovation culture, innovation system), achieving the city sustainable development based on the establishment of the city economic growth and transformation of the way of economic growth. Accordingly, innovation city concept model is established.

Innovation city concept model [2] can be summarized with the function expressed as: $D = f(I, G, S)$ D stand for the city innovation level, I, G, S stands for the three elements of city innovation ability, the city economic growth and change of patterns, and city sustainable development. City innovation ability is supported by the main body of innovation, innovation resources, innovation system, and innovation culture, which are also the core elements of innovative city; city economic growth and transformation of economic growth mode and city sustainable development on the basis of transformation of economic growth mode embodies the promotion effect of innovation on the city 's economic and social development, and it is the innovative city's basic function and practice on economic and social dimensions.

71.2 Construction of Evaluation Index System of Innovative City

Both the evaluation and adjustment of construction of innovative city depend on scientific innovative city evaluation index system [3], including three aspects: innovation ability of city knowledge, supporting capacity of city innovation environment, the effect of the city economic and social development on the innovation ability. In order to make the established index system evaluate construction process and development level of innovative city comprehensively, objectively and accurately, providing reference for all levels of government and relevant departments to formulate innovative city strategy goal and development plan and carry out smoothly, establishing the evaluation index system should follow these principles: The Systematic Principle [4]; Operability Principles; Comparability Principle.

71.2.1 Composition of Basic Index

The city knowledge innovation ability index: Knowledge creation and flow [5]: the creation of knowledge and ability to flow is the foundation of innovative cities. We evaluate knowledge creation and flow from aspects of R&D input, R&D professionals, patent level, and achievement. Specific index as follows: X_1: R&D expenditure in GDP ratio (%); X_2: ten thousand people of R&D scientists and engineers (people/ten thousand); X_3: the employment of invention patent grant (item/ten thousand); X_4: R&D activities personnel of scientific articles (article/ten

thousand); X_5: ten thousand people of technology achievements turnover (ten thousand Yuan/ten thousand); X_6: ten thousand people absorb technology achievements amount (Yuan); X_7: real per capita use of foreign capital. Enterprise technology innovation: under the conditions of market economy, the enterprise is the subject of the innovation, we evaluate enterprise technology innovation from the three aspects of the level of input and output efficiency R&D strength of, specific index as follows: X_8: enterprise R&D spending accounts for the proportion of the enterprise sales income (%); X_9: enterprise R&D scientists and engineers the total social R&D scientists and engineers ratio; X_{10}: new sales income of sales income ratio; X_{11}: technology digestion and absorption funds and technology introduced the proportion of funds (%). Infrastructure: infrastructure is the main carrier of city innovation activities going on smoothly, which is also the important factors to flow media. The evaluation index includes: X_{12}: ten thousand international Internet subscribers (households per ten thousand people); X_{13}: family computer penetration rate (set/hundred household); X_{14}: fixed telephone and mobile phone penetration rate (set/hundred people); X_{15}: R&D activities personnel new unit equipment fee (ten thousand Yuan/people); X_{16}: the scientific research and technical services comprehensive new fixed assets accounting for the whole society of new regulations assets ratio (%). (2) The support ability of city innovation environment.

Education culture: education culture is a reflection of the level of the urban innovation environment, embodying the urban education level and the quality of workers height, the main index includes: X_{17}: education expenditure in GDP ratio (%); X_{18}: average fixed number of year by education (years/people); X_{19}: student number in ten thousand people owned high school (people/ten thousand); X_{20}: collection in one hundred people owned library (books/ten thousand). Innovation system: an innovative city construction is guaranteed by system innovation, system innovation are the subject of the government, but the government of all kinds of behavior is difficult to use the exact quantitative index, two indicators of this article choose private enterprises and individual practitioners of all employees ratio, the local finance science and technology of funding local financial expenditure rates, among them the former through the employment in private and individual enterprise employees rate report of the nonpublic enterprises city system construction of encouraging degree, indirectly reflect city innovation vigor, the latter part of the government to the innovation direct support. The main index includes; X_{21}: Private enterprises and individual practitioners of all employees ratio (%); X_{22}: place of the finance and accounting for funding local financial expenditure ratio (%) (3) The city economic and social development for innovative support ability Economic growth levels: the city economic growth levels directly reflects the city's economic strength and the people's living standards, developed city economy is the basic and important sign of innovative city, specific indicators as follows: X_{23}: per capita GDP (Yuan/people); X_{24}: per capita GDP growth (%). The industrial structure optimization: the city industry structure transfers to high technology industry and the knowledge industry and modern service industry as the leading industry structure, promoting industrial structure development

fundamentals, the index reflecting the industrial structure optimization as follows: X_{25}: manufacturing employment population to total employment population ratio (%); X_{26}: the added value of the tertiary industry to GDP Ratio (%); X_{27}: high and new technology industry sector accounted for the ratio of industrial added value (%)); X_{28}: high technology export products in the ratio of total export products; X_{29}: knowledge service industry employment population accounts for the third industry employment population ratio (%). Economic growth mode transformation: for an innovative city, economic growth mode must be turned to rely more on intensive economic growth of science and technology innovation, the urban labor productivity, return on investment, output energy consumption rate should be reflected somewhat, the following measures changes of economic growth mode: X_{30}: the employment of labor productivity benevolence RMB ten thousand/person); X_{31}: one hundred million Yuan investment is one hundred million Yuan/new GDP(one hundred million Yuan); X_{32}: comprehensive energy output (Yuan/kgOf standard coal). X_{34}: The urban environment improvement: good natural ecological environment can attract more innovative talents, improving urban environment is important standard of measuring the degree of innovative city construction. Specific index as follows; X_{33}: air quality index; X_{35}: per capita public green area (square meters).

The above index system can evaluate an innovative city development level comprehensively from the economic, social and environmental aspects to a certain extent, reflecting the construction and development of an innovative city.

71.3 Comprehensive Evaluation Method of Innovative City Evaluation Index System

An innovative city construction evaluation is a comprehensive multiple evaluation [6], there are many selections of evaluation methods. But in general it can be classified into two categories: the subjective values, the method and objective method, the former is used mostly to the related areas of professional personage comprehensive consulting score, such as fuzzy comprehensive evaluation method; The latter is to determine the economic weight each index based on the relationship between the indexes variation or, through the measurement of the processing method, such as factor analysis method. The factor analysis and the fuzzy comprehensive evaluation method are introduced briefly.

Factor Analysis Method [7]: Factor analysis is a common method of multivariate statistical analysis, the basic idea is to seek the basic structure of the data through the study of the relationship between internal quantity, and the basic data structure is showed by a few known unobservable variables common factor. And these common factors can reflect the original main information to simplify data structure for the convenience of the research. We extract several major common factors from variable reflecting characteristics to reduce the original variables, the

amount of information that contains less relative loss, and then analyze the influence of the construction of an innovative city main factor. The original variables set for:$x_1, x_2, \ldots x_p$ main component is $z_1, z_2, \ldots z_m$. Then each factor and the relationship between the original variables can be expressed as:

$$\begin{aligned} x_1 &= b_{11}z_1 + b_{12}z_2 + b_{13}z_3 + \cdots + b_{1m}z_m + e_1 \\ x_2 &= b_{21}z_1 + b_{22}z_2 + b_{23}z_3 + \cdots + b_{2m}z_m + e_2 \quad \cdots \quad \cdots \quad \cdots \\ x_p &= b_{p1}z_1 + b_{p2}z_2 + b_{p3}z_3 + \cdots + b_{pm}z_m + e_p \end{aligned} \tag{71.1}$$

The matrix form is: $X = BZ + E$ Its value for the original X variable vector [8], B for factor loading coefficient matrix, Z is common factor vector, E for residual vector. Common factor $z_1, z_2, \ldots z_m$ is not related, with orthogonal model. Through the factor analysis, we can work out common factor loading coefficient and the residual. A complete factor solution should include two aspects of factor model and factor structure. Factor structure refers to reflect the index and factor relationship through the correlation coefficient; Factor model regression equation is the form of the index $x_1, x_2, \ldots x_p$ expressed as a factor $z_1, z_2, \ldots z_m$ for the linear combination. The specific procedure is as follows:

(1) Standardization transformation of the original data

$x'_{ij} = \frac{x_{ij} - \overline{x_i}}{\sqrt{s_i}} (i = 1, 2 \cdots m; j = 1, 2 \cdots n)$ In which $\overline{x_i} = \frac{1}{n}\sum_{j=1}^{n} x_{ij}$ $s_i = \frac{1}{n-1}\sum_{j=1}^{n} (x_{ij} - \overline{x_i})^2$

After standardization, the average value of x_{ij} is 0, the variance of 1, related matrix $R = xx^T$, assume Matrix after standardization is still x (2) For matrix R eigenvalue and eigenvector.

According to secular equation $|R - \lambda I| = 0$ get the eigenvector of matrix R. Matrix B and eigenvalue $\lambda_1 \geq \lambda_2 \geq \cdots \geq \lambda_p \geq 0$, and make $Z = B^T X$, Z is the main factor matrix.

(3) Establish a factor model: In the factor analysis, B, Z will be divided into two parts generally: $B = [B_1, B_2]$ $m \leq p$ $Z = \left[\overline{Z_1, Z_2}\right]$ $m \leq p$, Factor model [9] for $x = BZ = B_1Z_1 + B_2Z_2 = B_1Z_1 + \varepsilon$

Among them, B_1 for factor loading matrix Z_1 is main factor, ε for special factor. Factor models are as follows:

$$\begin{aligned} x_1 &= b_{11}z_1 + b_{12}z_2 + b_{13}z_3 + \cdots + b_{1m}z_m + \varepsilon_1, \\ x_2 &= b_{21}z_1 + b_{22}z_2 + b_{23}z_3 + \cdots + b_{2m}z_m + \varepsilon_2 \cdots \quad \cdots \quad \cdots, \\ x_p &= b_{p1}z_1 + b_{p2}z_2 + b_{p3}z_3 + \cdots + b_{pm}z_m + \varepsilon_p \end{aligned} \tag{71.2}$$

$z_1, z_2, \cdots z_m$ as the main factor, reflects the unobservable potential variable of the information respectively; b_{ij} for factor loading coefficient, is the load of the i index in the J factor, if certain index has a big effect in certain factor, the factor of load coefficient is big, and vice versa; ε_i for special factors, practical modeling can be ignored.

(4) Make sure factor and the cumulative contribution

The contribution of i factor is $d_i = \frac{\lambda_i}{\sum_{i=1}^{m} \lambda_i}$, contribution rate gives percentage of each factor variation degree. The greater the contribution rate, this factor is relatively more critical. Usually, the accumulation of contribution $(\frac{\sum_{i=1}^{m} \lambda_i}{\sum_{i=1}^{p} \lambda_i}) \geq 1$ is the basis of a factor disjunctive choice. (5) Factor loading matrix transformation in the specific analysis, and factors must can be explained, the factor explanation is by the factor matrix. In order to get more explicit analysis result, we need to coordinate by rotation, and that every factor loading in the new coordinate system that can be listed into 0 or 1 polarization, also contain by line polarization. There are four ways in the extensive use of statistical software SPSS listed in the rotation, respectively is: variance of the largest method, average variance orthogonal method, the four largest orthogonal method, oblique rotation, though the results would change with the different methods, to have a clear credible analysis result is the ultimate goal. (6) The total score of calculation value through the rotation and computation, we can get the ideal factor loading matrix B, and the factor score coefficient matrix A. The evaluation index score of each sample of can use the following formula: $Z_i = \sum_{i=1}^{m} z_i d_i = \sum_{i=1}^{m} \sum_{j=1}^{p} d_i a_{ij} x_{ij}$ d_i is the factor contribution rate; Z_i is the factor score: a_{ij} is the factor score coefficient, calculation by the factor loading matrix B_1 after rotation; x_{ij} is the index value after standardization Analysis method is to transfer index system basic message to the comprehensive factors, and then process with a few mathematical methods according to the comprehensive factors, the calculation of total score, and then evaluation, the size of the transfer information is according to the actual problems of different precision requirements through the control factor of the realization of the number [10].

To evaluate by factor analysis method, not only can we estimate the evaluation result precisely and error small or large, but also we can be sure that the factor mainly reflect what aspect, and the change of the index at all levels are mainly affected by which potential variables, to get the main factors affecting sample evaluation index and further improvement approaches.

71.4 Conclusions

Many cities choose innovative city as the future direction. In this article the index system are set up on the basis of the accurate connotation of an innovative city and two kinds of evaluation method are given to receive the reasonable evaluation results.

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Chapter 72
Some New Results for the Tree Indexed Markov Chains

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Abstract The strong limit theorem is one of the central questions for studying in the international Probability theory. The purpose of this paper is to give a strong limit theorem for functions of two-ordered Markov chains indexed by a kind of nonhomogeneous tree.

Keywords Tree-indexed markov chains · Strong limit theorem · Martingale difference sequence

72.1 Introduction

Let T be an infinite tree, $x \neq y$ be two different vertices of the tree T, there will be only one path between x and y: $x = z_1, z_2, \cdots, z_n = y$, where $z_1, z_2, \cdots, z_n$ are different vertices and z_i is next to z_{i+1}. So the distance between x and y is $n - 1$.

Definition 1 Let T be an infinite tree, $\{N_n, n \geq 1\}$ be a countable space, where N_n is a positive integer. If every vertex from level $n(n \geq 0)$ has N_{n+1} sons, the tree T is a *Bethe* tree in broad sense or a *Cayley* tree in broad sense. Particularly, let $N = \{0, 1, 2, \cdots\}$, $m(m \geq 2)$ be an integer, we divide N into several sets as follow:

$$
\begin{aligned}
(0) &= \{0, m, 2m, \cdots\cdots\} \\
(1) &= \{1, m+1, 2m+1, \cdots\cdots\} \\
&\cdots\cdots \\
(m-1) &= \{m-1, 2m-1, 3m-1, \cdots\cdots\}
\end{aligned}
$$

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When $n \in (i)$, we let $N_{n+1} = \alpha_i$ (α_i is a positive integer and not all of them is (1). $i = 0, 1, 2, \cdots, m-1$. In this way, we get a particular nonhomogeneous tree $T_{\alpha_0, \alpha_1, \cdots, \alpha_{m-1}}$.

In this paper, $T_{\alpha_0, \alpha_1, \cdots, \alpha_{m-1}}$ is denoted by T. We denote L_n be the set of all vertices on level $n (n \geq 0)$, $L_0 = \{0\}$, T_n be the subtree of T containing the vertices from level 0 to level n. We denote $|B|$ be the number of the vertices of the subtree B, $X^B = \{X_t, t \in B\}$, and $r(\sigma)$ be all of sons of the vertex σ.

Definition 2 Let $G = \{0, 1, 2, \cdots\}$ be a countable state space, $\{X_t, t \in T\}$ be a collection of G-valued random variables defined on the probability space (Ω, F, P). Let

$$p = \left\{p\left(x^{N_1+1}\right), x^{N_1+1} \in G^{N_1+1}\right\} \tag{72.1}$$

Be a distribution on G^{N_1+1}, and

$$P_n = (P_n(z|y, x)) \, \forall x, y, z \in G, \, n \geq 2 \tag{72.2}$$

Be transition probability on G^3 and satisfies $\sum_{z \in G} P_n(z|y, x) = 1$ ($\forall n$, $\forall x, y \in G$). If for any two vertices $\sigma, \tau \in T$, $\sigma \in L_n$,

$$\begin{aligned} &P(X_\sigma = z | X_{\overline{\sigma}} = y, X_{\overline{\overline{\sigma}}} = x \quad \text{and} \quad X_\tau, \text{ satisfying} \\ &\sigma \wedge \tau \leq \overline{\overline{\sigma}}) = P(X_\sigma = z | X_{\overline{\sigma}} = y, X_{\overline{\overline{\sigma}}} = x, \, = P_n(z|y, x), \, \forall x, y, z \in G, \end{aligned} \tag{72.3}$$

and

$$P\left(X^{T_1} = x^{N_1+1}\right) = p\left(x^{N_1+1}\right), \forall x^{N_1+1} \in G^{N_1+1} \tag{72.4}$$

$\{X_t, t \in T\}$ Will be called G-valued Markov chains of order two indexed by a nonhomogeneous tree with distribution (1) and transition probability (2), or called tree-indexed Markov chains of order two.

If for all $n (n \geq 2)$.

$$P_n = P = (P(z|y, x)) \, \forall x, y, z \in G$$

$\{X_t, t \in T\}$ will be called G-valued homogeneous Markov chains of order two indexed by a nonhomogeneous tree.

The strong limit theorem is one of the central questions for studying in the international Probability theory (c.f. [1–10]). The purpose of this paper is to give a strong limit theorem for functions of two-ordered Markov chains indexed by a kind of nonhomogeneous tree.

72.2 Main Results

Lemma Let $\{X_n, F_n, n \geq 0\}$ be a martingale difference sequence, let $S_n = \sum_{k=1}^{n} X_k$, then S_n converges $a.e.\omega \in \{\omega : \sum_{k=1}^{n} E[X_k^2 | F_{k-1}] < \infty\}$.

Theorem 1 Let $\{X_t, t \in T\}$ be a nonhomogeneous Markov chain of order two indexed by T with initial distribution (72.1) and transition probability (72.2), $F_n = \sigma(X^{T_n})$, let $\{a_n, n \geq 0\}$ be a nondecrease sequence of positive and F_{n-1}-measurable random variables, $f_n(x, y, z)$ be functions defined on G^3, $\{\phi_n(x), n \geq 1\}$ be a sequence of nonnegative measurable even functions defined on R, and when

$$|x| \uparrow \phi_n(x)/x \uparrow, \phi_n(x)/x^2 \downarrow \tag{72.5}$$

Let

$$A = \left\{ \omega : \frac{\sum_{s=0}^{\infty} \sum_{\xi_s \in L_s} \sum_{\xi_{s+1} \in r(\xi_s)} \sum_{\xi_{s+2} \in r(\xi_{s+1})} E\left[\phi_{s+2}(f_{s+2}(X_{\xi_s}, X_{\xi_{s+1}}, X_{\xi_{s+2}}) | X_{\xi_{s+1}}, X_{\xi_s}\right]}{\phi_{s+2}(a_{s+2})} < \infty \right\} \tag{72.6}$$

Then

$$\sum_{s=0}^{\infty} \sum_{\xi_s \in L_s} \sum_{\xi_{s+1} \in r(\xi_s)} \sum_{\xi_{s+2} \in r(\xi_{s+1})} a_{s+2}^{-1} \left\{ f_{s+2}(X_{\xi_s}, X_{\xi_{s+1}}, X_{\xi_{s+2}}) - E\left[f_{s+2}(X_{\xi_s}, X_{\xi_{s+1}}, X_{\xi_{s+2}}) | X_{\xi_{s+1}}, X_{\xi_s}\right] \right\} \tag{72.7}$$

Converges $a.e.\omega \in A$
Let

$$B = \left\{ \omega : \lim_n a_n = \infty \right\} \cap A \tag{72.8}$$

Then

$$\lim_{n \to \infty} \frac{1}{a_n} \sum_{s=0}^{n-2} \sum_{\xi_s \in L_s} \sum_{\xi_{s+1} \in r(\xi_s)} \sum_{\xi_{s+2} \in r(\xi_{s+1})} \left\{ f_{s+2}(X_{\xi_s}, X_{\xi_{s+1}}, X_{\xi_{s+2}}) - E\left[f_{s+2}(X_{\xi_s}, X_{\xi_{s+1}}, X_{\xi_{s+2}}) | X_{\xi_{s+1}}, X_{\xi_s}\right] \right\} = 0 \quad a.e.\omega \in B \tag{72.9}$$

Proof when $s \geq 0$, we let

$$f^*_{s+2}(X_{\xi_s}, X_{\xi_{s+1}}, X_{\xi_{s+2}}) = f_{s+2}(X_{\xi_s}, X_{\xi_{s+1}}, X_{\xi_{s+2}}) \\ I\big(|f_{s+2}(X_{\xi_s}, X_{\xi_{s+1}}, X_{\xi_{s+2}})| \leq a_{s+2}\big).$$

Denote $Z_{s+2} = \phi_{s+2}(f_{s+2}(X_{\xi_s}, X_{\xi_{s+1}}, X_{\xi_{s+2}}))/\phi_{s+2}(a_{s+2})$.
Because $\phi_{s+2}(a_{s+2})$ is F_{s+1}-measurable and the Markov property, we have

$$E[Z_{s+2}|F_{s+1}] = E\big[\phi_{s+2}(f_{s+2}(X_{\xi_s}, X_{\xi_{s+1}}, X_{\xi_{s+2}})|X_{\xi_{s+1}}, X_{\xi_s}\big]/\phi_{s+2}(a_{s+2}) \tag{72.10}$$

Let k be a positive integer and

$$A_k = \left\{ \omega : \sum_{s=0}^{\infty} \sum_{\xi_s \in L_s} \sum_{\xi_{s+1} \in r(\xi_s)} \sum_{\xi_{s+2} \in r(\xi_{s+1})} E[Z_{s+2}|F_{s+1}] \leq k \right\} \tag{72.11}$$

$$\tau_k = \min\{n : \sum_{s=0}^{n-1} \sum_{\xi_s \in L_s} \sum_{\xi_{s+1} \in r(\xi_s)} \sum_{\xi_{s+2} \in r(\xi_{s+1})} E[Z_{s+2}|F_{s+1}] > k \Bigg\} \tag{72.12}$$

When the right of (72.12) is null set, Let $\tau_k = \infty$, then τ_k is a stopping time.
Because $\sum_{s=0}^{\tau_k - 2} Z_{s+2} = \sum_{s=0}^{\infty} I(\tau_k \geq s+2) Z_{s+2}$ and $I(\tau_k \geq s+2)$ are F_{s+1}-measurable and Z_{s+2} is nonnegative, we have

$$\begin{aligned} & E\left(\sum_{s=0}^{\tau_k - 2} \sum_{\xi_s \in L_s} \sum_{\xi_{s+1} \in r(\xi_s)} \sum_{\xi_{s+2} \in r(\xi_{s+1})} Z_{s+2} \right) \\ & = E\left(\sum_{s=0}^{\infty} \sum_{\xi_s \in L_s} \sum_{\xi_{s+1} \in r(\xi_s)} \sum_{\xi_{s+2} \in r(\xi_{s+1})} I(\tau_k \geq s+2) Z_{s+2} \right) \\ & = E\left\{ \sum_{s=0}^{\infty} \sum_{\xi_s \in L_s} \sum_{\xi_{s+1} \in r(\xi_s)} \sum_{\xi_{s+2} \in r(\xi_{s+1})} E[I(\tau_k \geq s+2) Z_{s+2}|F_{s+1}] \right\} \\ & = E\left\{ \sum_{s=0}^{\tau_k - 2} \sum_{\xi_s \in L_s} \sum_{\xi_{s+1} \in r(\xi_s)} \sum_{\xi_{s+2} \in r(\xi_{s+1})} E[Z_{s+2}|F_{s+1}] \right\} \leq k \end{aligned} \tag{72.13}$$

Because $A_k = \{\tau_k = \infty\}$, from (72.13) we have

$$\sum_{s=0}^{\infty}\sum_{\xi_s\in L_s}\sum_{\xi_{s+1}\in r(\xi_s)}\sum_{\xi_{s+2}\in r(\xi_{s+1})}\int_{A_k} Z_{s+2}\mathrm{dp}=\sum_{s=0}^{\infty}\sum_{\xi_s\in L_s}\sum_{\xi_{s+1}\in r(\xi_s)}\sum_{\xi_{s+2}\in r(\xi_{s+1})} E[I(A_k)Z_{s+2}]$$
$$=E\left[I(\tau_k=\infty)\sum_{s=0}^{\tau_k-2}\sum_{\xi_s\in L_s}\sum_{\xi_{s+1}\in r(\xi_s)}\sum_{\xi_{s+2}\in r(\xi_{s+1})} Z_{s+2}\right]$$
$$\le E\left[\sum_{s=0}^{\tau_k-2}\sum_{\xi_s\in L_s}\sum_{\xi_{s+1}\in r(\xi_s)}\sum_{\xi_{s+2}\in r(\xi_{s+1})} Z_{s+2}\right]\le k \tag{72.14}$$

By (72.5), we have when $|x|$ increased, $\phi_n(x)$ increase. So from (72.14), we have

$$\sum_{s=0}^{\infty}\sum_{\xi_s\in L_s}\sum_{\xi_{s+1}\in r(\xi_s)}\sum_{\xi_{s+2}\in r(\xi_{s+1})} P(A_k((f^*_{s+2}(X_{\xi_s},X_{\xi_{s+1}},X_{\xi_{s+2}})$$
$$\ne f_{s+2}(X_{\xi_s},X_{\xi_{s+1}},X_{\xi_{s+2}})))$$
$$=\sum_{s=0}^{\infty}\sum_{\xi_s\in L_s}\sum_{\xi_{s+1}\in r(\xi_s)}\sum_{\xi_{s+2}\in r(\xi_{s+1})}\int_{A_k\left(\left|f_{s+2}(X_{\xi_s},X_{\xi_{s+1}},X_{\xi_{s+2}})\right|>a_{s+2}\right)}\mathrm{dp} \tag{72.15}$$
$$\le\sum_{s=0}^{\infty}\sum_{\xi_s\in L_s}\sum_{\xi_{s+1}\in r(\xi_s)}\sum_{\xi_{s+2}\in r(\xi_{s+1})}\int_{A_k} Z_{s+2}\mathrm{dp}\le k$$

By Borel-Cantelli lemma, we have

$$P(A_k(f^*_{s+2}(X_{\xi_s},X_{\xi_{s+1}},X_{\xi_{s+2}})\ne f_{s+2}(X_{\xi_s},X_{\xi_{s+1}},X_{\xi_{s+2}})))=0$$

Thus we have

$$\frac{\sum_{s=0}^{\infty}\sum_{\xi_s\in L_s}\sum_{\xi_{s+1}\in r(\xi_s)}\sum_{\xi_{s+2}\in r(\xi_{s+1})}\left[f_{s+2}(X_{\xi_s},X_{\xi_{s+1}},X_{\xi_{s+2}})-f^*_{s+2}(X_{\xi_s},X_{\xi_{s+1}},X_{\xi_{s+2}})\right]}{a_{s+2}} \tag{72.16}$$

Converges $a.e.\omega\in A_k$
Because $A=\bigcup_k A_k$, by (72.16), we have

$$\frac{\sum_{s=0}^{\infty}\sum_{\xi_s\in L_s}\sum_{\xi_{s+1}\in r(\xi_s)}\sum_{\xi_{s+2}\in r(\xi_{s+1})}\left[f_{s+2}(X_{\xi_s},X_{\xi_{s+1}},X_{\xi_{s+2}})-f^*_{s+2}(X_{\xi_s},X_{\xi_{s+1}},X_{\xi_{s+2}})\right]}{a_{s+2}} \tag{72.17}$$

Converges $a.e.\omega \in A$
Letting

$$Y_{s+2} = \frac{\left(f^*_{s+2}(X_{\xi_s}, X_{\xi_{s+1}}, X_{\xi_{s+2}}) - E\left[f^*_{s+2}(X_{\xi_s}, X_{\xi_{s+1}}, X_{\xi_{s+2}})|X_{\xi_{s+1}}, X_{\xi_s}\right]\right)}{a_{s+2}} \tag{72.18}$$

then $\{Y_{s+2}, s \geq 0\}$ is a martingale difference sequence. Because

$$\begin{aligned} E\left[Y^2_{s+2}|F_{s+1}\right] &= \left\{E\left[\left(f^*_{s+2}(X_{\xi_s}, X_{\xi_{s+1}}, X_{\xi_{s+2}})\right)^2|F_{s+1}\right]\right. \\ &\quad \left.-\left[E\left[f^*_{s+2}(X_{\xi_s}, X_{\xi_{s+1}}, X_{\xi_{s+2}})|F_{s+1}\right]\right]^2\right\}\Big/a^2_{s+2} \\ &\leq E\left[\frac{\left(f^*_{s+2}(X_{\xi_s}, X_{\xi_{s+1}}, X_{\xi_{s+2}})\right)^2}{a^2_{s+2}}|F_{s+1}\right] \end{aligned} \tag{72.19}$$

By (72.5), when $|x| \leq a_{s+2}$, $x^2/a^2_{s+2} \leq \phi_n(x)/\phi_n(a_{s+2})$, thus

$$\begin{aligned} \frac{\left(f^*_{s+2}(X_{\xi_s}, X_{\xi_{s+1}}, X_{\xi_{s+2}})\right)^2}{a^2_{s+2}} &\leq \frac{\phi_{s+2}\left(f^*_{s+2}(X_{\xi_s}, X_{\xi_{s+1}}, X_{\xi_{s+2}})\right)}{\phi_{s+2}(a_{s+2})} \\ &\leq \frac{\phi_{s+2}\left(f_{s+2}(X_{\xi_s}, X_{\xi_{s+1}}, X_{\xi_{s+2}})\right)}{\phi_{s+2}(a_{s+2})} = Z_{s+2} \end{aligned} \tag{72.20}$$

From (72.19), (72.20) and (72.10), we have

$$\begin{aligned} &\sum_{s=0}^{\infty}\sum_{\xi_s \in L_s}\sum_{\xi_{s+1}\in r(\xi_s)}\sum_{\xi_{s+2}\in r(\xi_{s+1})} E\left[Y^2_{s+2}|F_{s+1}\right] \leq \\ &\quad \sum_{s=0}^{\infty}\sum_{\xi_s \in L_s}\sum_{\xi_{s+1}\in r(\xi_s)}\sum_{\xi_{s+2}\in r(\xi_{s+1})} E[Z_{s+2}|F_{s+1}] \\ &= \sum_{s=0}^{\infty}\sum_{\xi_s \in L_s}\sum_{\xi_{s+1}\in r(\xi_s)}\sum_{\xi_{s+2}\in r(\xi_{s+1})} E\left[\phi_{s+2}\left(f_{s+2}(X_{\xi_s}, X_{\xi_{s+1}}, X_{\xi_{s+2}})\right)|X_{\xi_{s+1}}, X_{\xi_s}\right] \\ &\qquad \Big/\phi_{s+2}(a_{s+2}) < \infty \end{aligned} \tag{72.21}$$

$a.e.\omega \in A$
By Lemma 1, we have

$$\begin{aligned} &\sum_{s=0}^{\infty}\sum_{\xi_s \in L_s}\sum_{\xi_{s+1}\in r(\xi_s)}\sum_{\xi_{s+2}\in r(\xi_{s+1})} Y_{s+2} \\ &= \sum_{s=0}^{\infty}\sum_{\xi_s \in L_s}\sum_{\xi_{s+1}\in r(\xi_s)}\sum_{\xi_{s+2}\in r(\xi_{s+1})} a^{-1}_{s+2}\left(f^*_{s+2}(X_{\xi_s}, X_{\xi_{s+1}}, X_{\xi_{s+2}})\right. \\ &\qquad \left.-E\left[f^*_{s+2}(X_{\xi_s}, X_{\xi_{s+1}}, X_{\xi_{s+2}})|X_{\xi_{s+1}}, X_{\xi_s}\right]\right) \end{aligned} \tag{72.22}$$

Converges $a.e.\omega \in A$

By (72.5), when $|x| > a_n$, $|x|/a_n \le \phi_n(x)/\phi_n(a_n)$. So we have

$$\begin{aligned} &\left|\left\{E\left[f_{s+2}(X_{\xi_s}, X_{\xi_{s+1}}, X_{\xi_{s+2}})|X_{\xi_{s+1}}, X_{\xi_s}\right]\right.\right. \\ &\left.\left.-E\left[f^*_{s+2}(X_{\xi_s}, X_{\xi_{s+1}}, X_{\xi_{s+2}})|X_{\xi_{s+1}}, X_{\xi_s}\right]\right\}/a_{s+2}\right| \\ &\le E\left[\left|f_{s+2} - f^*_{s+2}\right|/a_{s+2}|F_{s+1}\right] \quad \text{a.s.} \\ &\le E\left[\left(\phi_{s+2}(f_{s+2})/\phi_{s+2}(a_{s+2})\right)I(|f_{s+2}| > a_{s+2})|F_{s+1}\right] \\ &\le E\left[\phi_{s+2}(f_{s+2})|X_{\xi_{s+1}}, X_{\xi_s}\right]/\phi_{s+2}(a_{s+2}) \end{aligned} \tag{72.23}$$

From (72.23) and (72.6), when $\omega \in A$, we obtain

$$\begin{aligned} \sum_{s=0}^{\infty} \sum_{\xi_s \in L_s} \sum_{\xi_{s+1} \in r(\xi_s)} \sum_{\xi_{s+2} \in r(\xi_{s+1})} &\left(E\left[f_{s+2}(X_{\xi_s}, X_{\xi_{s+1}}, X_{\xi_{s+2}})|X_{\xi_{s+1}}, X_{\xi_s}\right]\right. \\ &\left.-E\left[f^*_{s+2}(X_{\xi_s}, X_{\xi_{s+1}}, X_{\xi_{s+2}})|X_{\xi_{s+1}}, X_{\xi_s}\right]\right)/a_{s+2} \end{aligned} \tag{72.24}$$

Converges

By (72.17), (72.22) and (72.24), (72.7), follows

By Kronecker lemma, (72.9) follows.

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Chapter 73
Actuarial Pricing to Compound Option Under Ornstein-Uhlenback Process

Congcong Xu and Haiying Li

Abstract A model of the compound options was studied by supposing if the stock price obeys the exponential Ornstein-Uhlenback process. The exact solutions of underlying European option and European compound options were obtained. The related theory of stochastic differential equation was used and the definition of actuarial pricing approach was considered in order to obtain the solutions. Finally, the comparative analysis between the results of the actuarial approach and the No arbitrage pricing method was discussed.

Keywords Compound option · Exponential ornstein-uhlenback process · Actuarial approach

73.1 Introduction

With the growth of financial market, lots of exotic options are trading in the OTC market to meet clients' needs. Compound option is the standard option on a standard option being the underlying asset. The exercise payoff of a compound option involves the value of another one. The model of compound option was first used by [1] to evaluate the option on a share of common stock by partial differential method. The valuation of compound option with constant coefficient was

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studied in [2] and the time-dependent model of compound options by martingale method was obtained in [3]. References [4] and [5] studied the European option and compound option pricing formulas of stocks obeying the jump-diffusion process by the martingale method and actuarial method, respectively. Reference [6] obtained the valuation formulas of the compound option with stocks obeying the Levy process by the martingale method.

In 1998, the actuarial approach was proposed in [7] by converting the option pricing problem into determining the equivalent of the fair premium. No economic assumptions were used in the actuarial approach. Therefore this approach can be applied not only in the arbitrage-free, equilibrium, complete markets, but also in the arbitrage, nonequilibrium, incomplete markets. Ref. [8] obtained the accurate pricing formula of European option by actuarial approach with the evolution of the stock price following Ornstein-Uhlenback (O-U) process. An actuarial approach of the option pricing problem for a market model was discussed in [9], where the interest rates were stochastic and the stock prices were driven by generalized Exp-Ornstein-Uhlenback (Exp-O-U) process. Ref. [10] obtained the pricing formula of the call option on a call option of the European compound option. This stock price can avoid the varience in the same direction for traditional lognormal distribution. Furthermore, the upward trend of the stock price can be weakened.

In this study, we discussed an actuarial approach to the compound option pricing problem for a market model, in which the stock prices were driven by generalized Exp-O-U process. The equations of the pricing of general European option and European compound option were obtained. All the results can be applied to the complex incomplete markets.

73.2 Basic Models and Assumptions

In this study, two assets in the market were assumed. One is the riskless asset, which is called the bond. The other is the risky asset, which is the stock. A frictionless financial market in continuous time was considered. The evolution of the stock price S_t is suppose to follow the generalized Exp-O-U process

$$dS_t = S_t[(\mu_t - \alpha \ln S_t)dt + \sigma_t dW_t],\ S_0 = S. \tag{73.1}$$

where $S > 0$, (W_t) $t \in [0, T]$ is a standard Brownian motion defined on a probability space $(\Omega, F, \{F_t\}_{t>0}, P)$; μ_t and σ_t are the real deterministic continuous functions defined on $[0, T]$. F_t is assumed to be the natural filtration generated by the random variable W_t and α is constant.

Definition 1 [7] the process $\{S_t, 0 \le t \le T\}$ result in an expected (instantaneous) rate of return μ_t at time T defined as:

$$e^{\int_0^T \mu_t dt} = \frac{ES_T}{S} \tag{73.2}$$

Definition 2 [7] The value of the European option by actuarial approach is defined to be the expectation of the difference between the discount value of the stock price on maturity and the strike price on probability measure of the actual distribution of the stock price at the exercised option condition. The riskless asset is discounted by the riskless interest rate while the risky asset is discounted by the expected rate of return as defined as in (2). The necessary and sufficient conditions to execute of the European call option and the put option on the expiration date are the following two formulas, respectively.

$$\exp\left\{-\int_0^T \mu_t dt\right\} S_T > \exp\left\{-\int_0^T r_t dt\right\} K, \exp\left\{-\int_0^T \mu_t dt\right\} S_T < \exp\left\{-\int_0^T r_t dt\right\} K.$$

$C(S, T)$ denotes the European call option. $P(S, T)$ denotes the European put option whose stock price is S_t. K is the strike price and T is the expiration date. The value of the European option is defined by actuarial approach as follows:

$$C(S,T) = E\left[(\exp\{-\int_0^T \mu_t dt\} S_T - \exp\{-\int_0^T r_t dt\} K) \cdot I_{\{exp\{-\int_0^T \mu_t dt\} S_T > \exp\{-\int_0^T r_t dt K\}}\right], \tag{73.3}$$

$$P(S,T) = E\left[(\exp\{-\int_0^T r_t dt\} K - \exp\{-\int_0^T \mu_t dt\} S_T) \cdot I_{\{\exp\{-\int_0^T \mu_t dt\} S_T < \exp\{-\int_0^T r_t dt\} K\}}\right]. \tag{73.4}$$

Where I_A is the indicator function of the event A

Lemma 1 [9] If the stock price is driven by generalized Exp-O-U process (1), then

$$S_t = S^{e^{-\alpha t}} \exp\left\{e^{-\alpha t} \int_0^t (\mu_s - \frac{1}{2}\sigma_s^2) e^{\alpha s} ds + e^{-\alpha t} \int_0^t \sigma_s e^{\alpha s} dW_s\right\}, \tag{73.5}$$

$$\mathrm{ES}_t = S^{e^{-\alpha t}} \exp\left\{ e^{-\alpha t} \int_0^t (\mu_s - \frac{1}{2}\sigma_s^2) e^{\alpha s} ds + \frac{1}{2} e^{-2\alpha t} \int_0^t \sigma_s^2 e^{2\alpha s} ds \right\}. \tag{73.6}$$

Lemma 2 [4] If $X \sim N(0, \sigma_X^2)$, $Y \sim N(0, \sigma_Y^2)$, we can obtain

$$E(e^X 1_{(Y \geq b)}) = \exp\left(\frac{\sigma_X^2}{2}\right) N\left[\frac{-b + \mathrm{cov}(X, Y)}{\sigma_Y}\right] \tag{73.7}$$

$$E(e^X 1_{(X \geq a, Y \geq b)}) = e^{\frac{\sigma_X^2}{2}} M\left[\frac{-a + \sigma_X^2}{\sigma_X}, \frac{-b + \mathrm{cov}(X, Y)}{\sigma_Y}, \rho\right] \tag{73.8}$$

where N (•) is the standard normal distribution function and

$$M[x, y, \rho] = \frac{1}{2\pi\sqrt{1-\rho^2}} \int_{-\infty}^{x} \int_{-\infty}^{y} \exp\left\{ -\frac{u^2 - 2\rho uv + v^2}{2(1-\rho^2)} \right\} \mathrm{dudv}. \tag{73.9}$$

73.3 General European Option Pricing

Definition 3 Supposing that the stock process $\{S_t, t \geq 0\}$ obeys the generalized Exp-O-U process as (1) and the exercise date is T, the value of the underlying European call option at time $t$can be expressed as following:

$$\begin{aligned} C(S, t) = E\Bigg[& (\exp\{-\int_t^T \mu_s ds\} S_t - \exp\{-\int_t^T r_t dt\} K) \\ & \cdot I_{\{\exp\{-\int_t^{T_2} \mu_t dt\} S_{T_2} > \exp\{-\int_t^{T_2} r_t dt\} K\}} \Bigg] \end{aligned} \tag{73.10}$$

Theorem 1 The equation of the underlying European call option pricing at time t can be expressed:

$$C(S, t) = S_t N(d_1) - K \exp(-\int_t^T r_t dt) N(d_2). \tag{73.11}$$

Where

$$X = e^{-\alpha(T-t)} \int_t^T \sigma_s e^{\alpha s} dW_s, \quad \sigma_X^2 = e^{-2\alpha(T-t)} \int_t^T \sigma_s^2 e^{2\alpha s} ds,$$

$$d_1 = \frac{\ln \frac{S_t}{K} + \int_t^T r_t dt + \frac{1}{2}\sigma_X^2}{\sqrt{\sigma_X^2}}, \; d_2 = d_1 - \sqrt{\sigma_X^2}\,.$$

S_t is given by Lemma 1.

Proof From Definition 3, we can obtain

$$\begin{aligned} C(S,t) = & E\left[\exp\{-\int_t^T \mu_s ds\} S_t \cdot I_{\{\exp\{-\int_t^T \mu_s ds\} S_t > \exp\{-\int_t^T r_s ds\} K\}}\right] \\ & - \quad E\left[\exp\{-\int_t^T r_s ds\} K \cdot I_{\{\exp\{-\int_t^T \mu_s ds\} S_t > \exp\{-\int_t^T r_s ds\} K\}}\right] \\ & = I_1 - I_2 \end{aligned} \tag{73.12}$$

From Definition 1 $e^{\int_0^T \mu_t dt} = \frac{ES_T}{S}$, the equation $e^{\int_t^T \mu_t dt} = \frac{ES_T}{S_t}$ can be obtained.

From Lemma 1, we can obtain

$$S_T = S_t^{\exp(-\alpha(T-t))} \exp\left\{ e^{-\alpha(T-t)} \int_t^T (\mu_s - \frac{1}{2}\sigma_s^2) e^{\alpha s} ds + e^{-\alpha(T-t)} \int_t^T \sigma_s e^{\alpha s} dW_s \right\} \tag{73.13}$$

$$\mathrm{ES}_T = S_t^{\exp(-\alpha(T-t))} \exp\left\{ e^{-\alpha(T-t)} \int_t^{T_2} (\mu_s - \frac{1}{2}\sigma_s^2) e^{\alpha s} ds + \frac{1}{2} e^{-2\alpha(T-t)} \int_t^T \sigma_s^2 e^{2\alpha s} ds \right\}. \tag{73.14}$$

Then we can obtain

$$\begin{aligned} \int_t^T \mu_s ds = \ln \frac{\mathrm{ES}_T}{S_t} = (e^{-\alpha(T-t)} - 1) \ln S_t + \\ e^{-\alpha(T-t)} \int_t^T (\mu_s - \frac{1}{2}\sigma_s^2) e^{\alpha s} ds + \frac{1}{2} e^{-2\alpha(T-t)} \int_t^T \sigma_s^2 e^{2\alpha s} ds, \end{aligned} \tag{73.15}$$

Therefore, the following equations can be obtained

$$\mathrm{e}^{-\int_t^T \mu_s ds} = \exp\left\{(1-e^{-\alpha(T-t)})\ln S_t - e^{-\alpha(T-t)}\int_t^T (\mu_s - \frac{1}{2}\sigma_s^2)e^{\alpha s}ds - \frac{1}{2}e^{-2\alpha(T-t)}\int_t^T \sigma_s^2 e^{2\alpha s}ds\right\},$$

and

$$\mathrm{e}^{-\int_t^T \mu_s ds}\mathrm{S}_T = \exp\left\{\ln S_t - \frac{1}{2}e^{-2\alpha(T-t)}\int_t^T \sigma_s^2 e^{2\alpha s}ds + e^{-\alpha(T-t)}\int_t^T \sigma_s e^{\alpha s}dW_s\right\} \tag{73.16}$$

By considering the condition of $\exp\{-\int_t^T \mu_s ds\}S_T > \exp\{-\int_t^T r_s ds\}K$, we can obtain

$$\begin{aligned}
&\Leftrightarrow \exp\left\{\ln S_t - \frac{1}{2}e^{-2\alpha(T-t)}\int_t^T \sigma_s^2 e^{2\alpha s}dt + e^{-\alpha(T-t)}\int_t^T \sigma_s e^{\alpha s}dW_s\right\} > \exp\{-\int_t^T r_s ds\}K \\
&\Leftrightarrow e^{-\alpha(T-t)}\int_t^T \sigma_s e^{\alpha s}dW_s > \ln\frac{K}{S_t} - \int_t^T r_s ds + \frac{1}{2}e^{-2\alpha(T-t)}\int_t^T \sigma_s^2 e^{2\alpha s}ds \\
&\Leftrightarrow X > \ln\frac{K}{S_t} - \int_t^T r_t dt + \frac{1}{2}e^{-2\alpha(T-t)}\int_t^T \sigma_s^2 e^{2\alpha s}ds \triangleq c.
\end{aligned}$$

Where $X \sim N(0, \sigma_X^2)$ therefore we can obtain

$$\begin{aligned}
I_1 &= E\left[S_t \exp\left\{-\frac{1}{2}e^{-2\alpha(T-t)}\int_t^T \sigma_s^2 e^{2\alpha s}ds + X\right\}\cdot I_{\{X>c\}}\right] \\
&= S_t \exp\left\{-\frac{1}{2}\sigma_X^2\right\}\cdot E\left[e^X \cdot 1_{\{X>c\}}\right] \\
&= S_t N(d_1),
\end{aligned} \tag{73.17}$$

$$I_2 = E\left[\exp\{-\int_t^T r_s ds\}K \cdot 1_{X>c}\right] = \exp\left\{-\int_t^T r_s ds\right\}KN(d_2) \tag{73.18}$$

In the same way, the pricing equation of European put option can be expressed

$$P(S,t) = K\exp\left(-\int_t^T r_s dt)N(-d_2\right) - S_t N(-d_1) \tag{73.19}$$

73.4 The European Compound Option Pricing

The compound option is an option on another option. The exercise payoff of a compound option involving the value of another option. Therefore, a compound option has two expiration dates and two strike prices. There are four types of compound options. They are the call option on a call option, the put option on a call option, the call option on a put option and the put option on a put option. Take the European style call option on a call option as an example. On the first expiration date T_1, the holder has the right to buy a new call using the strike price $\hat{K}$. The new call has expiration date T_2 and strike price K.

There are three risk assets: the underlying assets (e.g., stock), the underlying option and the compound option. We define the price of the underlying option on domain $\Sigma_2\{0 \le S \le \infty, 0 \le t \le T_2\}$, which can be derived by Theorem 1. Then, the pricing of compound option can be obtained by Definition 4 on the domain $\Sigma_1\{0 \le S \le \infty, 0 \le t \le T_1\}$.

Definition 4 If the stock process $\{S_t,\ t \ge 0\}$ obeys the generalized Exp-O-U process (1), the value of the European compound call option on another European call option at the time 0 is:

$$\begin{aligned} CC(S,0) = E\Bigg[&(\exp(-\int_0^{T_1}\mu_t dt)C(S_{T_1},T_1) - \exp(-\int_0^{T_1} r_t dt)\hat{K}) \\ &\times I_{\{\exp(-\int_0^{T_1}\mu_t dt)C(S,T_1) > \exp(-\int_0^{T_1} r_t dt)\hat{K})\}}\Bigg] \end{aligned} \tag{73.20}$$

Lemma 3 [8] the condition $\exp(-\int_0^{T_1}\mu_t dt)C(S,T_1) - \exp(-\int_0^{T_1} r_t dt)\hat{K}$ is equivalent to the $\exp(-\int_0^{T_1}\mu_t dt)S_{T_1} > \exp(-\int_0^{T_1} r_t dt)S^*$, where S^* is the root of$\hat{K} = C(S^*,T_1)$.

From Definition 4 and Theorem 1, we can obtain the following results:

Theorem 2 The value of the European compound call option on a call option at the time 0 can be expressed:

$$\begin{aligned} CC(S,0) = SM[a_1, b_1; \rho] - K\exp(-\int_0^{T_1} \mu_t dt - \int_{T_1}^{T_2} r_t dt)\times \\ M[a_2, b_2; \rho] - \hat{K}\exp(-\int_0^{T1} r_t dt)N(a_2) \end{aligned} \tag{73.21}$$

Where

$$a_1 = \frac{\ln\frac{S}{S^*} + \int_0^{T_1} r_t dt + \frac{1}{2}\sigma_{X_1}^2}{\sqrt{\sigma_{X_1}^2}},\ a_2 = a_1 - \sqrt{\sigma_{X1}^2},$$

$$b_1 = \frac{\ln\frac{S^{\exp(-\alpha T_2)}}{K} + \int_{T_1}^{T_2}(r_t - \mu_t)dt + e^{-\alpha T_2}\int_0^{T_2}\mu_t e^{\alpha t}dt + \frac{1}{2}\sigma_{X_2}^2}{\sqrt{\sigma_{X_2}^2}},\ b_2 = b_1 - \sqrt{\sigma_{X_2}^2},$$

$$\sigma_{X_1}^2 = e^{-2\alpha T_1}\int_0^{T_1}\sigma_t^2 e^{2\alpha t}dt,\ \sigma_{X_2}^2 = e^{-2\alpha T_2}\int_0^{T_2}\sigma_t^2 e^{2\alpha t}dt,\ \rho = \sqrt{\frac{\sigma_{X_1}^2}{\sigma_{X_2}^2}}.$$

Proof From Definition 1, we have

$$e^{-\int_0^{T_1}\mu_t dt} S_{T_1} = S\exp\left\{-\frac{1}{2}e^{-2\alpha T_1}\int_0^{T_1}\sigma_t^2 e^{2\alpha t}dt + e^{-\alpha T_1}\int_0^{T_1}\sigma_t e^{\alpha t}dW_t\right\} \tag{73.22}$$

Therefore, the condition $\exp(-\int_0^{T_1}\mu_t dt)S_{T_1} > \exp(-\int_0^{T_1} r_t dt)S^*$ is equivalent to

$$\Leftrightarrow \exp\left\{\ln S - \frac{1}{2}e^{-2\alpha T_1}\int_0^{T_1}\sigma_t^2 e^{2\alpha t}dt + e^{-\alpha T_1}\int_0^{T_1}\sigma_t e^{\alpha t}dW_t\right\} > \exp\{-\int_0^{T_1} r_t dt\}S^*$$

$$\Leftrightarrow X_1 > \ln\frac{S^*}{S} - \int_0^{T_1} r_t dt + \frac{1}{2}\sigma_{X_1}^2 \triangleq c_1.$$

From Lemma 1, we obtain

$$S_{T_2} = S^{\exp(-\alpha T_2)}\exp\left\{e^{-\alpha T_2}\int_0^{T_2}(\mu_t - \frac{1}{2}\sigma_t^2)e^{\alpha t}dt + e^{-\alpha T_2}\int_0^{T_2}\sigma_t e^{\alpha t}dW_t\right\} \tag{73.23}$$

The conditions $\exp\{-\int_{T_1}^{T_2}\mu_t dt\}S_{T_2} > \exp\{-\int_{T_1}^{T_2} r_t dt\}K$ can be rewritten as

$$\exp\{-\int_{T_1}^{T_2}\mu_t dt\}S^{\exp(-\alpha T_2)}\exp\left\{e^{-\alpha T_2}\int_0^{T_2}(\mu_t-\frac{1}{2}\sigma_t^2)e^{\alpha t}dt+e^{-\alpha T_2}\int_0^{T_2}\sigma_t e^{\alpha t}dW_t\right\}$$

$$> \exp\{-\int_{T_1}^{T_2} r_t dt\}K$$

$$\Leftrightarrow -\int_{T_1}^{T_2}\mu_t dt+\ln S^{\exp(-\alpha T_2)}+e^{-\alpha T_2}\int_0^{T_2}(\mu_t-\frac{1}{2}\sigma_t^2)e^{\alpha t}dt+e^{-\alpha T_2}\int_0^{T_2}\sigma_t e^{\alpha t}dW_t$$

$$> -\int_{T_1}^{T_2} r_t dt+\ln K$$

$$\Leftrightarrow X_2 > \ln\frac{K}{S^{\exp(-\alpha T_2)}}+\int_{T_1}^{T_2}\mu_t dt-\int_{T_1}^{T_2} r_t dt\ -e^{-\alpha T_2}\int_0^{T_2}\mu_t e^{\alpha t}dt+\frac{1}{2}\sigma_{X_2}^2 C_2.$$

Where $X_1 N(0,\sigma_{X_1}^2),\ X_2 N(0,\sigma_{X_2}^2)$

From Definition 4 and Lemma 3, the value of the European compound call option on a European call option at the time 0 can be expressed as:

$$\begin{aligned}
\mathrm{CC}(S,0) &= E\left[\left(\exp(-\int_0^{T_1}\mu_t dt)C(S_{T_1},T_1)-\exp(-\int_0^{T_1} r_t dt)\hat{K}\right)\cdot\right.\\
&\quad \left. I_{\exp(-\int_0^{T_1}\mu_t dt)S_{T_1} > \exp(-\int_0^{T_1} r_t dt)S^*}\right] = E\left[\left(\exp(-\int_0^{T_2}\mu_t dt)S_{T_2}\right)_{I_{\{X_1>c_1,X_2>c_2\}}}\right]\\
&\quad -K\exp\left\{-\int_0^{T_1}\mu_t dt-\int_{T_1}^{T_2} r_t dt\right\}\cdot E[I_{\{X_1>c_1,X_2>c_2\}}]-\hat{K}\exp(-\int_0^{T_1} r_t dt)E[I_{\{X_1>c\}}]\\
&= S\exp\left\{-\frac{1}{2}e^{-2\alpha t}\int_0^{T_2}\sigma_s^2 e^{2\alpha s}ds\right\}\cdot E[e^{X_2}I_{\{X_1>c_1,X_2>c_2\}}]\\
&\quad -K\exp\left\{-\int_0^{T_1}\mu_t dt-\int_{T_1}^{T_2} r_t dt\right\}\cdot E[I_{\{X_1>c_1,X_2>c_2\}}]\\
&\quad -\hat{K}\exp\left(-\int_0^{T_1} r_t dt\right)E[I_{\{X_1>c\}}] = CC_1-CC_2-CC_3
\end{aligned} \tag{73.24}$$

Now the expectations CC_1, CC_2, and CC_3 can be calculated from Lemma 2:

$$\begin{aligned}\mathrm{CC}_1 &= S\exp\left\{-\frac{1}{2}e^{-\alpha t}\int_0^{T_2}\sigma_s^2 e^{\alpha s}ds\right\}\cdot E[e^{X_2}I_{\{X_1>c_1,X>c_2\}}]\\ &= S\exp\left\{-\frac{1}{2}\sigma_{X_2}^2\right\}\cdot\exp(\frac{1}{2}\sigma_{X_2}^2)M\left[\frac{-c_1+\sigma_{X_1}^2}{\sqrt{\sigma_{X_1}^2}},\frac{-c_2+\sigma_{X_2}^2}{\sqrt{\sigma_{X_2}^2}},\rho\right]\\ &= \mathrm{SM}[a_1,b_1,\rho]\end{aligned} \tag{73.25}$$

$$\begin{aligned}\mathrm{CC}_2 &= K\exp\left\{-\int_0^{T_1}\mu_t dt-\int_{T_1}^{T_2}r_t dt\right\}\cdot E[I_{\{X>a,Y>b\}}]\\ &= K\exp\left\{-\int_0^{T_1}\mu_t dt-\int_{T_1}^{T_2}r_t dt\right\}M[a_2,b_2;\rho]\end{aligned} \tag{73.26}$$

$$\mathrm{CC}_3 = \hat{K}\exp(-\int_0^{T_1}r_t dt)E[I_{\{Y>b\}}] = \hat{K}\exp\left(-\int_0^{T_1}r_t dt\right)N(a_2) \tag{73.27}$$

Theorem 3 The valuation formulas for the put option on a call option, the call option on a put option and the put option on a put option can be expressed as follows, respectively.

$$\begin{aligned}\mathrm{PC}(S,0) &= K\exp\left(-\int_0^{T_1}\mu_t dt-\int_{T_1}^{T_2}r_t dt\right)M[-a_2,b_2;-\rho]\\ &\quad-\mathrm{SM}[-a_1,b_1;-\rho]+\hat{K}\exp\left(-\int_0^{T1}r_t dt\right)N(-a_2)\end{aligned} \tag{73.28}$$

$$\begin{aligned}\mathrm{CP}(S,0) &= \mathrm{SM}[a_1,-b_1;-\rho]-K\exp\left(-\int_0^{T_1}\mu_t dt-\int_{T_1}^{T_2}r_t dt\right)\\ &\quad\times M[a_2,-b_2;-\rho]+\hat{K}\exp\left(-\int_0^{T1}r_t dt\right)N(a_2)\end{aligned} \tag{73.29}$$

$$\begin{aligned} \mathrm{PP}(S,0) = K\exp\left(-\int_0^{T_1}\mu_t dt - \int_{T_1}^{T_2} r_t dt\right) M[-a_2,-b_2;\rho] \\ -\mathrm{SM}[-a_1,-b_1;\rho] - \hat{K}\exp\left(-\int_0^{T1} r_t dt\right) N(-a_2) \end{aligned} \tag{73.30}$$

Remark 1 At the condition of $\mu_t = r_t$, the pricing of compound option is risk neutral and independent on the investor's risk appetite. Therefore, the value of the European compound call on a call option at the time 0 can be rewritten as

$$\begin{aligned} \mathrm{CC}(S,0) = \mathrm{SM}[a_1,b_1;\rho] - K\exp(-\int_0^{T_2} r_t dt) M[a_2,b_2;\rho] - \\ \hat{K}\exp(-\int_0^{T1} r_t dt) N(a_2). \end{aligned} \tag{73.31}$$

Remark 2 When $\mu_t = r_t$ and $\alpha = 0$, the conclusion of Theorem 2 is the result in [3].

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Chapter 74
Mental Health Evaluation Model Based on Fuzzy Comprehensive Evaluation

Ying Li, Donghui Li and Xinchun Wang

Abstract For the complex information in the system of mental health evaluation, an evaluation index system has been built. Based on fuzzy comprehensive evaluation method, a psychological assessment of the mathematical model has been built in order to properly evaluate the students' mental health status. And more scientific adjustment or treatment recommendations can be given. First, based on the mental health requirements a psychological evaluation index system divided into the 4-level indicators, 7 two indicators, and 18 three indicators is built. Second, the fuzzy comprehensive evaluation model of mental health is constructed using fuzzy comprehensive evaluation method. According to information collection, data processing and comprehensive evaluation the model is described in detail. Finally, the effectiveness of the method is verified by examples.

Keywords Fuzzy comprehensive evaluation · Analytic hierarchy process · Psychological assessment · Trend model

74.1 Introduction

World Health Organization [1] and foreign studies have found that psychological problems of children and adolescents [2], the elderly [3], low-income population [4] is in a higher incidence. At present, our mental health service resources are still

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very limited [5]. By the use of mathematical tools and the information provided by the test, how to improve the recognition rate of psychological problems accurately and efficiently is an important issue on the mental health care. In mental phenomenon the factors that affect mental health are all fuzzy. So it is difficult to fix a strict standard in determining the influence the factors bring to the mental health. Assessment of defining mental health or not and mental illness is relatively vague. Therefore, it will turn to be feasible if the fuzzy comprehensive evaluation theory is introduced into the research of psychological evaluation [6]. In fuzzy comprehensive assessment, the distribution of the weights depends mainly on our subjective judgment, it is difficult to precise the distribution of weight when there are too many factors. In order to reflect the results of the assessment objectively and scientifically, the paper attends to determine the weight of the mental health evaluation by the use of Analytic Hierarchy Process. And establish the fuzzy comprehensive evaluation model which is used to assess mental health status, then the rate of mental health status is evaluated.

74.2 The Steps of the Analytic Hierarchy Process

Identify the problem Clarify the scope of the problem including factors and the relationship between various factors in order to grasp the full information.

Create a hierarchy complex issues are broken down into various components called elements, the interaction association and affiliation between the elements to form different levels.

Establish the judgment matrix the pair wise comparison will be performed in all indicators of the same level by experts, according to the scaling method, their relative degree of importance is determined. After quantifying judgment results, we write the judgment matrix based on Satie proposed 1–9 scale method. It is show in Table 74.1.

According to the scaling method above, we will compare any two index included in the same layer, thus we can get the judgment matrix P shown as follows.

Table 74.1 Scaling method table

Scale	Meaning
1	ui and uj are the same important
3	ui is a little more important than uj
5	ui is obviously important than uj
7	ui is much more important than uj
9	ui is extremely important than uj
2,4,6,8	2,4,6,8 respectively indicates mean value of 1–3, 3–5, 5–7, 7–9
Countdown	Factors ui and uj get judgment the value of uij, uji = 1/uij

$$P = \begin{pmatrix} u_{11} & u_{12} & \cdots & u_{1n} \\ u_{21} & u_{22} & \cdots & u_{2n} \\ \vdots & \vdots & \cdots & \vdots \\ u_{n1} & u_{n2} & \cdots & u_{nn} \end{pmatrix} \tag{74.1}$$

Obviously, there are the laws that apply to any judgment matrix:

$$\begin{array}{l} (1)\ u_{ii} = 1 \\ (2)\ u_{ij} = 1/u_{ji} \end{array} \quad i,j = (1,2,3,\cdots,n) \tag{74.2}$$

(iv) After the judgment matrix is computed and normalized, we obtain the weight coefficients. The specific calculation steps are as follows:

Judgment matrix is normalized according to columns (the sum of all the columns is 1).

$$b_{ij} = \frac{u_{ij}}{\sum_{i=1}^{n} u_{ij}} \quad B = \left[b_{ij}\right]$$

In accordance with the row sum

$$v_i = \sum_{j=1}^{n} b_{ij} \quad V = [v_i]$$

Calculate the eigenvectors (normalized)

$$w_i = \frac{v_i}{\sum_{i=1}^{n} v_i} \quad W = \left[w_{ij}\right]$$

(v) The consistency test of judgment matrix.

In general, if the relationship $u_{ij} = u_{ik}/u_{kj}$ between various elements of the judgment matrix, the judgment matrix is provided with complete consistency. However, because of the complexity of objective things and differences in people's judgment, the complete consistency of judgment matrix is not possible. As long as the deviation within a certain range is acceptable, we need the consistency test.

$$R = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1m} \\ r_{21} & r_{22} & \cdots & r_{2m} \\ \cdots & \cdots & \cdots & \cdots \\ r_{n1} & r_{n2} & \cdots & r_{nm} \end{bmatrix}$$

Suppose that $\lambda_{\max}$ is the largest eigenvalue of n—order matrix, when $\lambda_{\max} = n$, we believe that the matrix is complete consistency. Under normal circumstances $\lambda_{\max} \neq n$, we usually test by the use of the consistency ratio. The formula is: $CR = CI/RI$

Table 74.2 N-order sentence matrix values

n	1	2	3	4	5	6	7	8	9
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45

In the equality above:

We name CR random consistency ratio of judgment matrix.

We name CI the consistency index of judgment matrices, it is given by:

$$\mathrm{CI} = \frac{1}{n-1}(\lambda_{\max} - n), \lambda_{\max} = \frac{1}{n}\sum_{i=1}^{n}\frac{(UW)_i}{w_i} \tag{74.3}$$

UW Is the product of the judgment matrix and the eigenvectors?

We name RI the judgment matrix's average random consistency index, it can be got by looking up the table. For a 9-order matrix, the RI values are listed in Table 74.2:

When CR < 0.1, the judgment matrix has complete consistency and the weight distribution is reasonable. Otherwise, we need to adjust the judgment matrix, until it is fully consistent.

74.3 The Principles and Procedures of Fuzzy Comprehensive Evaluation

The mathematical model of fuzzy comprehensive evaluation is made up of the index set U evaluation set V and the evaluation matrix R. Suppose that index set $\mathrm{U} = \{x_1, x_2, \cdots, x_n\}$, judgment collection $\mathrm{V} = (y_1, y_2, \cdots, y_n)$, and fuzzy subset $\mathrm{A} = (a_1, a_2, a_3, \cdots, a_n)$ which includes the weight of each index.

In the equation of A, a_i is the corresponding weight of indicator i and $\sum_{i=1}^{n} a_i = 1$ The evaluation of indicators i is a fuzzy relation on U to V: $R_i = (r_{i1}, r_{i2}, \cdots, r_{im})$. Thus, the total evaluation matrix of n factors is:

Therefore, we get the comprehensive evaluation results for the synthesis of A and B. Recorded as:$B = A \circ R = (b_1, b_2, \cdots, b_n)$

The system is very complicated and there are many indicators need to be considered and there are gradations between the indicators to classify the indicators in some way (by the form of dendriform data structure). Above all, we will make the comprehensive evaluation on each category, and then the senior comprehensive evaluation based on "category" is provided. This is a multilevel comprehensive evaluation. Take the secondary fuzzy comprehensive evaluation for example, we will explain the steps.

Step 1: According to some kind of property, the factor set $U = \{x_1, x_2, \cdots, x_n\}$ is divided into several subfactors set $U_1, U_2, \cdots, U_n$. Among them, $U_i = \{x_{i1}, x_{i2}, \cdots, x_{in}\}, i = 1, 2, \cdots, l$ Meet: $n_1 + n_2 + \cdots + n_l = n$, $U_1 \cup U_2 \cup \cdots \cup U_l = U$, for any $i \neq j$, $U_i \cap U_j = \varnothing$.

Step 2: Make a judgment for each subfactor set U_i, and set $Y = (y_1, y_2, \cdots, y_n)$ for review set, the weight distribution of every factor in U_i is $A = (a_1, a_2, a_3, \cdots, a_n)$ which was relative to V, if R_i is the single factor evaluation matrix, then we can get the judgment vector as follow,

$$B_i = A_i \circ R_i = (b_{i1}, b_{i2}, \cdots, b_{in}), i = 1, 2, \cdots, l \tag{74.4}$$

Step 3 see each U_i as a factor, $Q = \{U_1, U_2, \cdots, U_n\}$, Q is a factors set this moment, the single-factor evaluation matrix of Q is: Each U_i is part of U, and each U_i has respective weights according to the importance of the property. That is to say $A = (a_1, a_2, \cdots, a_l)$. Then, we can get the secondary comprehensive judgment vector as follow:

$$R = \begin{bmatrix} B_1 \\ B_2 \\ \cdots \\ B_l \end{bmatrix} = \begin{bmatrix} b_{11} & b_{12} & \cdots & b_{1m} \\ b_{21} & b_{22} & \cdots & b_{2m} \\ \cdots & \cdots & \cdots & \cdots \\ b_{l1} & b_{l2} & \cdots & b_{lm} \end{bmatrix}$$

Step 4 B is normalized, then make $\sum_{j=1}^{n} b_j = 1$.

Step 5 the evaluation results will be judged step by step, until it reached the highest level.

74.4 Mental Health Indicators System

Universities do not give a high degree of attention to students' mental health for a long time. Now the problem has been given enough attention. On the premise that the factors which affect students' psychological health have been fully considered, we have established a comprehensive evaluation index system of college students by making full use of the Delphi method, literature review method, and interview. The evaluation or the factors set by the system both have a significant impact on the mental health assessment, which can also fully reflect a number of qualitative and quantitative terms about the individual differences in college students. The Mental health evaluation index system will be described as follows (Table 74.3):

74.5 The Assessment Model for Mental Health

By using the method above, we can get the judging index at all levels which affect the mental health, the Analytical Hierarchy Process (AHP) is used to determine the value of each index weights. Then, we assess the mental health of students through the use of fuzzy comprehensive evaluation.

Because the contribution which is made by each indicator $U_i, i = 1, 2, \cdots, n$ to psychological health assessment results is different, we need to determine weight

Table 74.3 Mental health evaluation index system

	The primary indicators weights	The secondary indicators weights	The tertiary indicators weights
Mental health evaluation index system U	The personality measure	The complete and unified personality	The correct belief system
			The reasonable view of the world
			The correct outlook on life
		The emotional test	The emotional stability
			The mood optimistic
	The adaptability	The social adaptability	The ability to adapt to the environment
			The ability to deal with social life
			The interpersonal skills
	The cognition measure	The self-perception	The self-confidence
			Self-esteem
			Spontaneous Development of one's Own
		The sound will	The consciousness of action
			The decisiveness of the action
			The tenacity of the action
			The self-control of the action
	The capacity measure	The brainpower test	The intelligence test
			The creativity test
		The test of the achievement	The achievability

Table 74.4 The evaluation results

Grade indicators	Good 100–80	Normal 79–60	Mildly abnormal 59–40	Obviously abnormal 39–0
The correct belief system	4	5	1	0
The reasonable view of the world	5	4	1	0
The correct outlook on life	2	5	2	1

coefficient of each indicator to measure its contribution. First, we make the problem hierarchical. According to the influence brought by the various indicators which are about the mental health assessment, through the AHP, focusing on comparison between any two indexes, now we can construct the primary index

judgment matrix. When the results we got are indicated by the scale method of the Analytic Hierarchy Process, we can get the judgment matrix p as follows:

Assume that the evaluation team has 10 people, and they evaluate the student Mike's each indicator which is in "the complete and unified personality". They will get the evaluation results in Table 74.4 as follows.

$$P = \begin{bmatrix} 1 & 1/4 & 2 & 1/3 \\ 4 & 1 & 3 & 1/2 \\ 1/2 & 1/3 & 1 & 1/3 \\ 3 & 2 & 3 & 1 \end{bmatrix} \tag{74.5}$$

We can get the evaluation matrix R_{11} by normalizing in row as follows:

$$R_{11} = \begin{bmatrix} 0.4 & 0.5 & 0.1 & 0 \\ 0.5 & 0.4 & 0.1 & 0 \\ 0.2 & 0.5 & 0.2 & 0.1 \end{bmatrix} \tag{74.6}$$

In order to make the evaluation intuitive and easy to sort, we give the judgment set V = {good, normal, mildly abnormal, obviously abnormal} different value which corresponds to different grade. The specific valve V is {90, 70, 55, 35}, make $F = (90, 70, 55, 35)^T$.

We can get the following results according to the formula (74.1)–(74.4). The value of Mike's comprehensive evaluation is $B \circ F = (0.3029, 0.4939, 0.1568, 0.0464) \circ \begin{bmatrix} 90 \\ 70 \\ 55 \\ 35 \end{bmatrix} = 72.082$, We can conclude that the psychological health of Mike is normal.

74.6 The Conclusion

By measuring students' mental health indicators and the use of comprehensive evaluation method 4 of fuzzy mathematics, we get the classification level of the mental health of students. At the same time, we also studied the fuzzy evaluation criteria, the fuzzy relation matrix and fuzzy algorithm and obtained a satisfactory conclusion. So far, there have been a variety of comprehensive evaluation methods for psychological assessment. However, it does not mean that the comprehensive evaluation method has been perfect. There is lot of problem that need research constantly. Unfortunately, because the data source is limited, this article concerns only a relatively simple psychological assessment system. The ultimate purpose is that we hope that the paper can improve the experience of psychological assessment model and can give a more scientific adjustment or treatment recommendations.

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Chapter 75
Predictive Model of Population Growth in China

Zhijiang Wang, Jixun Song and Xiaolong Zhang

Abstract The population projections must be based on three basic elements fertility function, mortality function, and migration functions. In order to build predictive mathematical model of China we use the age shift operator algorithm, consider the discrete changes in characteristics of the population over the year to indirectly deduce the parameters of the state variable as a variable factor. Relay on the continuous population model and integral mean value theorem, the eventual establishment of forecast China in the short to medium-term and long-term population development of a discrete model of differential equations.

Keywords Discrete model · Reproductive mode function · The average fertility rate · Age-shift operator

75.1 Introduction

China is a populous country. The population issue has always been one of the key factors restricting the development of our country [1, 2]. According to available data we use the method of mathematical modeling analysis and forecast of the Chinese population as an important issue [3, 4].

There have been some new features of the development of China's population in recent years [5–7], for example, the aging process to accelerate the sex ratio at birth continues to rise, as well as the rural population urbanization and other factors, which affected the growth of the Chinese population [8–10].

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Based on the materials and the actual situation, as well as the characteristics and laws of population growth, we establish the mathematical model of China's population growth.

75.2 Analysis

75.2.1 Population Projection Model Analysis

Human is the main social development. The changes of population trend is an important effect of socio-economic development, thus the population forecast is an extremely important thing. There are two mathematical model of the population development process, one is deterministic model, the other is stochastic model, and each model is not only continuous model (partial differential equations), but a discrete model (differential equations).

The population projection is based on the basic data of the existing population parameters and taking into account the budget to make some changes on the future development of the population that may occur in future periods. The population projections in accordance with the length of the forecast period can be short-term, medium-term, long-term population projections. The forecast is generally the case of those more than 30 years or longer (e.g., 50 years) are long-term forecasts.

From the general sense, according to the forecast period can create different forecasting models, especially taking into account the discrete nature of time (years), long-term population projections are more suitable for the discrete model of the differential equations, and these models have high accuracy for short-term population, so combined with the requirements of this subject to forecasts the population for the short and medium term and long-term after 2005. We finally selected the use of age-shift operator principle of the discrete model found first-order differential equations.

75.2.2 Predict Parameters Analysis in the Population Projections Model

The population projection parameter refers to the conditions or elements based on population projections. Due to demographic changes in the future are always three basic elements which determined by the fertility function, mortality function and population transfer function. So the development and design of the population projection model are usually based on these three elements. But the combination of the data of the Schedule to this question, we have ignored the population migration factors, assuming that our population does not appear migrate or move into and move out of balance in the forecast year.

The reproductive patterns function, the average fertility rate of childbearing age for women and childbearing age women age sex ratio functions are internal factors that affect the birth rate, and thus can be used as the population projection parameters.

The above parameters function are binary function connect of year, age-related and is difficult to use statistical data to estimate, we assume that the future forecast year has no incidences (such as war, natural disasters, etc.), the above data in 2005 as the forecast-based data into the forecast, and in accordance with the basic data in 2005 to solve the model.

75.2.3 The Direction of Population Projection Model to Predict Analysis

Schedule in the upper right corner of the years of data gives us a sample survey of city (male/female), town (male/female), and township (male/female) basic data, for which we can roughly be obtained the proportion of city, town, township in that year. Statistical Yearbook give the total population in 2005 is about 1.30756 (billion). So we can get the total urban population in 2005 is approximately 362.41317 (million), the total urban population of about 223.9325 (million), the total rural population of about 721.2143 (million).

Further analysis of the Schedule data can be found, the data of the years have the same nature in the city, town, township, and the data established the basis of the mode. We forecast the country's population by city, town, and township and divided into three directions, the last we can predict the country's total population of that Year.

75.3 Model Assumes

In the forecast, assumption the mortality rate of all ages is fixed, and does not consider the impact of population mobility on the original model.

We suppose the proportion of the population of city, town, and township date that the data is determined in 2005 population sample survey.

Assume that women of childbearing age can birth a maximum of one times within a year, one times can only give birth to a child, the infant mortality rate from birth to 1 year period.

Assumption does not occur in the war, large-scale natural disasters and other unexpected events.

We assume that the question of the measured data is relatively accurate with no greater error.

The age unified by the 90-year-old, if the age of the population over 90.

The case of a serious imbalance in the proportion of men and women does not appear if the Government will implement policies to control the boy or girl,

If they were women of childbearing age the fertility of each of women and each age is the same, and give birth to boys and girls is a random event.

75.4 Explanation of Symbols

a	Said age (years)
t	Represents time (years)
$N(t)$.	Said that the total number of the population when the moment of t
$N(a,t)$	Said the total population of all younger than a when the moment of t
$x_i(t)$	During t years the total number of population of age between i and $i+1$. We integer here i as 0, 1, 2… Etc.
$p(a,t)$	Represent the population density function
$\mu(a,t)$	Relative mortality function
$\mu_{00}(t)$	Infant mortality rate
$\mu_i(t)$	As t years i-year-old age mortality
$\phi(t)$	The total number of infants born within 1 year
$\beta(t)$.	Annual women's average fertility rate
$k_i(t)$.	The proportion of female population in this age group
$h_i(t)$	Fertility patterns
$H(t)$	Transfer matrix of the population from t to t year
$B(t)$.	Fertility matrix

75.5 Model

We consider the continuous population evolution equations, age a and time t as continuous independent variable. This model is more convenient in the theoretical analysis, but not suitable for numerical computation and demographic analysis. In the quantitative calculation, in order to use the computer to solve the evolution equations of the population, we should discrete the age a and time t. Discrete a and t usually take them as integer values and take years as unit, and thus a continuous population development equation becomes a differential equation, which is the discrete model of the population of the development process. This model is not only suitable for computer calculation, simulation and data processing, but is consistent with the concept and the traditional demographic. Therefore, we consider a discrete model to predict the short-term and long-term trends in the Chinese population.

75.5.1 The Population Density Function

We make Binary function of the population $N(a,t)$ of the age a of first-order partial derivatives, i.e., $p(a,t) = \partial N(a,t)/\partial a$.

If $a_2 > a_1$, then $N(a_2,t) > N(a_1,t)$, a_m said that human beings can live up to the maximum age (this question is to take 90-year-old), then $p(a,t) \geq 0$, $p(a_m,t) = 0$.

We study that

$$x_i(t) = \int_i^{i+1} p(a,t)da, i = 0,1,2,\cdots,m \tag{75.1}$$

The total population of all age $x_0(t), x_1(t), x_2(t), \cdots, x_m(t)$, $x(t) = \{x_0(t), x_1(t), x_2(t), \cdots, x_m(t)\}$, $x(t)$ called the population of the state vector.

75.5.2 Modeling

During the t moment the population during age $[a, a+\Delta a]$ is $p(a,t)\Delta a$. When Δt time passed, at the moment of $t+\Delta t$ some people due to various reasons to death, the number of deaths is $\mu(a,t)p(a,t)\Delta a\Delta t$, while others live to the moment $t+\Delta t$, become the age of the $\left[a+\Delta a', a+\Delta a+\Delta a'\right]$. Noted a and t have the same dimension, and $^{da}/_{dt} = 1$ so $\Delta a' = \Delta t$. At the moment of $t+\Delta t$, the population number during age $\left[a+\Delta a', a+\Delta a+\Delta a'\right]$ is $p\left(a+\Delta a', t+\Delta t\right)\Delta a$ and obviously the following relation holds:

$$p(a,t)\Delta a - p\left(a+\Delta a', t+\Delta t\right)\Delta a = \mu(a,t)p(a,t)\Delta a\Delta t$$

It can also be equivalent to write

$$p\left(a+\Delta a', t+\Delta t\right)\Delta a - p(a,t)\Delta a = -\mu(a,t)p(a,t)\Delta a\Delta t$$

The above equation on both sides integrate from i to $i+1$, and make $\Delta t = 1$ (1 year), according to (1) can be obtained

$$x_{i+1}(t+1) - x_i(t) = -\int_i^{i+1} \mu(a,t)p(a,t)da, i = 0,1,\cdots,m-1 \tag{75.2}$$

We used integral mean value theorem on the right hand side, and

$$\int_{i}^{i+1} \mu(a,t)p(a,t)da = \mu(\xi,t)x_i(t), \xi \in [i, i+1]$$

Among them $\mu_i(t) = \mu(\xi, t)$, and conditions (75.2) becomes

$$x_{i+1}(t+1) = x_i(t) - \mu_i(t)x_i(t), i = 0, 1, \cdots, m-1 \tag{75.3}$$

By cybernetics we can study $\phi(t) = \beta(t) \sum_{i=a_1}^{a_2} \int_i^{i+1} k(a,t)h(a,t)p(a,t)da$

The women of childbearing age interval are $[a_1, a_2]$ (e.g., $[15, 49]$ in this paper). We apply value theorem on the right side

$$\phi(t) = \beta(t) \sum_{i=a_1}^{a_2} k_i(t)h_i(t)x_i(t) \tag{75.4}$$

Among them $h_i(t)$ meet the formatting condition $\sum_{a_1}^{a_2} h_i(t) = 1$

We define the infant mortality rate $\mu_{00}(t) = \frac{\phi(t) - x_0(t)}{\phi(t)}$

So we obtained a new equation

$$x_0(t) = (1 - \mu_{00}(t))\phi(t) \tag{75.5}$$

Simultaneous Eqs. (75.3,75.4, 75.5) up and get a complete discrete equations of population development:

$$\phi(t) = \beta(t) \sum_{i=a_1}^{a_2} k_i(t)h_i(t)x_i(t)$$

$$x_0(t) = (1 - \mu_{00}(t))\phi(t)$$

$$x_1(t+1) = (1 - \mu_0(t))x_0(t)$$

$$x_2(t+1) = (1 - \mu_1(t))x_1(t)$$

$$\cdots\cdots$$

$$x_m(t+1) = (1 - \mu_{m-1}(t))x_{m-1}(t)$$

This is a differential equations used all the year as time interval.

75.6 Model Solution and Results Analysis

Obviously, the solution process of the above model is a recursive process, each variable used data for the 2005 are binary function in the model. Then according to the model were obtained the 2006 data on the population of the city, town,

Table 75.1 Population projections in table (unit: million)

Time	City	Town	Township	Population
2006	36200.39	22656.96	72890.3	131747.6
2007	37156.97	22935.15	73748.7	133840.8
2008	37610.39	23205.28	74604.3	135420
2009	38059.15	23470.77	75475.2	137005.1
2010	38496.86	23738.72	76371.4	138607
2011	38920.42	24011.99	77304.5	140236.9
2012	39330.91	24288.62	78281.1	141900.6
2013	39726.8	24571.33	79278.5	143576.6
2014	40106.31	24853.82	80298.9	145259
2015	40465.71	25133.23	81308.1	146907
2025	42592.06	27291.99	89573.2	159457.3
2035	43170.88	28377.43	93986.6	165534.9
2045	42364.98	28611.52	95833	166809.5
2055	39097.41	27757.99	96235.3	163090.7
2065	34296.93	25596.7	94019.4	153913
2075	30949.65	25054.1	96878.2	152882

township, but cannot calculate the value of $\beta(2006), h_i(2006), k_i(2006), u_i(2006)$, so we can not directly in accordance with the situation in 2005 solved the equation by use the 2006 data, so we can only assume $\beta(t), k_i(t), \mu_i(t), h_i(t)$ are the age-related variables, these data in 2005 as a constant, and $H(t)$, $B(t)$ are constant matrix. Among them

Fertility rate = the proportion of women × women's fertility rate (the same age)

Total number of babies $= \sum_{i=15}^{49}$ the total population × fertility

$\beta(t)$ = Total number of babies/the total number of women of childbearing age

$k_i(t)$ Can be directly derived from the table

$\mu_i(t) =$ Proportion of male × male mortality + proportion of female × female mortality

$h_i(t) = \frac{f_i(t)}{\beta(t)}$

Then according to the model to predict the future population growth, and then using MATLAB calculated specific forecast data, see the Table 75.1 Calculate each age specific population data and long-term population data in the next 10 years.

It expected that in 2040 China's total population will reach its peak, more than 1.6 billion population, and this number will also be the highest peak of China, so the total number of long-term forecasts will also be acceptable in this range.

Taking into account the national population development strategy, long-term population forecast period bound to the year of population decline, combined with Table 75.1, we predicted China's population will begin to decline iby the 2040s. They also reflects the development of the total population in the twenty-first

century and after the 2070s tend to equilibrium the total population will be fluctuated between 1.5 and 1.55 billion.

The state will implement the necessary policies to the population, national population development stage strategic objectives: by 2010, the total population control to 1.36 billion people and the quality of the population is significantly improved; by 2020, the total population is controlled at 1.45 billion, substantially improve the quality of the population; by the middle of this century, the population peak will be controlled at around 1.5 billion, per capita income reached the level of moderately developed countries. Population quality and health standards are across the board. Taking into account the policy impact of human factors, the highest peak of China's total population will not reach the predicted value and the total population of the stability of the time will advance. Under the regulation of policy the sex ratio is gradually close to balance China's population will reach a stable state.

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Chapter 76
Training Management of High-Level Sports Teams in Ordinary Universities Based on Mathematics Model

Chunzhong Liu

Abstract With the strategic readjustment of China's education system reform and social needs of talent, there is the promotion of higher education to meet college students' moral, intellectual, physical, and other aspects of the comprehensive development of a comprehensive talent. Sports as a competitive exercise, is also a measure of the strength of a university standard, various colleges and universities have set up their own sports teams, recruitment of physical good as an athlete in college students. Colleges and universities should make efforts to run the excellent sports teams, and we must first establish and improve training the management system. Only through this we can develop the high level of university sports team building and promotion of athletes' level. Through literature survey and content analysis methods and the use of management of the related theory, college sports team's training management models were analyzed to provide a scientific basis for rational decision making of school leaders and managers.

Keywords Ordinary universities · High-level sports teams · Training management system · Literature survey · Content analysis method

76.1 Introduction

Sports reform and social development is the new requirements in twenty-first century [1]. At present, under China's national conditions, the development of competitive sports out of a single system to achieve diversified development

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pattern; ordinary institutions of higher learning how to play an educational and scientific and technological advantages to develop national outstanding college athletes; extensive training system into intensive cost-effective training system, to ensure that the sports sustainable development, and so these problems have a significant impact on the overall development of sports in the state of the twenty-first century [2], made from practical and theoretical scientific answer is very important [3, 4].

With the strategic readjustment of China's education system reform and social needs of talent, to promote higher education to meet college students, moral, intellectual, physical, and other aspects of the comprehensive development of a comprehensive talent. Sport as a competitive sport, college sports is also a measure of the strength of a university standard, various colleges and universities have set up their own sports teams, recruitment of physical good as an athlete in college students [5]. Colleges and Universities Should efforts to run the excellent team of sports teams, we must first establish and improve training management system, and only through this in order to develop the high level of university sports team building and promotion of athletes' level.

This paper through literature survey and content analysis methods and the use of management of the related theory makes an analysis of college sports team's training management model to provide a scientific basis for rational decision making of school leaders and managers.

76.2 College Sports Teams Overview

With the rapid increase of China's international status at the same time, the International Athletic Strength of the Chinese athletes is not so excellent, competitive sports as athletes in an activity of the exchange between countries, compared to sports in the United States, the overall strength of China's Athletics Strength still appears slow growth, poor management model, athletes comprehensive cultural quality of the overall trend in competitive sports, the progress made in reform and innovation of the athletes training is not enough, as is shown in Table 76.1 and Fig. 76.1.

Table 76.1 China-US contest project record table

	World college students sports records		The U.S. college students sports records		China college students sports records	
m	Male	Female	Male	Female	Male	Female
100	10.08 s	11.00 s	10.07 s	11.08 s	10.65 s	11.72 s
200	19.72 s	21.91 s	20.03 s	22.20 s	21.63 s	23.61 s
400	44.98 s	50.35 s	43.86 s	50.62 s	46.92 s	52.74 s
800	1min 43.3 s	1min 57.6 s	1min 43.57 s	1min 50.9 s	1min 50.4 s	2min 13.2 s
1500	3min 38.43 s	4min 5.35 s	3min 33.1 s	4min 8.9 s	3min 49.4 s	4min 37.6 s

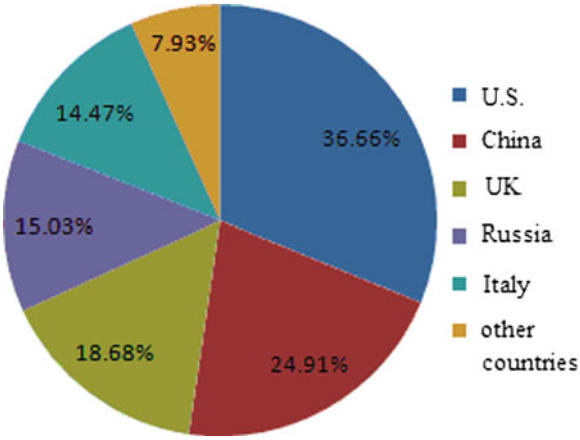

Fig. 76.1 Elite athletes ratio of countries in the world

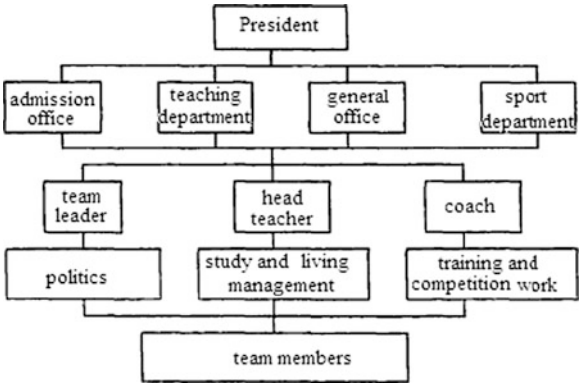

Fig. 76.2 Management structure of high-level sport team in college

At present, most of the country's domestic colleges and universities set up high-level sports teams, most of its training and management structures are more similar, mainly through the establishment of the Leading Group of the high-level sports teams to carry out day-to-day management of training and other transaction processing [6]. Under normal circumstances, the principal of the school in charge of sports play a leading group of sports teams, the training management structure system as is shown in Figs. 76.2 and 76.3.

Currently, colleges and universities are the introduction of management by objective system during the training management process, according to University sports teaching situation and the development of China's State Sports, a specific target system, follow these steps as is shown in Fig. 76.4. First we determine college sports teams related to organizational structure, followed by the training set of college sport management objectives, analysis and evaluation of training management objectives and, finally, management, evaluation and feedback on various subgoals to the next step for more detailed training objectives divided provide the basis [7].

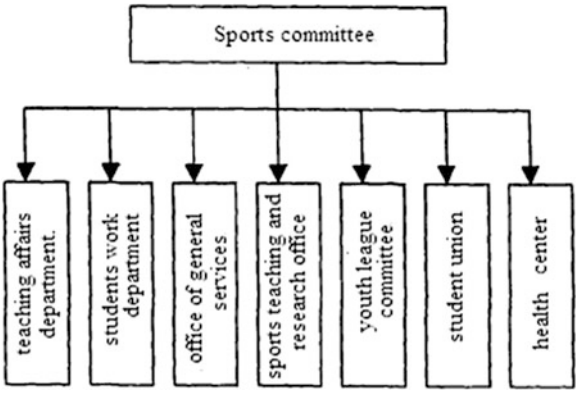

Fig. 76.3 Management organizations of college sports teams

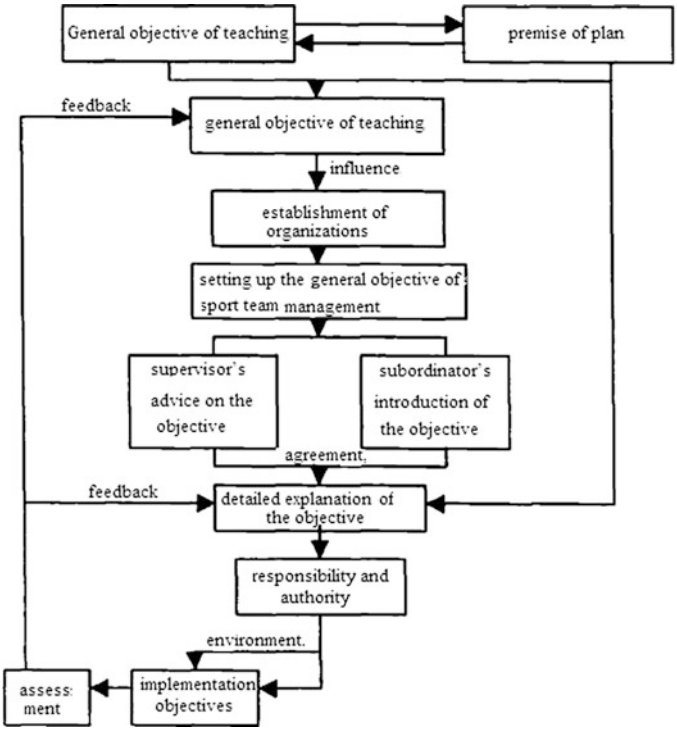

Fig. 76.4 College sports team management process

76.3 Management and Evaluation System of College Sport Team Training

76.3.1 Determine the Evaluation Index System

This paper uses the content analysis. Content analysis based on different research areas, the corresponding model of the corresponding system analysis model, and a more complete model of the current development model of linguistic analysis, index analysis model and feature analysis model, and so on. The model is mainly used in this paper as system analysis model. There are four aspects of the model, the required analysis of factors, including [8]: the analysis object frequency; the weights of the analysis of the object; to analysis to judge the value of the object; the analysis of the logical relationship of the object. Research procedures of the content analysis method can be divided into five parts, as follows: the content sampling and sampling to select the sports teams of different colleges and universities were randomly selected to ensure that the samples can objectively reflect the current management of the college sports teams actually. Index selection, sampling, summary extract an indicator, and select a relatively high frequency as the two indicators, two indicators are an indicator about their relationship affiliation. Quantitative analysis, level indicators and two indicators, frequency statistics, in accordance with their proportion arranged in order to reflect the weights of the college sport management influencing factors. reliability testing. To ensure the study of scientific rationality, and then a random sample of the total sample, repeat the above steps, the results obtained with the previous results are compared to detect whether consistency, According to the quantitative analysis and reliability testing to determine the indicators of the management evaluation system of the college sports teams. Content analysis, training management evaluation include the following, shown in Fig. 76.5.

76.3.2 Establishment of Mathematical Models

In this article, is the element method of calculation, the weights of the various training and management indicators multiplied by the scores of their income, then the sum method? The main models are as follows [9, 10].

$$F = \sum_{i=1}^{m} P_i \omega_i \tag{76.1}$$

$$P_i = \sum_{j=1}^{n} x_{ij} p_j \tag{76.2}$$

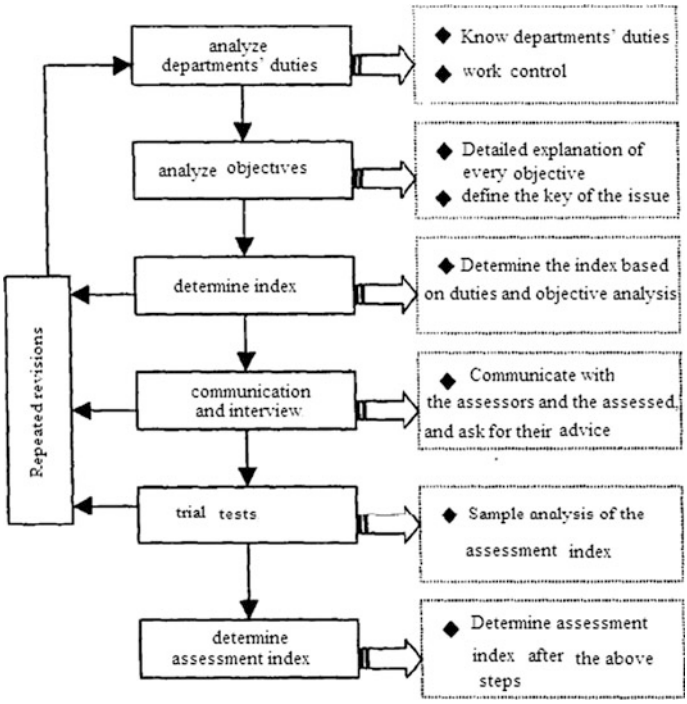

Fig. 76.5 Training management index flow chart

$$\sum_{i=1}^{m} a_i \omega_i, \sum_{i=1}^{m} a_i w_2^i, \cdots\cdots, \sum_{i=1}^{m} a_i w_n^i \tag{76.3}$$

$$W^k = B_k \bullet B_{k-1} \bullet \cdots\cdots \bullet B_2 \bullet B_1 \tag{76.4}$$

$$C_{.1} = \frac{\lambda_{\max} - n}{n-1} \tag{76.5}$$

In the above equations, F is the final overall evaluation score; ω_i indicates a single weighted value of the training elements (indicators); P_i is the score of experts to a single training elements (indicators), $x_{ij}$is the ith training management indicators in the jth evaluation elements from the final score; p_j indicates the proportion of the end of the first j elements of evaluation. In the equations, aij values can refer to Table 76.2. The first index weights Ai = i index is the frequency divided by the number of samples (i = 1, 2, 3, 4); the second index weights aij = aij appear frequency is divided by (ai1 + ai2 + ai3 + ⋯ aij of frequency), and aij is a subsidiary of i-level indicators index of the jth second indicators [11].

Table 76.2 Aij assignment referring table

Relative importance aij	Definition	Meaning
1	Equally important	Objective i and j are equally important
3	Slightly important	Objective i is slightly important than j
5	Very important	Objective i is very important than j
7	Obviously important	Objective i obviously important than j
9	Absolutely important	Objective i absolutely important than j

76.4 College Sport Team Training Management Measures

(1) The importance of the coach candidates

In the use of the coach, the school should create a comfortable environment for coaches and provide the necessary conditions. Schools should pay attention to the characteristics of competitive sports, follow the laws of competitive sports, taking fully into account the particularity of exercise training, a special management training instructor and coach in school leadership, the division of labor system; not the coach's training methods, training methods and training process be too much intervention.

(2) Sports teams athletes selection

Athletes should be chosen from multichannel and multifaceted. From the high technical level of the professional league selection of athletes, from high school selection, and select potential athletes from the testing of athletes younger.

(3) Scientific and rational training management

Athletes admitted to the university should implement a comprehensive management, research, and training athletes to develop the particularity of an effective management system, according to the special nature of the result of years of training, may be appropriately extended to learn a fixed number of year, you can take a more flexible teaching and assessment methods to relax the range of elective courses.

76.5 Conclusion

In recent years, the building of the college sports teams has been getting the strong support of the government and universities. Through the collaboration of other relevant departments of the school, and through the efforts of all coaches of the sport and art of teaching ministry, we have constructed a diligent study and are willing with dedication, to encourage and coach teams. With high-level sports team management and coach, training organization managers should take full account of the sports specialty training objectives for our training programs,

training programs must adapt to the needs of the development of the social situation. At the same time, coordination and improving colleges and universities management of high-level sports teams is an important task.

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Chapter 77
Research on the Role of Vocabulary in the Teaching of English Writing Based on Mathematical Statistics Law

Lihua Yang

Abstract In this paper, the role of vocabulary in the teaching of English writing is described. We use mathematical methods to analyze the role of vocabulary in English writing and take sophomore students in a test case as an example for analysis, highlighting that the vocabulary accumulation can effectively promote writing and teaching quality, and derive a mathematical model to the English writing teaching and provide theoretical support for the improvement of students' English proficiency.

Keywords Vocabulary · Teaching of English writing · Mathematical analysis · Model · Mathematical statistics

77.1 Introduction

As communications, transportation, and technology continue to evolve, the pace of globalization continues to promote the exchange of different languages, which is becoming increasingly common. With the rapid development of today's linguistics, English is a language used by most of the world's countries and a large number of people [1]. English education in China has spread to middle school students, the quality of English teaching is what people pay attention to. Affected by the traditional exam-oriented education, English teaching examination-oriented thinking is getting more prominent.

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In recent years, the country's economic development has been rapid, so there is intense thirst for knowledge and access to international knowledge, which requires a good grasp of English. Hence we need to develop more English talents [2, 3]. Accumulation of vocabulary in English teaching has a direct impact on the quality of teaching, but also affects the quality of the exchange. In addition, the role of vocabulary in the examination is important [3, 4].

The accumulation of vocabulary in English writing has a very important position, and the quality of writing is closely related. Many scholars in the study found that students 'foreign language writing the biggest factor is the lack of vocabulary, which is also the greatest difficulty encountered by the students' writing [5]. Ma Guanghui and Qiufang use the LISREL program to make an in-depth analysis, and the study found that the accumulation of vocabulary has a direct impact on English writing skills [6]. Those who can get high writing scores are often students with rich vocabulary.

77.2 Relationship Between Vocabulary and Writing Teaching

Vocabulary use is largely manifested through writing, but also to some extent reflects the level of the teaching of writing. Writing the total number of words, that is, the length of the text, is generally considered an important indicator to measure writing fluency in writing. Vocabulary and writing teaching relationship studies have focused on each other; their correlation is mainly reflected in the composition of the total number of words and writing teaching methods, but also the richness of vocabulary, little in this regard to the length of the text and vocabulary on the comprehensive consideration. Ma Guanghui and Qiufang then make a speculation after their study: They speculate that the greater the students master the vocabulary, the vocabulary used to express more things written in the writing will be more, thereby increasing the length of the article, improving writing level, and promoting the quality of teaching [6]. In the richness of the vocabulary in the vocabulary and writing teaching performance, Engber's analysis obtained by studying found that the correlation coefficient between the richness of teaching writing skills and vocabulary of about 0.43, also come to that the lower writing teaching is, the higher vocabulary reproduction ratio will be.

The teaching of writing is a very important part in foreign language teaching, which has been playing an important role. For university education, a 4 year undergraduate English teaching can encourage students to master English words and simple dialogue, the quality of the teaching of writing is a prerequisite [7]. The State Education Commission announced a new College English Syllabus in 1985 to more stringent norms put forward new demands in the English writing skills for college students in English language proficiency required to complete the University four English learning students in accordance with the subject and outline of the proposed write essay of not less than 100 words within 30 min, and

can express their ideas, to avoid syntax errors. The teaching of English writing in order to cultivate students' English writing skills, and promote students to master the writing and presentation skills, complete a simple conversation and writing. English writing as a traditional teaching subjects, the purpose is to let with the integrated use of language ability, and expand the thinking ability of students in English discourse. With a rich vocabulary, combined with good writing and level of education, non-native speakers will be able to write idiomatic English for full understanding of English and Chinese language and cultural differences is necessary. Vocabulary and writing quality of teaching satisfaction trends can be made in accordance with the relevant research and mathematical analysis, the smooth curve in Fig. 77.1 marked the vocabulary and writing quality of teaching satisfaction. Through mathematical methods we can draw the curve formula [8]:

$$y = -0.1094Ln(x) + 0.4853 \tag{77.1}$$

77.3 Mathematical Analysis of the Role of Vocabulary in English Writing Teaching

77.3.1 Research Object

To further analyze the role of vocabulary in English writing and to draw the theoretical model guiding significance, the article uses mathematical methods to investigate and study, combined with the statistical theory of a school sophomore English test as the analysis object [9].

The students taking the exam are from two natural classes, with a total of 148 people. Students take the exam in the primary and secondary schools are similar to English learning experiences in college, and their English teacher is the same person.

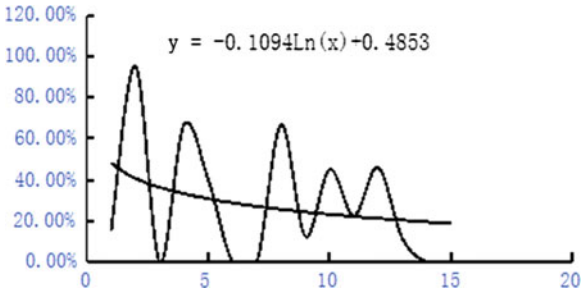

Fig. 77.1 Geometric curve of vocabulary and writing teaching satisfaction

77.3.2 Testing Means and Methods

(1) Writing within the time limit

This test means refers to the subject of known composition, which was required within the given time to write an English essay [10]. For instance: the essay topic is "Taught by Teacher or Parents", and gives an outline. The first paragraph is with the subject "The present situation of teaching", and the second is "The advantages and disadvantages of taught by the teacher or parents," and the third paragraph with the subject is "solutions to the problem". The stipulated time for half an hour, there is no word limit. Score standard is CET 15-point scales. There are two testers, and have participated in the CET marking work. The average score of the two examiners is the final score.

(2) Vocabulary test

The measurement tools used in this study is vocabulary test, Paul Nation, "10,000 vocabulary test, namely: controlling output vocabulary test (controlled productive vocabulary test). In abroad, the majority of researchers are using this tool, because it is not time-consuming, with a certain degree of reliability and validity, but also can effectively measure was word mastery. For example: There are 20 incomplete sentences, and they were asked to part of speech and word form are correct, according to the context and the beginning of a few letters to fill in the appropriate word.

77.3.3 The Analysis of Relative Data

(1) The examinations carried out a descriptive analysis of limited composition analysis to analyze the textbook identifies students master the vocabulary and writing vocabulary[11, 12].Table 77.1 is the class standard vocabulary and writing words statistics which Fig. 77.1 shows the class standard vocabulary and writing words histogram statistics.

According to the statistics in Table 77.1 and Fig. 77.2 and descriptive results, it can be seen that the ordinary high school textbooks identifies the vocabulary of the average of 1557.96 word, less than half of the ordinary high school graduate

Table 77.1 Statistics of the standard vocabulary and writing vocabulary

		The number of students	Average deviation	Standard deviation	Standard deviation
Standard vocabulary	1	74	1661.75	457.666	53.203
	2	73	1452.64	669.325	78.332
	Total	147	1557.96	580.233	47.851
Writing vocabulary	1	74	885.72	271.962	31.613
	2	73	846.81	325.271	38.074
	Total	147	866.45	299.232	24.686

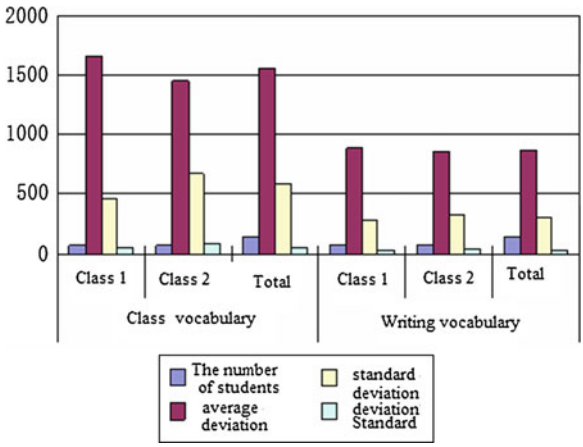

Fig. 77.2 Histogram statistics of standard vocabulary and writing vocabulary

master class standard vocabulary; students' writing to use the average vocabulary of 866.5 words, the proportion of a quarter of the course standard vocabulary, comprehensive evaluation of secondary school students can be drawn the level of vocabulary is not optimistic, but also indirectly reflects the level of English Writing at not.

(2) Paul Nation "10,000 levels of vocabulary test is used for the measurement tool measured data and analysis to study vocabulary richness of vocabulary, text length and composition scores and vocabulary divided into two groups for correlation analysis. Table 77.2 is the influence of two sets of vocabulary in the teaching of writing, and Fig. 77.3 is the histogram of the influence of two sets of vocabulary in the teaching of writing.

From Table 77.2 and Fig. 77.3, we know that group in the length of the text, writing scores, complex words, as well as the T-unit length of the four aspects and we can draw from the analysis in from the first class "l,000 words, the use of point of view more than two groups, a group of vocabulary errors of more than two groups.

Difference significant, we use the *t* test in order to study the indicators of the length of the text, writing scores, complex words, as well as the T-unit length using independent samples. Table 77.3 is the data of the five factors by using *t* test analysis.

Table 77.2 The influence of two sets of vocabulary in the teaching of writing

Vocabulary sets		Writing scores	Writing length	1000 words	Complex words	T-unit length	Vocabulary errors
Group 1	Average	8.23	162.3	81 %	8 %	11.19	1.3
	Standard	2.32	34.54	0.032	0.026	1.92	1.45
Group 2	Average	8.91	185.14	79 %	10.49 %	11.52	1.08
	Standard	2.06	39.35	0.044	0.035	2.04	7.25

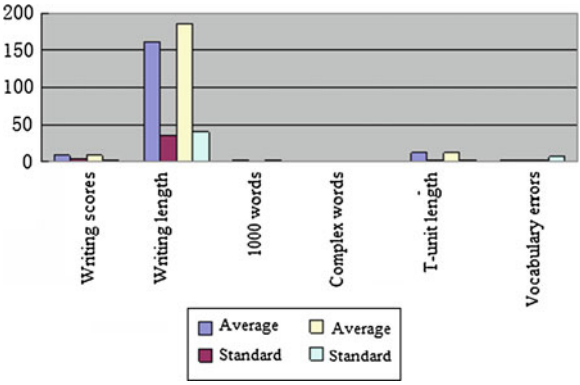

Fig. 77.3 Histogram of the influence of two sets of vocabulary in the teaching of writing

Table 77.3 Data of the five factors by using *t* test analysis

	Average	Range	Minimum	Maximum	Deviation	Peak
Vocabulary	5.72	13	0	13	3.24	−0.29
Writing score	8.84	10	3	13	2.23	−0.04
Text length	176	193	103	296	39.19	0.47
T-unit length	11.35	8.21	7.92	16.13	2	−0.3
1,000 words	79.9 %	20 %	68 %	88 %	0.045	0.15
Complex words	9 %	16 %	3 %	19 %	0.038	0.25
Vocabulary errors	1.05	15	0	15	1.1	18.46
T value	Writing Score	Text length	Complex	Words	T-unit length	
	−0.97	−2.43	2.87	−4.01	−0.75	

77.4 Conclusion

This paper uses mathematical methods to make a systematic analysis of the role of vocabulary in the English writing teaching, combined with relevant examples to analyze the role of vocabulary in English writing, thus emphasizing the accumulation of vocabulary can effectively promote writing skills and quality of teaching. The use of mathematical methods to analyze the results is more convincing, which proves to be a powerful guide in the teaching of writing.

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Chapter 78
Analysis of College Students' Employment and Entrepreneurship Based on Mathematical Statistic Law

Jianfeng Cui and Tao Xiong

Abstract This paper analyzes the status quo of the current college students' employment and entrepreneurship. And combined with the survey instances, this paper made a depth analysis of the different views and trends of college students for employment and entrepreneurship. We use the university graduates in a city as the object of study to make college students employment and entrepreneurship analogy, pointing out the differences in college students' employment and entrepreneurship, the existing problems and its solutions.

Keywords College students · Employment and entrepreneurship · Analogy analysis · Mathematical statistic law

78.1 Introduction

According to statistics from related departments in the past 5 years, China's annual increase in new demand for labor total about 18 million, but annual supply of labor during this period about 20 million, will inevitably lead to 2 million of the surplus labor [1, 2]. From the overall situation, the current performance of our labor: more than one a lack of the situation, the overall labor supply than demand in the professional and technical research type and supply of engineering talent is less than demand. The Years 2000–2009 university graduates and the increase of comparison are shown in Table 78.1; Fig. 78.1 is the growth curve of the number of graduates [3].

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DOI: 10.1007/978-1-4471-4853-1_78,

Table 78.1 The number of university graduates from 2000 to 2009 and their increase in comparison

Years	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
The number of graduates (10,000)	107	115	145	212	280	340	413	495	559	611
Year-on-year growth (%)		7.4	26.1	46.2	29.2	21.4	21.5	19.8	12.9	9.2

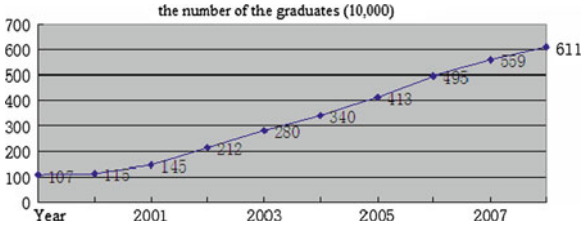


Fig. 78.1 Growth curve of the number of graduates

In 2011 there are nearly 6.4 million college graduates in China, a sharp increase in the number of graduates is to promote employment issues had become the focus of the current society, but also the education departments must face, Employment and entrepreneurship [4]. College graduates leave school after the two roads, but current employment or business, it is extremely difficult in a powerful wave of society. Each graduates are constantly thinking and improving themselves, wanting to excel in the vast sea, seeking suitable but also conducive to the development of a variety of ways. University graduates are often at a loss of career paths of their own employability training and construct so in the face of market demand and are able to adapt to the social good [5]. The face of enormous pressure on employment in many university graduates, have chosen their own businesses, which also attracted the close attention of the community, national government departments have also introduced various preferential policies for entrepreneurship for college students to find a way to encourage and support college students venture, which can alleviate some of the pressure on employment is also able to create value. Pioneer Park of many colleges and universities were established, and made a great contribution and a full range of support for student entrepreneurs [6].

78.2 Comparative Analysis

78.2.1 Comparative Analysis of the Situation

The face of the current economic environment particularity and graduated from the army every year surge in college students on the situation of employment and entrepreneurship, showed a different attitude and choice of employment, entrepreneurship, and careers are not the same. 10,000 graduates for a City University conducted a survey; more than 50 % of graduates think that the current employment

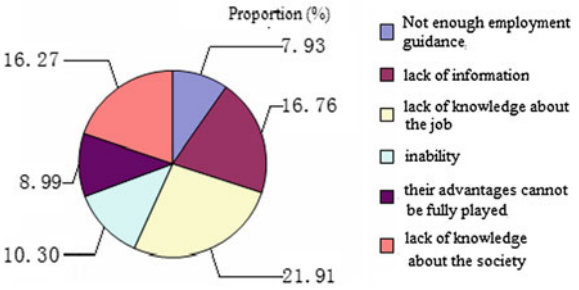


Fig. 78.2 Various factors' proportion the graduates worried about in hunting jobs

Table 78.2 Comparison of student attitudes to employment and entrepreneurship

Employment			Entrepreneurship		
Easy (%)	General (%)	Difficult (%)	Easy (%)	General (%)	Difficult (%)
42	24	34	20	16	64

outlook is more optimistic about employment prospects. Employment situation, 82.47 % of the graduates find employment situation as grim. More than 60 % of the students are very optimistic or more optimistic about the future.

When it comes to the factors that they worried about, 7.93 % of the graduates think that school guidance of the employment is not enough; 16.76 % of the graduates think that the information is less; 21.91 % of the graduates think on the job expertise less well understood; 10.30 % of people think in talking about the distress factors in the job personal capacity; 8.99 % think their own advantage cannot play very well; 16.27 % of the relative lack of understanding of the society. Graduate students participating in the survey, 46 % of students feel that the employment rate of less than 50 %; 25 % of the students that the employment rate from 50 % to 70 %; only a small portion of people think that the employment rate of 70 % and 90 %. Salary requirements, want to get high salary expectations are generally high. Figure 78.2 is the proportion of various annoying factors in the job.

For employment and entrepreneurship situation analysis, we get the mixed views of the 10,000 graduates on different situations. Table 78.2 is the comparison of student attitudes to employment and entrepreneurship.

It can be seen in the face of employment and entrepreneurial graduates that both are not optimistic. Entrepreneurship or employment cannot easily find a suitable career planning, the proportion of less than 50 %. Due to the special nature of entrepreneurship, risk, and investment needs more than cooperation or team the joint efforts of so many students just to get smooth employment.

78.2.2 Tendency Comparative Analysis

For university graduates, the majority of jobs are in favor of the relevant government departments and state-owned enterprises, and give priority to the economy is

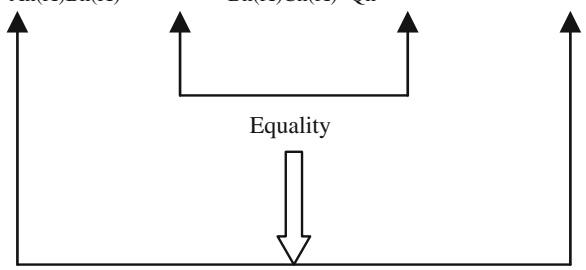
relatively developed the first-line, second-tier cities and the southeast coastal city of choice of employment areas [7]. A city of 10,000 graduates of the situation analysis, nature of work in the relevant government departments and state-owned enterprises accounted for 61.74, 14.39 % of private enterprises, foreign-funded enterprises accounted for 15.61 and 8.26 % would choose their own businesses.

To analyze the choice of work location, those who choose to go to the more developed economies of the first-tier, second-tier cities,and the southeast coastal cities to seek development is the choice of most students, the proportion of 47.30 %; choose to go to the central city to develop their own career, only 32.70 %. Analysis of the reasons that relatively large development opportunities and a good social resources, and protection accounted for 56.64 %; that the living conditions for the pursuit of development accounted for 16.62 %; pure fancy entrepreneurial environment has the advantage of accounting for 6.74 %; determined to return home and contribute to the home construction accounted for 10.87 %; for parents' arrangements or other reasons, respectively 2.13 % and 7 %. Table 78.3 is the employment and entrepreneurial tendency ratio table.

78.3 Analysis of Differences in Employment and Entrepreneurship

We use analogy to make in-depth analysis, analogy argument by the following derivation to demonstrate correct and powerful variance analysis [8].

The analog X	The analogized Y
A1(X)B1(X)	B1(X)C1(X)
A2(X)B2(X)	B2(X)C2(X)
Pn=An(X)Bn(X)	Bn(X)Cn(X)=Qn



Most of the graduates have had the idea of their own businesses, but the capital investment and the accumulation of experience has become the bottleneck of their own businesses. University graduates are not bent staring at the community posts competitors, to the neglect of their own abilities and qualities. As a university graduate, in fact, more should be based on new jobs, the pioneers of new things for the community to create and fight for more employment opportunities.

The characteristics of entrepreneurs of university graduates mainly include [9, 10]: (1) passion is high, but the overall capacity is low. The level of entrepreneurship and quality level directly restricts college students' start their own

Table 78.3 Employment and entrepreneurial tendency ratio table

Nature of the work	State-owned enterprises	Private enterprises	Foreign enterprises		Starting their own career	
Selection ratio (%)	61.74	14.39	15.61		8.26	
Region	Economically developed areas		Central regions		Other regions	
Selection ratio (%)	47.30		32.70		20	
Motive	Good development opportunities	Good living conditions	Good entrepreneurial environment	Parents' arrangement	Making contributions to the hometown	Other reasons
Selection ratio (%)	56.64	16.62	6.74	2.13	10.87	7

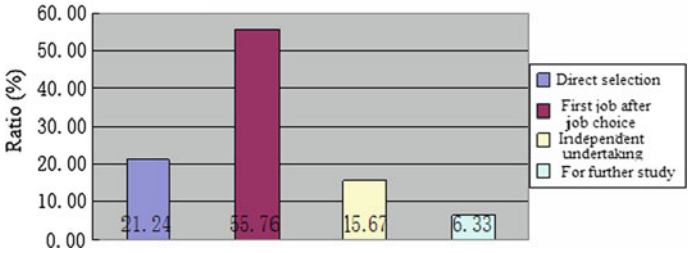


Fig. 78.3 College students' plan after graduation bar chart

businesses probability of success. (2) Susceptible to the impact of public opinion and the impact is profound. (3) The relatively low technology content, operation and sale of a narrow range. Most students choose the Internet to shop, catering industry, management consulting, etc., limitations. (4) The business failure rate, the less successful cases. (5) People have their own business idea, but few participants. College students' plan after graduation is shown in Fig. 78.3.

There are many college students choosing the first job and career, and college students treat Job Hunting on Figure numerical analysis shows that 21.24 % of the step after graduation to get a suitable job and stable income; 55.76 % of people intend for employment after careers; 15.67 % intend to continue their studies; 6.33 % want to start their own businesses. Each individual's career development is a gradual change in the overall ladder type. Graduates according to their own development, initiates to seize opportunities and different jobs experience, and then continue to grow. Some scholars have suggested that currently they do not have access to a more satisfying career, follow the "first employment, after careers, then start" principle is very meaningful.

78.4 The Problems of Employment and Entrepreneurship and Their Solutions

The world economy, the rapid development of economic globalization, in-depth implementation of the main problems of China's employment and entrepreneurship as follows [11]: The career of the rather conservative, cannot keep up the pace, high expectations of career goal. The majority of career motivation is self as the core, cannot be considered as comprehensive factors. Career showed multidirectional instability, and make people feel uncertain. College students toward the society in the process, will encounter a variety of contradictions, leading to consider when choosing a career too much, cannot act decisively to miss the good employment opportunities. Many people do not have a clear understanding of the concept of entrepreneurship, do not understand some basic rules and there is no depth to consider the venture of the necessary conditions, such as funding, contacts, experience, and risk.

78.5 Conclusion

We make an analogy analysis based on the entrepreneurship and employment, and the problems in the graduate employment, the entrepreneurial process, the need to take the following measures: Government departments help increase the employment of university graduates: as much as possible to increase employment opportunities, fully expands employment channels, the establishment of the talent market, held online recruitment for job seekers and employment information for graduate employment, the enterprise system, in order to constantly improve and simplify related procedures and to entrepreneurship procedures and other processes. Higher education institutions offer career guidance and career planning courses to promote students to change their ideas as soon as possible, a clear understanding of the situation. Organizing various seminars and consulting services to enhance students' employment and entrepreneurial awareness, from the psychological and ideological truly recognize the importance and urgency of the current employment from a passive change initiative. Should also focus on training students' hands-on ability to urge college students to grasp theory with practice, and enhance students' ability to solve problems, and thus effectively avoid the expertise out of touch with the needs of the community to prevent the occurrence of unrealistic expectations, etc., to improve the employability of force. College students should have as early as possible a clear understanding of the employment situation, and firmly establish the awareness of career planning to make a reasonable career planning, according to their own situation, starting from the current full use of a good time at university, and continue to study scientific and cultural knowledge. To enhance their professional skills, enrich and improve them, improve their competitive strength. They are in the face of choice of employment and entrepreneurship after graduation, but entrepreneurship is an advanced form of employment. They need to consider the actual situation and give full play to their abilities.

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Part VIII
Information Management Systems and Software Engineering

Chapter 79
Closed-Loop Control System of Single-Phase AC FFU Motor

Yiwang Wang, Bo Zhang and Hui Pan

Abstract Aiming at the demerits of traditional open-loop control system of single-phase alternate current fan filter unit (FFU) induction motor, a speed closed-loop control system of single-phase alternate current induction motor (SPIM) was designed and developed in this paper to achieve high-precision speed regulation control of FFU system. The control system used the dsPIC30F3010 as the control core chip. The control method is discussed and the main hardware circuit and software design are given. Experimental and practical results show that the proposed system is reasonable and has good speed control performance; the system can also meet the control requirements of FFU project application.

Keywords Fan filter unit (FFU) · Single-phase alternate current induction motor · Speed regulation · Closed-loop control system

79.1 Introduction

The fan filter unit (FFU) is an efficient air supply filter equipment with blower. The FFU as a purification equipment is widely used in a variety of clean project applications [1]. The general FFU has the components of fans, filters, chassis, and electrical control unit. The general FFU fan driver often uses single-phase

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induction motor [2] (hereinafter referred to as SPIM). The key technology of FFU control system is the FFU fan speed regulation control, to control the SPIM to achieve wind volume control. The traditional FFU using open-loop control system methods have many demerits, such as control accuracy is not high, speed static and dynamic poor performance, etc. To meet industrial requirements, development and design low-cost, high control accuracy, high reliability FFU motor control system has a very important industrial significance.

Therefore, in order to improve the deficiencies of the traditional FFU control systems, a novel FFU variable voltage variable frequency (VVVF) closed-loop control system was designed based on DSCdsPIC30F3010 [3], to improve FFU System control performance, system efficiency, and energy saving. The entire closed-loop control system is a feature-rich, reliable operation. Finally, experimental verification of the effectiveness and superiority of the proposed design system is presented.

79.2 System Description

The overall structure of the FFU variable frequency closed-loop control system is illustrated in Fig. 79.1, where closed loop operation permits to keep the FFU fan speed at the desired level by adjusting the voltage and frequency output of inverter circuit.

The whole control system is a typical cross of an AC VVVF structure. The main circuit uses 220 V AC power supply, after the single-phase bridge non-controlled rectifier and filter to get a smooth DC voltage supply to the SPIM of FFU system. The auxiliary power supply circuit is switching power supply to the controller system. The output of inverter is controlled AC supply SPIM. The control part is based on dsPIC30F3010 chip, plus voltage and current detection, speed detection, fault protection, and other circuits.

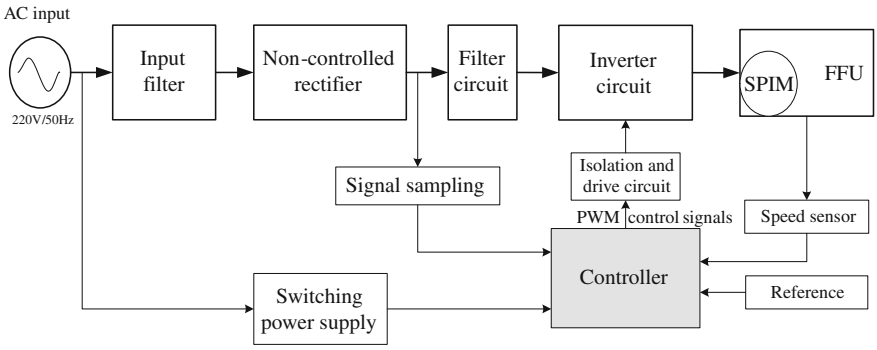


Fig. 79.1 Schematic diagrams of the FFU closed-loop control system

79.3 System Operating Principle and Control Methods

79.3.1 Operating Principle

The FFU fan uses single-phase SPIM. SPIM is only a single winding structure that cannot produce a rotating magnetic field and is often used to place the main and auxiliary winding phase structures in a different location on the stator. In order to obtain the starting torque [4, 5], the secondary winding needs the series capacitor [6].

SPIM speed, frequency, and polar relationship between the numbers available is calculated by the following formula:

$$n = 60f(1 - s)/p \tag{79.1}$$

where n is the speed of SPIM in rpm, f is the electrical frequency of the power supply in Hz, p is the number of electrical poles in the motor stator, and s is the slip. From the formula can be seen the change in frequency, slip, and the pole number that can change the speed.

Changing the pole number adjusts the speed of SPIM control mode-related motor structure, and is limited to a few less used fixed speeds. Change in the input power frequency can be for a wide range of speed controls for work efficiency. However, the change in frequency will cause the flux to increase, resulting in serious motor heating, and even damage.

Changing the voltage made for changing the frequency must be synchronized to maintain a constant voltage/frequency, that is, variable voltage variable frequency speed control. The SPIM VVVF governs the general sinusoidal pulse width modulation (SPWM) of this design using the speed control mode.

The two-phase three-legs inverter circuit implements the SPWM control inverter main circuit as shown in Fig. 79.2. Removing the motor running capacitor using software to achieve the main winding's current 90° ahead of secondary winding has the advantages of wide speed range and high-voltage utilization.

79.3.2 Closed-Loop Control Methods

The control system adopts the closed-loop speed control strategy to get good steady state and dynamic characteristics as shown in the block diagram of Fig. 79.3.

The speed use proportional integral (PI) closed-loop control has the merits of flexibility and high accuracy. The difference between reference speed and actual speed the after proportional integral algorithm, as a new duty cycle control signal, to control the motor speed. The control logic can be expressed as:

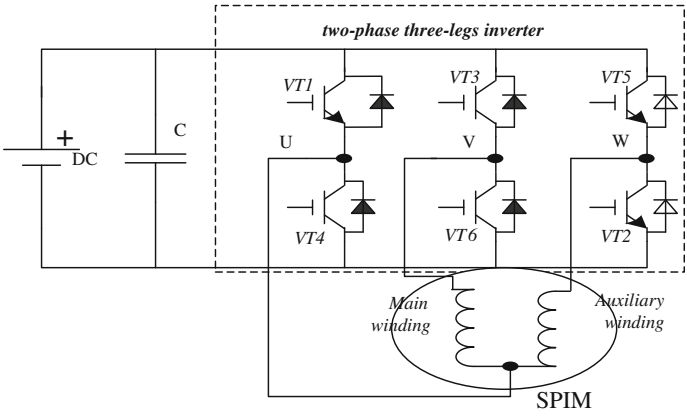


Fig. 79.2 Configuration of two-phase three-leg inverter

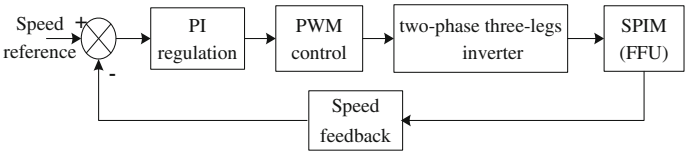


Fig. 79.3 Block diagram of the closed-loop control system

$$u(t) = \mathrm{K}_p\, e(t) + \mathrm{K}_i \int_0^t e(t)\mathrm{dt} \tag{79.2}$$

where K_p is the speed proportional coefficient, K_i is the speed integral coefficient, $e(t)$ is the error between the reference speed and actual speed, $u(t)$ is the duty cycle control signal.

79.4 System Design and Implementation

79.4.1 Main Circuit Design

The main circuit design includes the topology and device selection in this design. The main circuit topology is the common AC–DC–AC structure, single-phase AC power by the rectifier into DC, and then DC inverse that becomes amplitude and frequency adjustable variable voltage variable frequency AC power supply to the SPIM, to the complete FFU fan speed regulation control. The main circuit uses bridge rectifier modules and intelligent power inverter module design, including

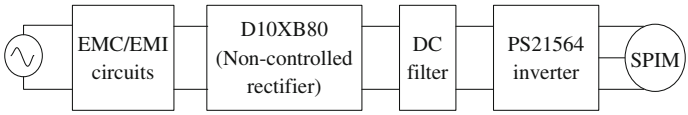


Fig. 79.4 The main circuit schematic

rectifier circuit that selects D10XB80 rectifier module; inverter circuit uses a Mitsubishi PS21564 DIP-IPM module. The main circuit schematic is shown in Fig. 79.4.

79.4.2 Control Circuit Design

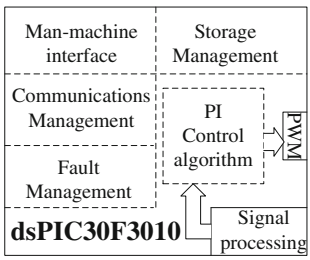
The control circuit used dsPIC30F3010 as core control chip, which is a high-performance, 16-bit sigital signal controller, including modified harvard architecture, 6 PWM output channels, 3 duty cycle generators, and 10-bit analog-to-digital converter. The control circuits mainly include signal acquisition and processing circuit, man–machine interface circuits, communication circuits and other auxiliary circuits. Figure 79.5 shows the control circuit functional block diagram.

79.4.3 Software Development

The control software uses the C programming language to write software. Modular thinking design, include the main program module, data acquisition and processing module, the PI algorithm speed control module, human–machine interface processing module, and communication module. The main program module is the operative part of system program, including system initialization, register configuration, the sub-module calls, and the watchdog reset function.

The speed control module is the main function module according to the speed of feedback and input reference value, called the PI control algorithm; the output SPWM control signals on FFU motor VVVF speed control. The control program flowchart is shown in Fig. 79.6.

Fig. 79.5 Control circuit functional block diagram



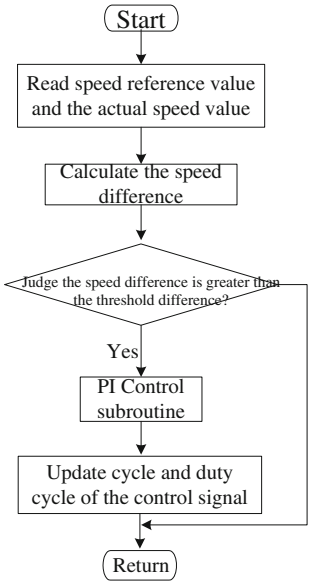


Fig. 79.6 The flowchart of control program

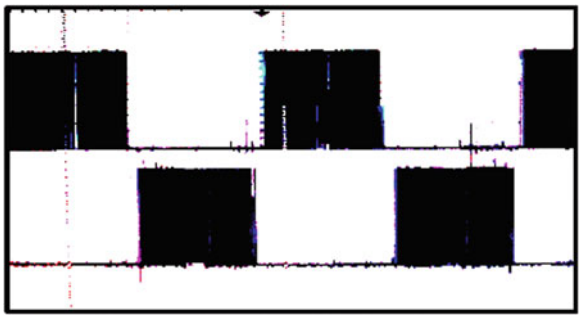


Fig. 79.7 Output voltage

79.5 Experimental Verification

In accordance with the above-mentioned, the design and development of the controller is applied to FFU fan control. Parameters and rating of experimental SPIM are: Rated-Voltage 220 V/50 Hz, Rated-Output: 150 W, Poles: 4, Rated-Speed: 1800 rpm.

Record running waveform of the experiment is shown in Fig. 79.7 where the controller controlling the output waveform is SPWM waveform, the inverter output voltage and adjustable frequency sine wave. Figure 79.8 shows the output current waveform.

From the effects of long-running work, the control system stable and reliable operation, the motor running smoothly, compared with conventional FFU control

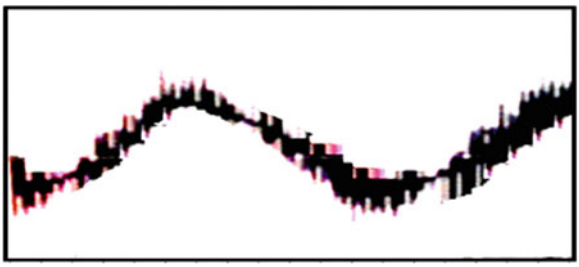


Fig. 79.8 Output current

system has advantages of high efficiency, low noise, precise control and reliable, user acceptance,and praise.

79.6 Conclusions

The experiments illustrate that by using the closed-loop control method, the FFU system has advantages of high efficiency, good performance, reliable, and stable. The proposed control algorithm is feasible to achieve good performance, eliminate the torque ripple, and enhance the dynamic response, and robustness performance. These provide a guideline for in-depth study on FFU control systems. Meanwhile, the proposed system also has broad application prospects.

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Chapter 80
Personal Health Records System Based on App Engine

Bin Mu, Cheng Xiong and Shijin Yuan

Abstract The Personal Health Records (PHR) system stores all the personal health information about the residents. As an infrastructure database system, there are many challenges in its development. It explores the characteristics of PHR system and studies the cloud computing technology: Google App Engine. Then, according to the study result, a PHR system is designed and developed on Google App Engine. The technologies of Google App Engine are very suitable for solving problems such as scalability and semi-structure data modeling.

Keywords PHR · App engine · Cloud computing · Bigtable · GFS · Mapreduce · Datastore

80.1 Introduction

Cloud computing technology provides users with a cheap, virtualized, ultra-large-scale computing capability and a safe and reliable storage capacity, and ensures extreme flexibility and convenience. The traditional information system needs to maintain the hardware and software, it costs much, and is very hard to scale, which limits some potential applications. For example, it is hard to implement the instant

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retrieving of large data and analyzing on big data; with limited storage capacity, the system administrator has to do some data migration work when data grow over the system's capacity. In the world of cloud computing, due to its virtual nature, the infrastructure may auto scale whenever the user needs, which means the user does not have to care about scalability. As the cloud computing platform is generally a parallel platform, hence taking advantage of parallel computing and storage, it is possible to implement some applications that require massive computing power and short time respond. This study aims to design and develop a personal health record system that can take advantage of the cloud computing platform: Google App Engine.

The remainder of this paper is organized as follows: Section 80.2 explores the characteristics of the PHR system, Sect. 80.3 studies Google App Engine and its key technologies, and Sect. 80.4 discusses the design and development of the PHR system. Finally, Sect. 80.5 presents the conclusions and future work.

80.2 The Characteristics of PHR System

Many problems are very hard or even impossible to resolve in a traditional PHR system, so it is important to identify the essential nature of the PHR system. Thus, according to these characteristics, it is possible for this study to take advantages of cloud computing to solve the problems.

80.2.1 The Diversity of Health Information

There is no doubt that the health information about a person from birth to death is very complex, and the data structures of these data may be different, including structured, semi-structured, and unstructured data. The relational database system is a good fit for structured data, but it is not suitable for semi-structured or unstructured data.

One source of health information is the process of variety medical service. Most of them are stored in the hospital's information system in the form of medical documents. Therefore, the PHR system must provide a data exchange interface to receive of send document in a standard format.

80.2.2 Guarantee Parallel Processing

The PHR system stores large amounts of personal health information and needs to handle massive data sets. As a foundation medical system, it needs to provide services of short delay and large amount of computation. For example, the diseases

control system may request statistic computation service. So the PHR system must provide a parallel processing mechanism to analyze massive data.

80.2.3 Security Characteristic

The PHR system stores much personal health information; the security sensibility is very high, so it needs a sophisticated secure mechanism. Meanwhile, it should satisfy the characteristics of various structure data and parallel processing.

80.3 Google App Engine

Google App Engine is a cloud computing service provided by Google in the form of a platform widely known as Platform as a Service (PaaS). It abstracts out all the details of the infrastructure. Applications deployed on it are automatically scale based on the request number; it also provides an ultra large and scalable database system, bunch of services to accelerate the development circle, a fully supported development environment, and a very convenient user interface to manage applications. Although it is very easy to develop and deploy applications to Google App Engine, it is best to understand it and its underlying technologies.

80.3.1 Introduction

Google App Engine is a PaaS service provided by Google built on Google's infrastructure. GAE mainly supports the development of Web applications; developers can choose to use Python or Java to develop the applications. Since GAE mainly supports Web development and considers the distributed environment and secure problem, Google constrains the usage of socket and local file writing but provides URL Fetch and Memcache service to help users to walk around these constraints. It also provides a number of services to help developers accelerate the develop circle. These services include task queue, E-mail, Blobstore, Image, Authentication, XMPP, Channel, Mapper, etc. GAE uses DataStore, a core module of GAE, to persist data; it is a core module of GAE. Different from relational database, GAE datastore is a schemaless database, which means it does not need a fixed data schema up front. A record in datastore is called an entity. Two entities of the same kind can have different properties, even the type of the same property can be different, so the data modeling will be very different from relational data modeling.

80.3.2 Architecture

Figure 80.1 is the architecture of app engine, the front end receives request from users and routes the request to static file server or app server base on the data from app master; the App master stores the meta data of files or applications. The App server is stateless and this fact is essential to the scalability of google app engine. Datastore is used to persist application data, it is also scalable.

80.3.3 Underlying Technology of Datastore

The datastore is based on bigtable, so it has some common features with bigtable. Bigtable is a distributed storage system for managing structured data that is designed to scale to a very large size: petabytes of data across thousands of commodity servers. A Bigtable is a sparse, distributed, persistent multidimensional sorted map. The map is indexed by a row key, column key, and a timestamp; each value in the map is an uninterpreted array of bytes [1]. Bigtable provides a key-value-based persistent mechanism that can store structured or semi-structured data. Because it does not have a strict schema like RDBMS it can add attribute columns even when the program is running. Thus it can store data with various structures.

Bigtable uses Google File System (GFS) to manage its files. GFS is a distributed file system designed to store and process a huge number of files [2]. It divides a big file into many chunks and stores them in different nodes, the master node stores the meta data of these files. For a file with its chunks distributed in different nodes, GFS can accelerate the file reading speed by parallel reading.

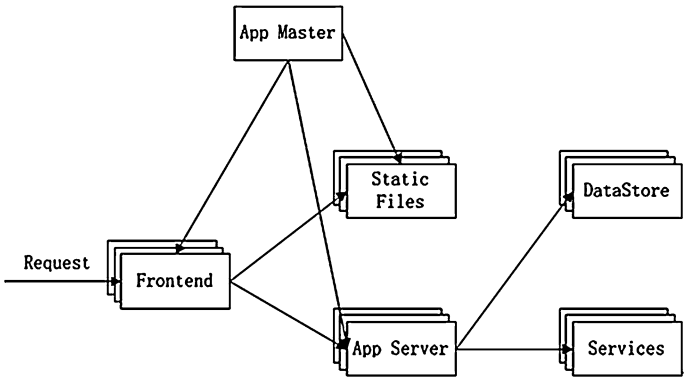

Fig. 80.1 Architecture of Google App Engine

80.3.4 MapReduce on Google App Engine

MapReduce is a programming model and associated implementation for processing and generating large data sets. Users specify a map function that processes a key/value pair to generate a set of intermediate key/value pairs, and a reduce function that merges all intermediate values associated with the same intermediate key. Programs written in this functional style are automatically parallelized and executed on a large cluster of commodity machines [3]. With this model, users can easily leverage the advantages that MapReduce provides, including automantic parallelization, fault-tolerance, data distribution, and load balancing.

There is an open-source library for doing MapReduce-style computation on the Google App Engine platform, AppEngine-MapReduce [4], which provides an implementation of mapper and shuffler. The user only needs to implement a reducer, and then can perform MapReduce computation on Google App Engine platform using the data from datastore.

80.4 Design and Development of PHR System

According to the knowledge of PHR system's characteristics and Google App Engine, this study designed and implemented a PHR system built on Google App Engine.

80.4.1 Architecture

Figure 80.2 is the architecture of PHR system. The data access layer hides the details of the low-level datastore API and provides data accessing service to the business logic layer. The business logic layer includes five modules: Authorization Management, Users' Behavior Log, Domain, Document Exchange, and Archive. The PHR API layer provides a higher level abstraction by using one or more modules of the business layer. The client, whether it is a Web application or a desktop GUI application, can access the PHR system by invoking its API. The documents exchange module provides services related to exchange data in the form of xml documents, the archive module provides archive service to users, and users can view their archived data by selecting the time range.

80.4.2 Domain Data Modeling

Domain module is responsible for accessing personal health data and maintains its consistency. Bigtable is schemaless, where the domain module has to enforce

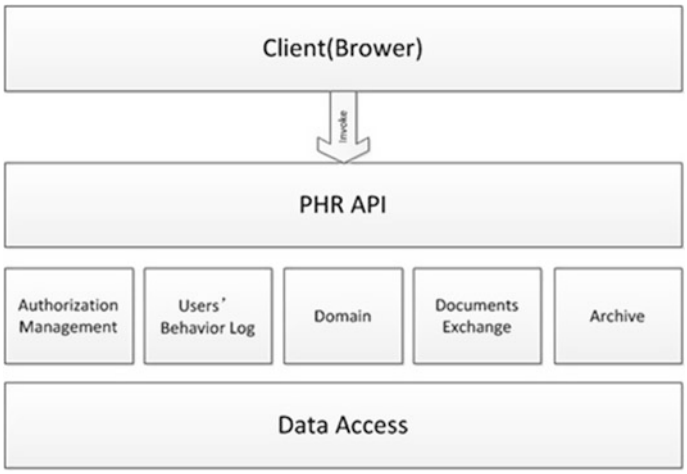

Fig. 80.2 Architecture of PHR system

schema at the application level. In the PHR system, data are usually read several thousands of times more than they are written, so it is reasonable to optimize the reading speed other than writing. Additionally, Datastore uses bigtable as its backend, bigtable uses GFS to store its files, the same data will have several copies in different machines, so reading data is much more efficient than writing. In RDBMS, normalizing data is a good way to reduce duplication, and it makes it more efficient to write data, but the tradeoff is it makes it inefficient to reading data. So we have to denormalize data to speed up data reading. This means an entity may have many properties that can reduce the need for joint operations.

Entities may be stored on different machines; aggregating from several entities may be very inefficient. GAE datastore provides a mechanism called entity group that ensures that the data in the same entity group will be localized on the same machine. Hence aggregating data from the same entity group is more efficient than from different groups.

The PHR system divides personal health data into the categories of problems, medical records, test results, procedures, immunizations, allergies, and medical files. Taking problems data modeling as example, the detailed information about a problem entry includes the disease name, its corresponding ICD-10 code, start date, end date, doctor note, etc. Sometimes, only few of a problem entry may be needed, for example, a list view displaying the problems, but datastore will fetch all its properties when retrieving the entity. Thus in considering its reading efficiency, there is a need for an entity that contains properties that are subsets of the properties of the entity that contains detail information. This may save a lot of data transfer between the datastore and application.

80.4.3 Security

Authorization management module provides a sophisticated authorization management service. The owner of a health record can fully control who can access his/her health data, what data he/she can view, what operation he/she can do on the data, for example, the owner can authorize his/her private doctor to edit cold item under problems category, but the private doctor cannot delete this item.

Users' behavior log module is responsible for recording all operations that a user does against the health data; it is useful to audit the user behavior, and can help the user to view the change history of his/her health data.

80.5 Conclusion and Future Work

This paper aims to implement a personal health record system on Google's PaaS cloud platform App engine. By analyzing the characteristics of PHR system and exploring the underlying technologies of App engine, this study proposes an implementation that fully utilizes the benefits that Google App engine provides. In addition, it provides a sophisticated security mechanism that can ensure safety.

The PHR system is designed to be a data system that can store a lot of data, especially the personal health data and users' behavior log data. By utilizing the parallel computing mechanism that the AppEngine-MapReduce framework provides, it is possible to provide instant analyzing service based on personal health data and users' behavior log data.

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Chapter 81
Efficient Applied Software Talents Training Scheme

Yi Xiang, Jun Peng, Liang Lei and Ying Wu

Abstract In view of the current status quo of the university computer science students whose engineering practice capacity cannot meet the needs of IT companies, the relevant analysis was given to the problems that are present in a computer professional teaching of the colleges and universities in our country, for the purpose of improving their ability of engineering practice. By considering the software industry needs, educational concepts oriented at applications by applying their knowledge are introduced. The school–enterprise cooperation is innovated with the integration of extracurricular scientific and technological innovation activities to create a featured practice teaching platform. The "million lines of code project" is implemented to improve students' ability of engineering practice, so as to develop application software talents that are urgently needed by IT enterprises.

Keywords Million lines of code works · School–enterprise cooperation · Practice teaching platform · Ability of engineering practice · Application software talents

81.1 Introduction

With the development of China's information industry, all kinds of talent have seen a substantial increase in demand [1, 2]. However, a "dilemma" can be found in our software talents training: on the one hand, the software enterprise is difficult

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to recruit suitable software talent; on the other hand, many computer-related graduates are difficult to find a counterpart job [3]. As early as 2001, the Ministry of Education established 35 national model software colleges, aiming to explore an innovative training model that emphasizes practical ability of application software talents. Nearly, 10 years of exploration and practice has seen the improvement of computer science graduates of colleges and universities in terms of software practice ability. However, the dilemma still exists [3, 4]. The gap for enterprises in need of IT talent has become a bottleneck to restrict the development of the IT companies.

81.2 Problems Analysis

We performed an in-depth study on the "dilemma", that is, the difficulty in IT industry recruitment is interwoven with the difficulty in finding a job for computer professionals. Through a series of research, we found that such "dilemma" phenomenon is rooted in that fact, that is, there is a considerable gap between engineering practice ability of graduates and business requirements. Because of this gap, the computer software personnel training is discipline orientated, that attaches great importance to the theoretical teaching, while ignoring the ability of engineering practice urgently needed by enterprises. Teachers lack experience in actual project development, resulting in the ability of engineering practice being unable to meet the requirements for students' enterprise-class development [5]. Investments by schools are obviously inadequate in practice teaching, including the funding, the efforts of teachers and students, causing the effect of the practice sessions being difficult to guarantee. In view of the economic and security factors, businesses are often unable or unwilling to provide the necessary conditions for the students' internships. Lack of open practice, teaching, and management platforms as the support to the practice of teaching reform and implementation, the end result is that students entering the business need a "transition" process, which in fact creates a "lag" need for talent in enterprises [6, 7]. For this reason, in-depth thinking is necessarily given in our computer training mode for the professional talent with a particular focus on strengthening students' ability of engineering practice.

81.3 Reform of Practice Teaching System and Implementation of "Million Lines of Code" Project

The connotation of the million lines of code project is combined with the social needs and respect for the personnel training law by amending the personnel training program and improving the curriculum. Additionally, it also includes the reform of the practice teaching system, the implementation of school–enterprise

cooperation, building the library of teaching cases, and improving teaching methods and assessment tools to ensure that the entire 4 years of college training process is in line with the requirements of the industry for the students' ability and knowledge structure, so that students may receive systematic training that covers at least 1 million lines of code development. The volume is as great as a million lines or even tens of thousands of lines.

81.3.1 Building Personnel Training Programs to Meet the Needs of IT Companies, Focused on Training Practice Ability

The attention is first paid to the source, and then personnel training program is optimized to strengthen practice teaching. Our cultivation program for the computer professional talent is designed by persisting in market demand that drives the theoretical teaching content. Specifically, the actual project development drives the practical teaching content and the teaching method reform, while strengthening interpersonal communication skills and developing team spirit, plus, school–enterprise cooperation to implement the training mode as "3 + 1 joint training". This "3 + 1" Training Mode refers to the curriculum-based learning that is dominated by specialized theory and supported by professional practice in the first 3 years. In the fourth school year, the "on-campus and off-campus teaching practice platform" is used for learning the system and development capabilities which are focused on professional knowledge and practice skills to enhance their professional theory. This is a new application professionals training model, where practice teaching is given credit ratio of more than 30 % of the total credits. The curriculum also includes the confirmatory experiments and project-driven experiments, aiming to help students clarify the necessity for the training of enterprise–class integrated development, where the period of receiving the training of the ability of engineering practice in the enterprise model may reach 1 year. The development of the personnel training program provides a strong support for varied forms and means of practice teaching, the enriched practice of teaching content, and for building a multidimensional practice teaching system and the implementation of the "million lines of code" project. Under the guidance of the "3 + 1" personnel training programs, efforts are made to actively adjust the curriculum, teaching content, the reform of teaching methods and means, while updating the supporting syllabus, and the experimental guide books and other resources building so as to meet the needs for training the students' ability of engineering applications. Table 81.1 presents the training plan prepared by the University for the Computer Science and technical personnel with the credits and hours allocation.

Table 81.1 Training plan prepared by the university for the computer science and technical personnel with the credits and hours allocation

Type of courses	Nature of the course		Lecture (h)	Internship (h)	Experiment (h)	Total hours	Total credits	Ratio (%)	Ratio of total credits (%)
Theory course	Obligatory	Public courses	816	24	62	872	52.5	43.20	29.20
		Specialized courses	382	76	54	512	32	26.30	17.80
	Elective	Specialization electives (limit)	154	48	54	256	16	13.20	8.90
		Specialization electives (minimum requirements)		162	190	176	11	9.10	6.10
		Public elective courses (minimum requirements)				160	10	8.20	5.60
Total of theory courses			1352	310	360	1976	121.5	100	67.50
Practice course	Obligatory	Compulsory experiment course (confirmatory)				48	3	5.10	1.70
		Compulsory nonexperimental course (project type)				152	19	32.50	10.60
		Enterprise–class integrated development				112	14	23.90	7.80
	Elective	Experimental courses (limited selection)				24	1.5	2.60	0.80
		(Confirmatory)				48	21	35.90	11.70
Total of practice courses			0	0	0	384	58.5	100	32.50
Total			1352	310	360	2360	180	100	100

Note In the practice link, sports and extracurricular courses are completed with the number of hours and credits subject to the half-to-half calculation

81.3.2 Innovative School–Enterprise Cooperation to Create a Featured Practice Teaching Platform, Providing Strong Support for the Implementation of the "Million Lines of Code" Project

Chongqing Municipality stays now in a period of economic restructuring. This provides a historical opportunity to build the IT industry as the first pillar industry. We should take full advantage of the geographical advantage of the new campus being adjacent to Xiyong Microelectronics Industrial Park, actively docking with the settled IT companies to achieve the innovative school–enterprise cooperation model by the establishment of an on-campus and off-campus internship training and practice teaching base. By way of the free availability for the enterprise to use the development and office space and other supporting facilities, IT companies may be attracted to have part of the production entities introduced into the school for the establishment of enterprise production, R&D base, and the training base for students. This may help the companies to reduce production costs, and as agreed, the companies may accept students and teachers to the base of training and practice. Teachers and high school students may take full advantage of the platform to join the project development teams of an enterprise, where they may have chance to understand the business development process at zero distance, learning the mainstream technologies and management methods used by enterprises, and also gaining a feeling of corporate culture. At the same time, attention should be given to the actual software project being converted into the training of teaching resources. Specifically, enterprise projects are decomposed, and related subprojects are classified into the relevant basic courses and specialized courses in the training segment. In the last year of practice teaching, students can rely on the actual project cases, and the introduction of enterprise project development processes and management methods, as well as the mainstream IT new technology and recruiting IT companies with certain strength and the specialized training institutions, from which the first-line technicians are invited for teaching. In such a way, the students in the school can acquire the practical engineering experience in enterprise software development, making it possible for them to get advance understanding of work processes and corporate culture of the IT companies. This may shorten the "role conversion" time that may be taken by graduates in the enterprise, help them join into the development team in the shortest period of time, and create value for the enterprises.

Meanwhile, the school has been making efforts to effectively promote the laboratory opening and to improve the quality of experimental teaching and the completion of independent research and development with the help of experimental teaching and management platform that are characterized by "teaching, learning, monitoring and management". School teachers have independently developed the experimental teaching network and information opening and running management system, which is composed of three highly integrated subsystems, including campus card authentication system, IP video surveillance system,

and the experimental project management system. This leads to the integration of online course selection and appointment, online teaching and guidance, and online monitoring and management promoting the full liberalization of the laboratory.

81.3.3 Million Lines of Code Project with the Organic Integration of Extracurricular Scientific Activities to Improve Students' Engineering Ability

By way of the establishment of scientific and technological innovation base of college students, opening labs, students' participation in teacher research, and funding the students' science and technology innovation team, development projects are placed to actively support the students in participating in various competitions. Since 2007, the University has specially set up innovation labs for students, including purchase of equipment and related laboratory supplies worth nearly 500,000 yuan to provide space and equipment for students in extracurricular engineering development, training, and technological innovation activities. The independent innovation lab is under the operation mode of students' self-management, with teachers involved in the tutor role. This innovative laboratory is used as a platform for technological innovation with the help of students' community organization, conducting scientific and technological innovation of the students' academic salon, and lectures for the purpose of "teaching, helping and driving". In our computer professional personnel training program, it is clear required that students participate in the "competition—class scheme", namely, to use the competition to substitute the courses and credits before graduation is permitted. The "competition—class scheme" refers to the extra-curricular student may use his spare time in the specified academic year or semester for building their own team, relying on independent innovation lab space and equipment to complete the assigned science and technology creation in the engineering background. Each participating staff has to undergo a result assessment by submitting the winning design report, works display, and defense, while works are awarded in groups. The University will hold the "Knowledge Forum" and other students' scientific and technological innovation lectures, as well as the on-campus technology contest to further enhance the science and technology innovation atmosphere. In accordance with the basic idea as "creating an atmosphere, research training, competition breakthrough and incentive protecting", the early support, the medium-term guidance, and the following-up award way of work are combined to mobilize students' activity of participation in the discipline contests, enabling our students to achieve outstanding results in various national competitions. Over the past 3 years, computer science students have consecutively obtained outstanding achievements in the academic competitions, such as the American Mathematical Modeling Contest, the National Computer Works Competition, the National IT Competition on Application Level, Chongqing Municipality Shengqun Cup SCM

Competition, and Chongqing Programming Competition receiving a total of an international first prize, 19 national awards, and dozens of provincial and ministerial level prizes.

81.4 Conclusions

The University is orientated by the needs of enterprises for student ability in the implementation of the "million lines of code" project, school–enterprise cooperation to enhance students' ability of engineering practice. This provides new ideas and methods for the cultivation of high-quality computer professionals to meet the needs of software companies. In recent years, the practice shows that our computer professional personnel training quality has significantly improved and our students are highly recognized by the employing units with respect to their solid theoretical foundation and excellent engineering practice ability. Under the pressure of the expanded enrollment of the national higher education year by year, the employment rate of our computer science students has been maintained at a ratio of 94 % or above, and this figure is steadily rising. The students have the quality of employment improved significantly, and this further enhanced the confidence of student employment.

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Chapter 82
Solution of Online Reimbursement System on Campus Network

Guang Biao Sun, Jun Zheng, Lu Yang Gao and Hui Wang

Abstract With the development of the teaching scale in universities with more than one campus, especially after carrying out national treasury centralized payment, reimbursement is becoming a serious problem. Regarding widespread financial reimbursement, this paper tries to design and realize an online reimbursement system based on campus network, putting forward the goal and the overall framework of the system, analyzing and studying the landed of the reimbursement system, appointment reimbursement, query, and application of accounting treatment to achieve the method that simplifies the electronic work and network. Then we can standardize and improve the financial reimbursement processes and improve accounting efficiency and service level.

Keywords Reimbursement system · Universities · Network

82.1 Introduction

University financial experience from the accounting treatment of type to the accounting and handling of heavy-duty computerized accounting to accounting changes, are the changes proposed to apply the skills and level of financial requirements [1, 2]. So, to handle the important support skills as a university financial accounting information system must comply with the financial requirements for the extensions that must be after the control to control the steering in advance and do

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[3, 4]. With the opening of the campus network, the implementation of the cash reimbursement system, maturing financial software construction accounting environment, and accounting skills increasingly rely on technology and financial processes unable to meet the need for faculty, online booking reimbursement system happens to be in began construction of such an environment [5–7]. Line reimbursement system designed to regulate the reimbursement of the financial units of business processes, enhance the work efficiency of the financial unit, save the reimbursement of staff time and the leadership of the processing time [8], and the staff reimbursement network and continue to promote the financial information for the technology and network construction, the innovative concept of financial management and improve financial conduct business level.

82.2 The Online Reimbursement System Needs Analysis and Solution

82.2.1 Requirements Analysis

Build a break with tradition hand, from the geographical and time constraints network reimbursement system, university financial management of scientific, networking and standardization. Related to financial services due to financial reimbursement, reimbursement of operating the technical content is not high, but the operation of the complex degree of specification to implement the difficult, the process is more flexible. The online reimbursement system design is necessary to regulate the financial sector reimbursement of business processes, improve financial sector efficiency, save the reimbursement of staff time and the leadership of the processing time, and the staff reimbursement network. The online reimbursement system B/S structure the support staff at any time, any place, the Internet browser to submit reimbursement claims and reservations. Online booking reimbursement system through the campus network, independent of time and space constraints, the teacher may apply in the campus network terminal, make an appointment, print and other operations; the treasury to advance understanding of arrangements for reimbursement apply to audit the original documents, automatically generated vouchers. Ensure the timeliness and completeness of financial information, but also greatly reduce the workload of the finance staff, to improve the precision level of financial management. Online booking reimbursement system will fill in the standardized documents, business approval process, the transparency of financial audit, in order to raise the overall quality of financial information, financial information is accurate, complete and timely role in the management. Online reimbursement system can also be at the same time, budget management, financial accounting, online banking system interconnection, interoperability is not only a major change to the traditional ways of working, but also for the scientific development of the universities financial information system to create a new platform.

82.2.2 Solution Analysis and Selection

According to the functionality of the online booking for reimbursement, we proposed two alternative solutions.

(1) The program is implemented in the accounting of the center within the local area network is essentially the same case, the realization of the principle is network online operation, the data centralized management. The installation of a dedicated remote application server or a database server, and the bureau rent a green DDN special line connected to the NTU. If you take into account network security, we recommend using a firewall. Accounting unit connected to the Internet (or terminals are connected to the ISDN terminal through Modem, this can also increase speed), log into a central server, through the front of our software connected to the central server system, direct operations and save each accounting unit reimbursement member input all the data stored on a central server. In this mode, each accounting unit reimbursement member in the unit of input data is equivalent to directly operate on a central server. The advantage of this program is easy to implement, public DDN is established by the existing long-distance digital telephone and telecommunications department and the city's digital telephone and wide coverage, and full-featured communications networks, thus the use of the DDN to the formation of a user's computer networks with less investment, effective fast, easy to use features. The shortcomings of the program is a waste of resources, use of high cost, because the online operation requires the use of accounting unit, and the current stability of the network is not very good, easy to break; followed via the Internet to access the LAN, there are security risks.

(2) The second solution in the accounting unit to set up a terminal, with appropriate application software, the accounting unit in the local database input after, through dial-up Internet access, data transfer to the accounting center remote application server database, central database from time to time to receive data transmitted by the accounting unit and placed in a temporary database. Accounting unit reimbursement member of the original documents sent to the center of the foreground window, the window of the front desk staff to bring up the temporary repository of data, after the check, go to the official database. See Fig. 82.1. The program has the advantage of accounting units in the input data without the online operation, do not need to spend the appropriate calls, and thus a lower cost; transmission time is relatively short, and not on the Internet network, so security is better; to left on the local server data to facilitate the accounting unit financial data queries. The program requires each unit corresponds to one platform and accounting center, accounting center should be an application server.

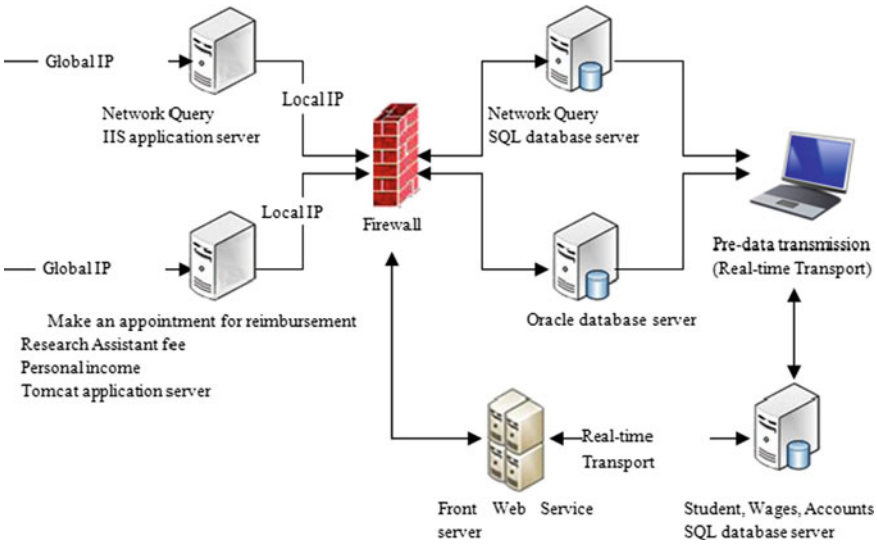

Fig. 82.1 **a** Schematic diagram of the second solution

82.3 The Reimbursement System of Online Booking

82.3.1 System Program Structure Design

Figure 82.2 shows, online reservation reimbursement system adopts B/S three-tier architecture. In the three-tier structure, ask the introduction of software and application server, the presentation logic on the client, the business logic on the application server, and data logic on the database server side. Such a large amount of data access to only interact with the middle-tier application server, without affecting the database server, the efficiency would be enhanced. Teachers to fill the reimbursement information, query, modify, and submit data to the Web server. System administrator on the Web server access control account assignments, user management, and basic data operations Treasury Web server data to the accounting documents of the business process.

The system architecture process financial database and reservation system database the two can be passed on the basis of the data, and audit appointment document information. All users can connect through the Web server print server to print the data to form the final reimbursement documents.

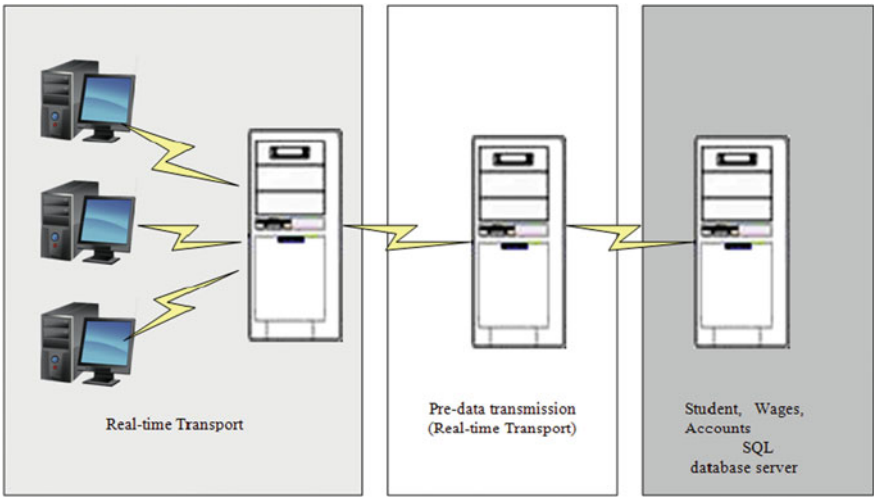

Fig. 82.2 Online reservation reimbursement system adopts B/S three-tier architecture

82.3.2 System Design Features

System design and development in the openness of the system, scalability, maintainability, advanced technology, practicality, safety, timeliness, stability and norms, etc. should have outstanding advantages.

The openness of the system design using the open network communication protocols (TCP/IP), to adapt to the mainstream operating system, data operations to comply with the standard database query language (SQL), data exchange to establish the current widespread adoption of xml technology, to ensure that the system on the open platform, and other business application systems have good interconnection and interoperability. The system supports the application of the digital campus unified authentication, to support the University EAI integration.

Scalability and maintainability of the system using C/S combination of the diverse architecture of the B/S, give full play to the respective merits of heterogeneous, so that the system has good maintainability, system analysis and design using object-oriented, component, three layer structure, middleware technology, and extensive use of xml technology, so that the system has good scalability. System and nonfinancial income, capital monitoring system, the Senate, on-line banking system, assets, systems, personnel systems, research management system, logistics management system, school work management system and so the data interaction and linkage.

The advanced technology system development and application of advanced technologies in areas such as Dot Net and J2EE support based on the design of components, polymorphism, inheritance and interfaces, but also provide a basis for class library to perform I/O, XML processing, en pool database access, text manipulation and other advanced features.

The practicality of this system evolution decades, the essence of the company products, fully meet the requirements of the college application, has good practicability. The system provides a friendly user interface, simple and beautiful, easy to learn, to provide a full operating prompts and text and images to help.

Security in the full access to database data, the system provides password-based services, data confidentiality features, the use of information classification and role-based access, to establish a specific user access to the specified database, to provide for CRUD data access control. The system is running with the transaction mechanism, has a strong fault tolerance, to ensure that user data is accurate and secure. The perfect data backup and recovery functions, use of shared Sal Server Database to provide a very convenient and powerful database synchronization features, the database all the difference between scheduled backups to the database on the remote machine to ensure that when a database server downtime, misuse or remote backup database data loss caused by natural disasters and save the data integrity and timely recovery.

Operating efficiency of the system take full advantage of the features and advantages of the shared database, to strengthen the rational planning of the data, to establish a reasonable and efficient database access mechanism to ensure maintenance of data and easy to use. For example, use stored procedures and views to improve the speed of data access due account of redundancy to improve the access speed. Response for the system input, update and query time of departure into account, according to business needs and the basic characteristics of the database and general business operation response time should be less than 5 s; the operation of the large amount of data should not be more than 30 s.

Stability is the protection of long-term operation of the system for historical data and long-term inactive data points stored in the repository, a close correspondence between the multiple historical databases and the current database. This not only improves system speed, at the same time enhance the system stability. The system also extends the database load balancing mechanism to control the number of connected users at the same time, adequate protection of the stability of the system. Powerful system monitoring software and complete system log management for the system user's login, modify, or delete key operation records backup for future need to check and verify. System errors that occur in the operation of classification to protect the stability of the system is running.

Normative system design and development process to fully understand the higher education system of quality management standards and operational characteristics, specifications and requirements, so this system at the same time, the software development process, software CMM level standards and application projects based on norms and standards; development specification and implementation of the project specifications and specific requirements to ensure the standardization of software engineering.

82.3.3 Business Process

The online reservation reimbursement process is divided into the following steps: (1) go to the website, fill out the reimbursement information (including basic information, the type of business and claims information, payment information), and print the claims. (2) Appointment reimbursement. (3) In accordance with the appointment, to carry the original certificate to the Finance Office for reimbursement. (4) Financial audit of claims and the original certificate and apply for reimbursement, and automatically generate accounting documents.

82.3.4 Functional Design

Reimbursement for college financial business, the main design of the following features: (1) loan management module to complete the single entry of the borrower, the borrower information query, delete borrower information, loan amount check. (2) The claims management module, including: expense report entry, claims inquiries, claims delete, reimbursement documents recorded automatically calculate the reimbursement of the total reimbursement of the amount of accounting. (3) Fixed asset management module, including: the information furnished in fixed assets, fixed assets, reimbursement information inquiry, asset accounting, automatically calculates the reimbursement based on reimbursement documents record the total, and so on. (4) Audit function modules, including borrowing a single audit, claims audit, fixed assets audit of three modules. (5) Role permissions management: the role permissions to involve all staff, including general staff, financial and asset. Different roles see different information. General staff is only responsible for entry and information submitted; asset responsible for auditing the fixed assets subject and submitted to the Finance staff to continue the review; financial officers responsible for the review of all documents.

82.4 Application of the Reimbursement System of Online Booking

82.4.1 Application for Landing System

Reimbursement people log online booking reimbursement system, after the way of the user name, password, and authentication code to authenticate the user, the user identity on the feasible user records. The choice of reimbursement projects, fill out the reimbursement of the basic information, such as reimbursement of costs, payment methods, application of scanner-related attachment scanning uploaded to the system.

82.4.2 Audit of the Original Bills

Reimbursement online fill order, the system is scheduled to automatically submit to the competent leadership for approval, approval of the leadership is not the time, place limitations of applying a digital signature and approval of business. And secure digital signatures for online reimbursement of security countermeasures. Necessary functional units of the special operations audit, the Treasurer audit before the audit after appointment.

82.4.3 Grade Appointment

Reimbursement staff to fill out the list of reimbursement of necessary appointment in the appointment of reimbursement system, compared to the same costs as reported bill, you can select multiple merge appointment, appointment and perform the manipulation, and select the reimbursement of time and reimbursement sites, print the bill of appointment reported.

82.4.4 Processing Appointment Online Business

Staff with the appointment of entry into force of newspaper bill reimbursement specified time by appointment to appointment the point of financial reimbursement to complete the actual task of reimbursement. Financial front auditors in accordance with the reimbursement held by the serial number of the reported bill, from the online booking reimbursement system bring up the report he submitted bills, accounting staff to carefully review the reimbursement bills, including the examination of original documents and online documents are the same, the project, reimbursement the correct type, the audit is correct will be converted into vouchers, to assume that the reimbursement data problem, and financial officers can directly modify the certificate in a single system interface. Reimbursement documents after the reimbursement, according to the appointment reimbursement, the reimbursement people choose cash to the cashier window recipients; choose a cash settlement will be reimbursement payments direct hit on the debit card, and after the SMS notification reimbursement.

82.5 Conclusion

Tthe online booking reimbursement system is for financial units that deal with a large number of bills daily. Its implementation will make the work simple on the electronic network, thereby reducing the financial staff, inefficiency, cumbersome

workload, and reduce bills on the whole process, which greatly increases the college finances. The online reservation reimbursement system has been in implementation for a short time, and only a small number of colleges and universities in the country are using it. However, after the non-stop exploration and improvement, the business efficiency advantages will show in the near future. The online booking system will overhaul thoroughly the reimbursement system and will promote a wide range of applications.

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Chapter 83
Research of Accounting Information System Under E-Commerce

Quan Quan, Yaping Li and Lingli Wang

Abstract With the development of e-commerce and the implementation of accounting information system, more and more people begin to realize the advantages of the accounting information system and the major changes it brings about. In this environment, the corporate accounting system has gradually become an information society. This paper describes the characteristics of the accounting information system and demonstrates the necessity for enterprises to strengthen construction of accounting information system. In particular, this chapter analyzes the problems of accounting information system under e-commerce environment, and offers some corresponding countermeasures to these specific problems.

Keywords Accounting · E-commerce · Security · Countermeasures

83.1 Introduction

With the advent of the information age, e-commerce has developed rapidly in the context of economic globalization; the whole society has become the network economy, which is closely linked to e-commerce. In e-commerce, transactions are through the Internet. This kind of globalization, high-speed, and virtualization economic model has a big effect on the traditional corporate accounting model.

Nowadays, especially in the IT field, we are going through rapid development and change. Every corner of the world is affected by these developments. The information system is undoubtedly changing the world [1] and business enterprises having the biggest share are also being influenced due to these changes.

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In business enterprises, good management is based on correct and timely information. Timely, correctly, and meaningful information undertakes very important missions in monitoring the activities of the enterprise, implementing functions such as planning, organizing, and controlling by the management because preparing, implementing plans toward the future illiterately, and making control operation are impossible [2]. Accounting information is also a system presenting the correct and timely information in making decisions of management of business enterprise.

83.2 The Challenges of Accounting Information System Under E-Commerce Environment

Because of the complexity of the e-commerce environment and the particularity of the accounting problems, the security problems of the accounting information are various.

83.2.1 The Risk of Hardware and Software

Hardware risk refers to computer hardware, due to natural factors, such as flood and fire, which damage the computer hardware and the whole system. At the same time, because of the influence of factors by management, it leads to computer hardware damage and even leads to the loss and leak of financial information.

Software risk comes from the unauthorized and illegal stealth of enterprises information and hackers' malicious attacks. Meanwhile, the intrusion of computer virus may be intercept, steal, counterfeit, or destroy the accounting information, which leads to the distortion of accounting information and poses serious threat to the computer network information security [3].

Under the environment of the Internet, the financial data comprises the important commercial secrets that belong to enterprises, so it is hard to avoid illegal workers who intrude into the accounting information system, and damage the moral operation maliciously, or threaten the accounting information to seek interests.

83.2.2 High Risk of Malicious Modification of Accounting Information

With the development of computer technology, computer viruses have also diversified constantly with many characteristics, such as speed of transmission, multiple transmission ways, and difficult preventions. Therefore, it poses a serious threat to the safety of the accounting information. Computer hackers make use of network vulnerabilities, using linear monitoring, information intercepted, password

temptation, counterfeit false information inserted, and other means to attack information system from all levels, so that the accounting information faces various risks such as being intercepted, eavesdropped, and fake. Moreover, in the network environment, as long as there are rioters wanting to steal, intercept, and destruct information, when data are transmited through the line, it can be easily accomplished [4]. Virus and hackers stealing accounting information maliciously becomes a threat to the security of accounting information system.

83.2.3 Accounting Software is Immature

The electronic commerce network is the carrier of accounting, and accounting software is the tools for accountants. All kinds of software in the market, from the quality to the performance, have certain gaps in the objective demand under the development of e-commerce. The process of research and development of application of accounting software has become extremely complex because of limited developers and objective economic activity, making the software inconsiderate. This therefore leads to software that lacks flexibility, strain capacity, mutual compatibility, and antiviral capacity. The immature accounting software seriously hinders the full development of electronic business accounting [5].

83.2.4 Security Measures are Imperfect

At present, in electronic business activities, security has become a pressing problem. The computer's own vulnerability, false operations by accounting personnel, black attack, and tamper e-commerce websites, destroy the accounting data and even the entire system. So it causes huge economic losses amounting to ten of thousands. Among them, the consequences of black attack are the most serious, because it may destroy financial data, making the whole accounting information system paralyzed. Especially when some important accounting information materials are stolen from illegally invaders, the economic loss is more serious.

83.2.5 The Increase Difficulty of Internal Control Audit Mechanism

In the traditional manual accounting system, authority control is a common internal control mechanism, from the occurrence of economic operations to the formation of accounting information, during which every link has to be signed and sealed by the relevant departments to ensure authenticity of accounting information effectively. In the accounting information system under e-commerce environment, enterprises

may worry about the exposure of the related material, which may lead to negative influence to the enterprises, and so as to influence their competitiveness, and thus the enterprises will adopt transfer, aside, one layer of encryption and hidden method to deal with the accounting information, greatly adds to the difficulty of the internal audit. At the same time, high concentration of data may also make unauthorized copying, destroying the important data of enterprises. The enterprises' internal auditing and accountants must be supplemented with professional knowledge and computer technology, using complex check technology. Only in this way can he be a proper accountant. Meanwhile, it will also increase the time and cost for internal audit [6].

83.2.6 Corresponding Laws and Regulations are Imperfect

The rapid development of e-commerce far beyond the existing legal system standards, the characteristics across region and across national borders make the information hard for notarization and arbitration. Many countries including China still lack the e-commerce transactions responsibility and reliability of laws and regulations, especially the newly issued accounting law for which definite regulations have not been fixed for accounting problems as yet.

83.3 Improvement in Security Countermeasures of Accounting Information System Under E-Commerce Environment

83.3.1 Technical Measures

83.3.1.1 Establish a Firewall

Firewall is a network system built on the separation of the protected internal and external networks. According to the different regions of the accounting information system, multi-level firewall system can be set up.

83.3.1.2 Improve Accounting Information System Data Standard Interface Technology

Although all the forms of data obey the WWW protocol, the types are various. By the same token, when the enterprise through electronic accounting information system external interfaces are sent to external data, the type of its value have a choice. First of all, through the client interface software simulation testing, access to the other side to accept the type of data issue after the adjustment data types. Therefore, strengthen the data sharing of the system, also promoting network data

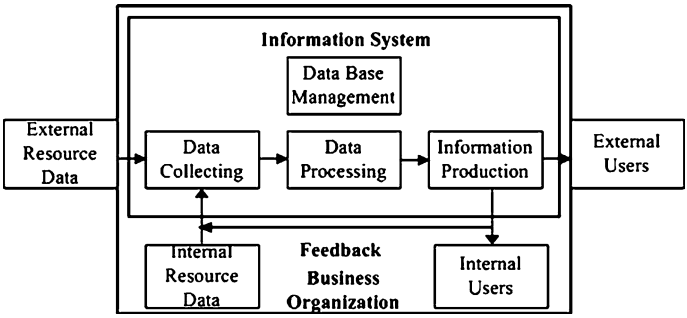

Fig. 83.1 General model for accounting information system

2-way exchange success and becoming one of the essential factors of implementation of e-commerce (Fig. 83.1).

83.3.1.3 Improve Data Encryption Technology

Data encryption technique puts little influence on service and openness of the network. It is the preferred method that protects the accounting information system against bugging. For information applications that have to be kept strictly secret, some unusual and highly safe algorithms may be used, such as Skipjack, Safer etc., to encrypt the data.

83.3.1.4 Establish Multi-Server Data Backup

In view of the current memory media of accounting information system, it should be done in parallel multi-server mode. In this mode, several copies of data are executed simultaneously from time to time. When the main server fails, the backup servers will immediately take over the job in order to maintain the normal data transmission and processing.

83.3.2 Internal Control Management

83.3.2.1 All Aspects of Internal Transmission Realize Digital Standard Management

The realization of e-commerce not only shows in the electronic world's commerce enterprise activities, but also specifically manifests in digital transmission of goods and materials in all aspects inside the enterprise. The achieving of internal digital standards is not only conducive to a comprehensive system,but also the number of

scientific management, the resulting data is also propitious to reference data and accounting standards of the external transactions in order to avoid unnecessary loss.

83.3.2.2 Link Up with Enterprise Capital Account System to Promote Online Payment Directly

For enterprises, directing LAN (local area network) to the bank account can directly realize the transfer and income of funds on the net as well as improve the enterprise capital turnover rate. At the same time, it can ensure the smooth implementation of the trading. However, an obvious problem is the security and confidentiality in this technique realm. As a result, we must make the switch on the internal management of system, and the security protection, and so on to prevent data leak and interception. What is more, the system should cope with the bank account for timing or regular checks at the same time. When there is abnormal data, the system should blockade the bank account immediately to check a release timely. Of course, all of this should be completely automatically achieved through the system-side interface data verification module.

83.3.2.3 Establish a Sound Internal Audit System, Strengthen the Internal Audit Oversight

In order to ensure effective operation of internal control mechanisms, and achieve the benefits of enterprise management information ultimately, enterprises should undertake audits for the accounting information and internal control systems. First, improve the auditing standards. With changes in the internal control in e-commerce environment, the modern audit based on system evaluation will produce significant changes. This will be not only conducive for successful completion of the enterprise management audit work, but also conducive to the perfection of internal control of accounting information under e-commerce environment. Second, the enterprise should establish incentive and restraint mechanisms. Enterprises should introduce incentive and restraint mechanisms to implement the internal control system. The unit will not only establish a scientific, effective reward and punishment policy, but also need to improve the standard of reward and punishment policy continuously with the improvement of internal control.

83.3.3 External Environment Factors

83.3.3.1 Require to Strengthen the Development of Accounting Software and Construction of Accounting Information System

The accounting software is the basic link of accounting information system under e-commerce. Only by increasing the development of accounting software,

assessment, inspection efforts can enable e-commerce accounting software to become safer, more reliable, more accurate, and clearer. Thus, it will be acceptable for accountants. In the software system development, we should pay more attention to develop management function, such as anti-virus function, prevention of hackers attack, prevention of incursion, and prevention of data distortion. On management, the e-commerce software should realize enterprise entirety management, business ability of collaboration management. In finance, desktop accounting software realizes all accounting functions, such as data remote processing, remote statements, audits, and monitoring. Integration will realize online tax, transformation of data, information online, and online specialists.

83.3.3.2 Require to Improve Market Environment

Network economy creates a whole new market. The development of accounting must focus on market environment problems. There are two points in the market environment problems: one is the logistics management service environment. This is another important source in the network accounting treatment of electronic documents. We must improve the logistics management environment to support the development of accounting. Let the standardization of goods be unified logistics management, including warehousing, quality inspection, outbound, etc. The other problem is bank's capital settlement service environment. This is also the important source of network of electronic accounting treatment. Whether enterprises and corporation on a bank of settlement account trusteeship and liquidation transfer system service can be realized in fast, convenient, and unobstructed conditions, are important environment constraints in network accounting development.

83.3.3.3 Require to Improve the Politics and Regulations Risk

Policies and regulations are seriously lagging behind the requirement of practice. The direct performance is lacking in legal system safety and healthy development; the direct performance is that the existing economic laws and regulations are not applicable to the existing economic accounting information system. In addition, in accounting as a "new thing", theorists and practitioners are exploring accounting procedures and methods. Different business have different accounting methods, so that accounting information quality lacks comparability. In this case, the government should timely develop relevant policies and regulars. But at the same time, in order to develop we should pay attention to the network accounting practice, detailed policies, and regulations. Therefore, to make appropriate accounting guidance, policies and regulations are placed in front of the problem, which cannot be ignored.

83.4 Conclusion

Development of accounting information system is the inevitable result of social economy environment change. Social networking, economic globalization, and trade liberalization are three features of current social environment. Particularly, e-commerce is the embodiment of the features. With rapid development of e-commerce, manking is striding forward in the age of information. Hence, it will surely produce comprehensive and profound impacts on traditional accounting in today's society. In other words, when faced with huge impacts and challenges in the accounting industry due to new environment, all we can do is to grasp the nettle and keep forging ahead in order to meet the needs of the times. Contrarily, sticking around or sticking to convention will be a dead end.

Acknowledgments The paper is financially supported by the Beijing University of Posts and Telecommunications.

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Chapter 84
Radio Frequency Identification Books Monitoring System

Quan Bi Chang, Li Juan Wang and Zhi Jie Fan

Abstract This paper introduces the concept and characteristics of radio frequency identification (RFID) technology and overviews the main characteristic of RFID books monitoring system which is different from the traditional magnetic anti-theft monitoring system, analyzes system constitution, principle of design, working pattern and so on, and points out the insufficiency of the system.

Keywords RFID technology · Monitoring system · Applications

84.1 Introduction

As a new kind of automatic identification technology, radio frequency identification (RFID) has been applied in electronic article surveillance systems (EAS), Portable data capture systems, Positioning systems etc. In recent years, with the growing maturity of the technology and innovation, it attracted great attention, especially in the 1990s when RFID technology became the library recognition mode [1]. In 1998, the National Library of Singapore in the Bukit Batik community library first pioneered the use of HF RFID [2], to improve the efficiency of borrowing and returning books.

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84.2 RFID Technology Introduction

RFID technology uses RF signal through space coupling (alternating magnetic field or electromagnetic field) to achieve non-contact transmission of information, and passes the message to identify the purpose of the technology. It is through RF signal automatic target recognition and access to relevant data that work is identified without human intervention. Being the wireless bar code version, RFID technology has some powerful functions such as waterproof, prevents magnetic, high temperature resistant, long service life, distance, read labels data can be stored data encryption, and larger capacity and store information change etc., that is superior to bar codes [3].

84.3 Application of RFID Technology in Libraries

RFID has already been in use in the library system for 10 years. The National Library of Singapore was the first to use RFID technology in Asia. In a sense, it is possible to say that libraries have adopted a relatively mature RFID product, and this product is driving the development of library automation [4]. Since 2000, Australia, Singapore, Mainland China, Hong Kong SAR and Taiwan are testing or using the library UHF RFID. Compared with HF RFID applications, UHF RFID application in library has advantages in price, performance, ease and Publishing community and supply chain integration, and other areas [5].

In China, the Cheng Yi Institute of Jimmie University Library was the first to put RFID systems in use in February 2006. It is considered as the milestone in RFID application in the Chinese library [6]. This successful operation, can be described as far-reaching significance, provides reference for other libraries. Shenzhen Library, Wuhan University Library, Shantou University Library, National Library, Hangzhou Library, Beijing Institute of Petrochemical Technology libraries, Zhejiang library completed the conversion of the RFID system in 2009 [7].

Most public and University libraries have planned for RFID systems application, from 2006, since the start of the first RFID library; China has dozens of RFID libraries. Based on the unique advantages of RFID, it possesses recognition technology that is unmatched by other RFID systems and has become the development trend of the library management system.

84.4 RFId Books Monitoring System

The introduction of the RFID system in libraries may reduce the librarian's duplicated strains, improve circulation and collection management efficiency, and increase the safety of the library [7]. Thanks to the introduction of the RFID technology, the service environment of "a door check, the entire opening" has

been constructed, thus putting forward new requirements for the book monitoring system. Different from the traditional monitoring by way of magnetic induction, the new RFID books monitoring system not only monitors books for the installation of RFID tags in real time, but also meets the special environmental needs to ensure the safety of books, such as monitoring the large flow of people, the peak flow for a particular session or a larger monitoring range,and so on.

84.4.1 Overview of RFID Library Monitoring System

RFID books monitoring system is an intelligent system that can scan and identify books with RFID tags, which is used for the security control of collection of books so as to realize the anti-theft and monitoring purposes [8]. This system distinguishes the status of books which is carried by readers next to their skin or in their bags (whether getting borrowing process) to ensure books security.

84.4.2 RFID Books Monitoring System Constitution

RFID Books monitoring system consists of a security door (or channel gate), book label sensor module, RF reader, Control board, RS232 serial line, buzzer, the host computer, monitoring, special power supply, Control software, etc.

84.4.3 The Operation Principle of RFID Books Monitoring System

The RFID books monitoring system achieves the effective control of books by reading chip, chip data validation [9]. When readers carry a book with RFID tag through the security door, the induction module is triggered. After the reader reads the chip information, the reader will give information to the host computer. The host computer verifies the information and issues directives to the reader; the buzzer starts an alarm, and meanwhile there is a display on the host computer screen about the title of the book, the alarm call, alarm time information etc., which will assist the staff to identify and deal with them, and thus monitoring the books safely.

84.4.4 The Operating Mode of RFID Books Monitoring System

The system can be divided into two operating modes: online mode and offline mode.

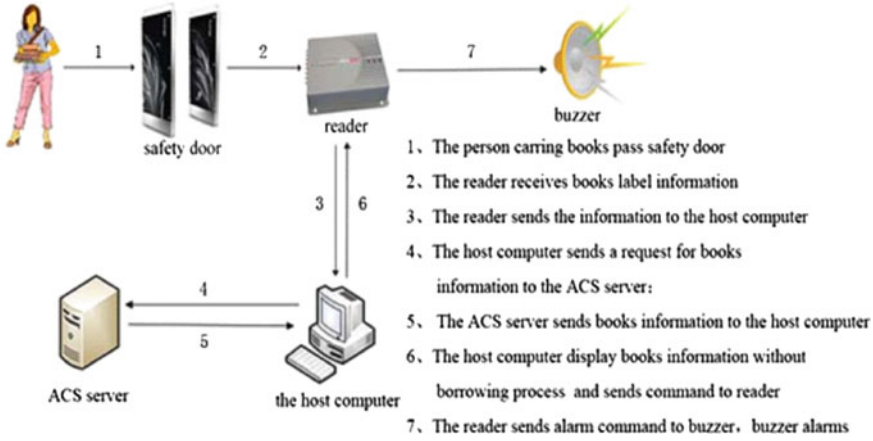

Fig. 84.1 The online mode

84.4.4.1 The Online Mode

According to the code of the tag's electronic product code (EPC) obtained by the reader, the information is sent to the host computer. Monitoring software translates EPC code into books bar code, and gains the book information in the RFID library. If the system has the session initiation protocol session initialization protocol (SIP2) interface, the status of the books will be obtained by SIP2 interface [10]. According to the status of books, if they belong to those that cannot be lent out or without borrowing process, the control software of the host computer sends the alarm command to the reader, and the reader completes the alarm. This mode is called "online mode", because it needs to connect the reader and the host computer together to the library network, carrying on the data communication through the TCP/IP pattern (Fig. 84.1).

84.4.4.2 The Offline Mode

According to the type code of the electronic label such as the Books label, frame standard, or layer standard label, library card, etc. [11]. And EAS anti-theft -bit (0x01 or 0x00), if the electronic label type code is the Books label, and the EAS anti-theft bit is 0x01, then the buzzer alarms and the label information is sent to the host computer. Otherwise, the buzzer does not alarm or send a message. This mode is called "the off-line mode". Because this mode can be detached from the host computer and runs alone, this mode can be subdivided into two kinds of circumstances: (look Figs. 84.2, 84.3).

The reader amplifier normally opens, and the reader only receives books label information without borrowing process. Once the reader receives the label information, the buzzer alarms immediately, and the host computer can receive the

book information only and displays books information without borrowing process. This mode is widely used with stable operation and high detection efficiency.

The mode has a function of counting people: book alarm and people counting are separated, and the reader amplifier is timed off. When a person passes through the security door, the two teams of infrared sensors installed in door will be activated. The Control board sends power-on amplifier instructions to the reader and tells the fact that someone has passed and it also can distinguish the passing direction of the person. The reader sends the information to the host computer, and the host computer counts statistics.

84.4.5 The Main Characteristics of RFID Books Monitoring System

84.4.5.1 System Practicality

The front end products of the system products and system software have good learn ability and operability. In particular, the operability makes the management person with primary computer's operating level able to grasp the essentials of the system's operation, and reach the operating level and complete the duty by a simple study.

84.4.5.2 The Stability of the System

The system has been put on the market and stability characteristics have been tested by a number of customers.

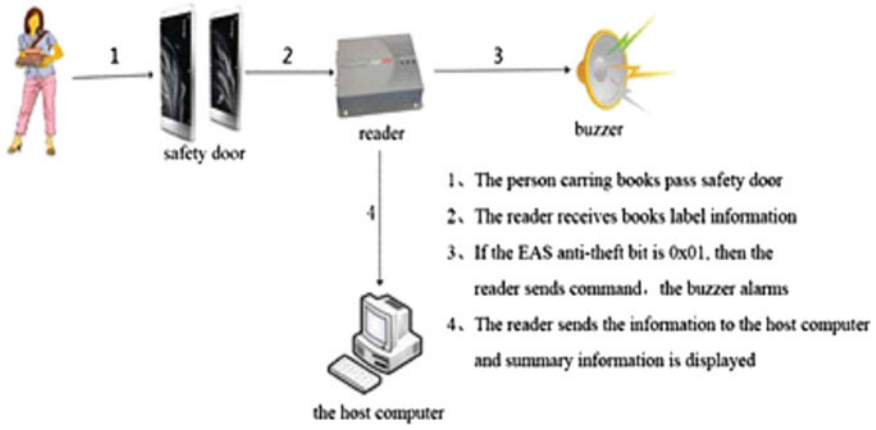

Fig. 84.2 The Offline mode 1

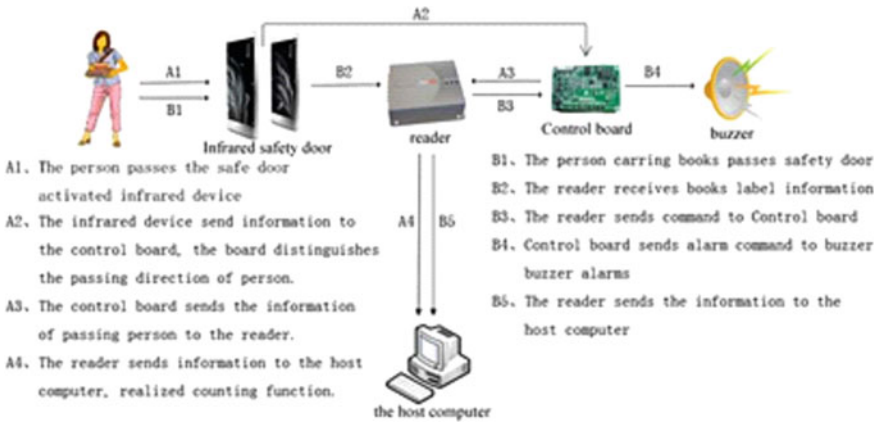

Fig. 84.3 The Offline mode 2

84.4.5.3 The Safety of System

All equipment and accessories have safe performance and reliable operation in line with the Chinese or international safety standards, and may work effectively under the non-ideal environment. The functions such as a strong real-time monitoring function and linkage alarm function, and the function that alarm log is automatically generated, fully guarantees the safety of users environment.

84.4.5.4 The System Scalability

The design and implementation of the system consider the future of the expandable actual needs: flexible change or update every subsystem, meet the different needs of the time, and keep long time leader.

84.4.5.5 The System Maintainability

The operation of the system can work with power on. The process of maintaining does not need too many appliances. From the computer configuration to system configuration, the configuration of the front end equipment takes the full consideration of the system. The maintaining of the whole system is line type, and therefore it will not cause the stop of equipment normally running because of the partially maintaining of the equipment.

84.4.5.6 The System's Advantage

The products adopt advanced techniques which ensure the system will not fall into disuse, and it can meet the needs of access control system with its highly sensitivity, wide-ranged detection, and the reduction of alarms and missed alarms

84.5 The Main Disadvantages of RFID Books Monitoring System

At present the main uses of the RFID monitoring system is judgment method of the bibliography database and security. Because both are related to data transmission or amendment between the tag and sensor, this may give the library hacker an opportunity to exploit. And since tag data are not write-protected, hackers may write the data label directly with special equipment and seriously damage the system security; hence data security is the key consideration for not only the RFID Books monitoring system but also for the RFID system in the future.

84.6 Conclusions

Although there are some problems in the application process, with the development of the RFID technology and the progress of the network technology, the RFID books monitoring system will be becoming better and approach perfection day by day and play an important role in the future library management.

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Chapter 85
Design and Implementation of Campus GIS

Shunxi Yan, Xiaolei Wang and Dongfa Li

Abstract To take Hebei United University as an example, the system used C# language, GIS platform—SuperMap IS.NET5 as well as SQL Server 2000 database as the foundation of the system development. It first made a design on the overall framework, function module, and database structure. Based on the design, the system realized digital campus management, for example, the daily maintaining and browsing on the campus' spatial and attributes information, retrieving relevant information according to the given conditions, positioning the results on the map and conducting spatial analysis such as path analysis, buffer analysis, and overlay analysis. The campus GIS will greatly improve the efficiency of school management and will facilitate the daily life of students.

Keywords Campus GIS · Thematic map · Spatial analysis · Database

85.1 Introduction

Along with the reform of our country higher education management system and with the colleges' merging, the campuses of the university are becoming more and more. Pushing down by school work's informatization and by the enrollment and employment's network, a system for a unified management, online publishing

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and querying, spatial orientation becomes an urgent need. Starting from the hierarchical and overall concept, combining the actual situation of the campus network, using advanced network technology and based on the traditional campus management system, campus GIS builds a digital space which expands the realistic campus' time and space dimension, improves the traditional teaching efficiency, and realizes the education process of comprehensive information [1].

Hebei United University has many campuses such as the main campus, Qinggong campus, Jitang campus, with a large area and many buildings [2]. It is more difficult to achieve effective management with conventional management methods. The use of the existing WebGIS technology can help solve these problems, achieving information web publishing [3, 4].

85.1.1 Hardware Environment

LAN: switched Ethernet of 10 M/100 M.

Center server: one or two Founder business Kei server.

Client: CPU: PII 400, recommended more than a PIII 1.0 G; memory: not less than 512 M, recommended using 1 G or greater; hard disk: 20 G above; display: 64 M memory; VGA resolution: 800 × 600 or above, recommended more than 1024 × 768.

External devices: data acquisition and output systems such as scanners, digitizers, and printers [5].

85.1.2 Software Environment

By comparison of the WebGIS platform software and comparison of the main constructor methods, Supermap IS.NET is finally selected as the WebGIS server. Relative to other WebGIS development platform, SuperMap IS.NET is simpler. Many functions can be achieved without writing any code such as Hawkeye map, layer control, and legends. Furthermore, SuperMap IS.NET provides a lot of development examples and more convenience. Because of the system safety requirements, Microsoft SQL Server 2000 is used as the spatial information and attribute information database, ASP.NET language, combined with XML language for the system development. The operating environments are as follows:

Server: operating system: Windows 2000, Windows XP, Windows Server version 2003 or higher; professional software: IIS, SuperMap IS.NET, and with dongle.

Client: Windows 95/98/NT/2000/XP/2003(With IE browser).

Development environment: Microsoft Visual Studio.NET 2003.

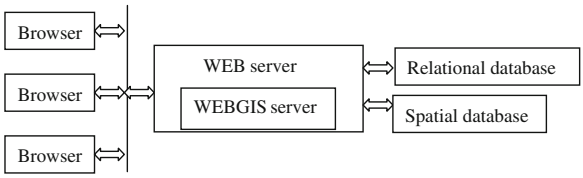

Fig. 85.1 System structure

85.2 System Design

The campus GIS is the digital space of all campuses in the university. System uses B/S structure which is relatively mature. All servers are on the network center. The users access the server through the browser and query the needed information, as shown in Fig. 85.1.

85.2.1 Function Module Design

The campus GIS includes the following modules: campus overview, campus map, campus buildings, thematic browse, spatial analysis, teachers' information, students' information, campus charisma, and online forums. The submodules are contained in the corresponding major functional modules.

Campus overview: in the interface, we can understand the overview of the Hebei United University, view the news released by the school, enjoy the entertainment news, and go into the chat room through the user registering and user logging.

Campus map: through the Hebei United University campus map, the users can browse, query the buildings and landscape features, control layers, and do some basic operations on the map, such as zooming in, zooming out, panning, printing, etc.

Campus buildings: the module mainly realizes the classroom buildings and dormitories' information query, positioning, and graphical query.

Thematic browse includes thematic maps of Hebei United University and other schools in the province, reflecting Hebei province's education information intuitively.

Spatial analysis module mainly includes buffer analysis, path analysis and the closest facility analysis.

Teachers' information: the module allows teachers to browse and query information needed. The relation of the university, the colleges, the departments and the professionals is represented by a tree structure in the module. The root node is the Hebei United University, followed by the colleges, departments, and the professionals. The user clicks on each sub node to obtain the corresponding results. It also provides a conditional query, including the fuzzy query and precise query. Query results are listed in the list box. Information browsing and querying function in the module call Information DB, and the module for students' information is similar to the teachers.

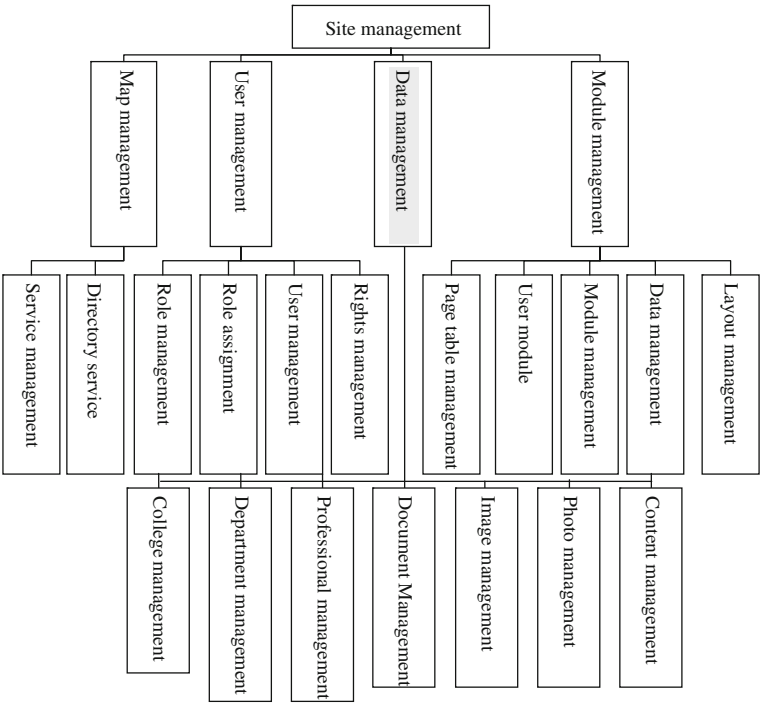

Fig. 85.2 Website management modules

Campus charisma: the module introduces the university by way of the pictures. Users can also make a picture-uploading operation.

The online forum is an information exchange platform. Users can perform troubleshooting, the information's releasing, sharing, communicating, which uses the XML language.

The design of the site management is the focus of this system, its structure as shown in Fig. 85.2. Among them, the page table management is to control each page of the webpage layout. The page can be changed, deleted, and increased. The increase or decrease in webpage will not affect existing data.

85.2.2 Database Design

(1) The use of stored procedures

Supported by the logic components for data access, you can use the stored procedures to perform a number of actions of data access. The system stores the part of programs written using Transaction-SQL as stored procedures in SQL Server, creating a program to call the stored procedures and processing the results of data. The stored procedures can return the result sets to the caller by receiving parameters

and the result sets' format is determined by the caller. Then it returns a status value to the caller to specify the call success or failure. It also includes operation statement to database, and can call a stored procedure in another stored procedure. In this way, it has the following advantages using stored procedures in SQL Server rather than calling a program written by Transaction-SQL on the client computer:

(a) The stored procedures created can be called multiple times in the program, which greatly improves the portability of the program;
(b) The stored procedure is precompiled. When the first time you run a stored procedure, it will be analyzed and optimized by a query optimizer which gives the final execution plan in the system table, so that it can achieve faster execution speed;
(c) When the client computer calls the stored procedure, the network transmission is simply the call statement and this can reduce network traffic;
(d) Through the limit to the execution of a stored procedure, the system administrator can limit access to the corresponding data.

(2) Data sheet

(1) The process of page table's automatic generating and its submodule's automatic loading contains the page table data and the module data which also contains module type data. The table is as follows: page table, module table (Modules), page-module relational table, module type table.
(2) The data of the users and their roles. In order to realize the user permissions dynamically, the desired tables are: table for the users (User), permissions table (Roles), user-permissions table (UserRole), permissions-page table (RoleTabs).
(3) The data for teachers, students, and college information is stored in the tables: the information of teachers (SC_TEACHERS), the information of colleges (SC_COLLEGEDIC), the information of departments (SC_DEPARTMENTDIC), the information of professionals (SC_SPECIALITY-SET), and the students' information form (SC_STUDENTS). Each table is formed of three parts: field name, data type, and field size, taking the students' information table for example, as shown in Table 85.1.
(d) The data for buildings and other facilities is stored in the following tables: the student dormitories' basic situation (SC_DORMITO-RY_TABLE), the student dormitories' information in use (SC_DORMITORY_USE), the classrooms' basic situation (SC_CLASSROOM_TABLE), all of the classrooms' information in use (SC_CLASSROOM_USE).
(e) Pictures, photos, and webpage data are stored in the following tables: table of contents (Contents), pictures (Pictures), photos (Photos).Each table is formed of five parts: field name, data type, field description, key references, and notes. Taking the Tabs table for example, it is used to store the name of each page, the structure as shown in Table 85.2.

Table 85.1 Students' information

Field name	Data type	Field size
Student ID	Char	12
Name	Char	10
Gender	Char	2
College	Char	20
Department	Char	10
Class	Char	20
Birthday	Nchar	10
Political affiliation	Char	10
Hometown	Nchar	100
Dormitory	Char	10

(3) Spatial layers

The layers include four categories: point, line, area and text, as shown in Table 85.3.

85.3 Implementation of the System

85.3.1 Basic Functions and Query Module

The basic functions of the system include selecting, zooming, roaming, free zooming, the former view, the latter view, refreshing, Hawkeye, measurement, etc. It is completed by clicking on the corresponding button of the menu bar or toolbar.

Table 85.2 Structure of Tabs table

Field name	Data type	Field description	Key references	Notes
Tab ID	Int	Page number	Pk	Primary key
TabName	VarChar	Page name		
TabOrder	Int	Page order		

Table 85.3 Spatial layers

Category of the layer	Content of the layer
Point layers	Road boundary line, road centerline, the boundary of land type
Line layers	Road boundary, road centerline, the land's boundaries
Area layers	Lawns, teaching buildings, teachers' apartments, students' dormitories, assisted living facilities, auxiliary teaching facilities
Text layers	Names of buildings, roads and other facilities

It also can realize the bidirectional querying between the graphical data and attribute data. If you want to query graphical data through its' properties, you need click the appropriate button and set the query conditions, such as the names of buildings, then the query result will be located on the map. At the same time, by clicking the query result on the map, all the properties of it will be showed [6].

Travelling path inquiring: first, you need set the starting point, the end point and other points on the road, then the shortest path through these points will be found and displayed on the map.

Close information's inquiring: selecting the feature type and setting the reference point, you can find the shortest path from the reference point to the corresponding features; The key codes for close information's inquiring are as follows:

```
soGeoEvent ObjGeoEvent = null;
double X, Y;
int Count = ObjTrackingLayer.EventCount;
if (Count < 1)
{
MessageBox.Show("pleasechoose the point!", MessageBoxButtons.OK, Message
BoxIcon.Stop);
return;
}
ObjGeoEvent = ObjTrackingLayer.get_Event(Count);
X = ObjGeoEvent.x;
Y = ObjGeoEvent.y;
EventPoint.x = X;
EventPoint.y = Y;
```

85.3.2 Analysis Module

The module of "overlay analysis" provides the mathematical models of overlay analysis for the abstract data type and object type, so several groups of graphical elements on the same scale and in the same region can be superimposed. For example, if you implement overlay analysis among the layers of dormitory, canteen, boiling water room, and business district, you will know school logistics' service quality; if you implement overlay analysis between the layers of the greening area and teaching building, it will tell you the school's greening rate.

The buffer analysis module: first you need to set the buffer conditions in the pop-up form of buffer analysis, and then a buffer result layer will be added on the map. If required, the objects falling in the buffer area can be further inquired [7].

85.4 The Summary

This paper mainly introduces the process of design and implementation of digital campus. Different from the general campus information system, campus information is combined with GIS in the system. First, the program is dynamically managed: the interface organization, page layout and the module organization are completely based on the database; second, all the information's browsing and querying are based on electronic map, more intuitive. In addition, you can conduct various kinds of spatial analysis. With the rise of the campus network, campus geographic information system will become an effective tool for the campus' planning and management, also for the students' life and learning.

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Chapter 86
Island Resources Management System Based on GIS

Xue-yu Mi, Yang Li, Lin Zhang, Guang Chen and Ai-hong Zhang

Abstract The management and exploration on island resources has played an important role on improving the utilization ratio and proper exploration of sea resources. The whole system based on the requirement of sea resources, and normalizes on many aspects based on GIS, such as model information of island house-building construction, island statistical data, travel spots data, species on plants and animals, visualized density on plants and animal distribution and information inquiry, etc., and provide necessary information on tourism and statistics of island resources. The system include the functions on law enforcement, tourism, and display of island to help the managers utilize and manage sea resources scientifically and properly, and as the same time there is a great contribution on marine affairs of our country.

Keywords Marine resources · Management information systems · EV-globe systems · The island

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86.1 Introduction

Now the main point on island management is exploration and management on island resources [1, 2]. As the development of the computer technology, remote sensing technology and 3-dimension digital earth technology, 3D GIS are widely used. By using the technology on 3D digital earth and remote sensing [3, 4], the great real-time 3D geographical management analysis was established and support feasible technical approach on effective visual display and management data on island [5, 6]. The establishment on national island information system can reflect the contribution of island on every aspect and as well provide the basic platform on comprehensive management of land, integrate the data on island affairs, observation, and base [7, 8]. By using the technology on 3D GIS and remote sensing to realize comprehensive management on island and improve construction, exploration and level of planning and designation, and to realize joint dispatch on each aspect [9, 10]. It played a profound effect on the island information contribution and modernized comprehensive management on island.

86.1.1 Systematical Analysis

There are broad space and ample resources at sea. As the development of population and consumption of nonrenewable resources on earth, to contribute and explore the sea is good for human beings development. For better use and management on island resources, protection on marine ecological environment and maintenance on sustainable development of resources, the unique method is to establish a perfect marine resources management system according to recent market necessity.

C# and EV-Globe programming is adopted and combined technologically and feasibly.

System target is oriented to marine law-enforcement department and other business departments provide marine environmental data and law-enforcement reference that needed by law-enforcement department, provide the input interface and data integration platform on environmental, meteorological, and rounding condition data and provide evidence for sustainable comprehensive management on island.

86.1.2 Designation of System

The entire structure of system, as shown in Fig. 86.1.

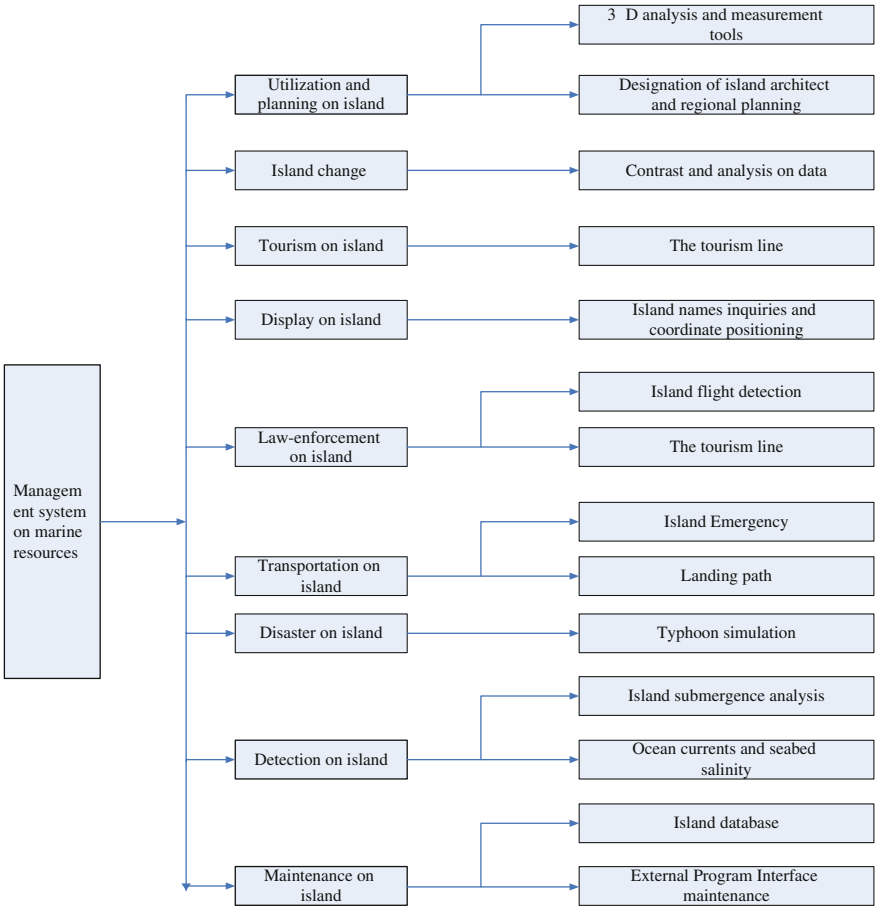

Fig. 86.1 The general structure on designation of systematical function module

86.2 System Functional Design

86.2.1 Designations on Database

The database of this project includes the databases on landform and physiognomy, remote sensing images, basic geography, 3D module, marine information, and system. And according to the characters of data, they can be divided as relationship structure data, space vector data, image vector data, structured textual and nonstructure data, and they are a comprehensive database concluding attribute data and vector data.

86.2.2 Interface Designation

The master-control interface of the marine information management system based on GIS is accomplished by the designation of C#, it is a set of completely independent exploring system of Windows and is a visualized higher level programming designation language to objects. It provides the friendly interface and great functional application software system to users and users can directly select the provided active and function to program, edit and test the application program of Windows by using the system main interface designed by C#.

GIS Port Designation

The designation of inter-operation port means to design the port in GIS, subsystems in GIS and subsystems in modules and realize that communicate between and share the functions. And the using port of this system is as follows:

Internal Port

On the internal port, every module conveys the information through calling functions, conveying parameters and exiting value. The information conveyed by port will be conveyed as the structural packed data in the form of parameters and exited value.

External Port

This system uses the ports of software Http Client Map and Result Set Grid to realize the function of map's parameters layer.

86.3 System Realization

86.3.1 Main Interface of System

The interface of system adopt Direct3D rendering interface and changed the fixed interface edition of traditional menu and status bar. It will render the menu on desk through esprit and improve the interactivity of UI. As shown in Fig. 86.2.

Fig. 86.2 The main system interface

Table 86.1 Planning data

Field name	Alias	Types	Empty or not	Primary key	Remarks
ID	Planning demonstration area ID	Int	Not	Primary key	
NAME	Planning demonstration area Name	Varchar (20)	Not		
LONGITUDE	Longitude	Numeric (5, 5)	Not		
LATITUDE	Latitude	Numeric (5, 5)	Not		
DESC	Description information	Varchar (500)	Yes		
PIC	Image information	Image	Yes		
Media	Video information	Varchar (50)	Yes		Store video path

86.3.2 Utilization and Planning on Island

The utilization and planning on island mainly displays the recent exploring districts and check the districts data on real-time, which can add the architectural model and island districts to realize the virtual management and provide data to the planning and decision making of island, as shown in Table 86.1 and Figs. 86.3, 86.4.

The necessary data: housing and relative architectural model, statistical data on island and planning result on island (Table 86.2).

Fig. 86.3 Island use 1

Fig. 86.4 Island use 2

86.3.3 Changing on Island

According to the data on population of relative time point, length of the coastline and area, make a compare and analysis to display the change on relative parameters in some time. It can help to make a decision on comprehensive management on island and to provide relative scientific data to the research on island changing, as shown in Fig. 86.5.

Table 86.2 Model data

Field name	Alias	Types	Empty or not	Primary key	Remarks
ID	Planning demonstration area ID	Int	Not	Primary key	
NAME	Planning demonstration area Name	Varchar (20)	Not		
LONGITUDE	Longitude	Numeric (5, 5)	Not		
LATITUDE	Latitude	Numeric (5, 5)	Not		
DESC	Description information	Varchar (500)	Yes		
PIC	Image information	Image	Yes		

Fig. 86.5 Island change contrast changes in the island area

Fig. 86.6 Disaster simulation

The necessary data: the relative statistical data (previous years)
Requirements: longitude and latitude information
The length of the coastline, the area of island and counter data

86.3.4 Tourism of Island

According to the tourism data that displayed about famous scenery on island, we can set the tourism line and the transportation tools and realize management on island, and it is convenient for tourists to check and information analysis at the same time it can provide some suggestions to make tour scheme.

86.3.5 The Module on Disaster of Island

We can make module on the effect scale of typhoon according to strength, core place, wind turbine, speed and moving direction of the typhoon and make sure the line it goes and which island it will emerged according to the exact analysis.

86.3.6 The 3D Display of Islands

We can stimulate islands by using the digital topography, remote sensing and 3D GIS technology to realize amplification and reduction on the 3D scenes. As shown in Fig. 86.6.

86.4 Conclusion

Nowadays the geographical information systems are mostly used on city planning and municipal management. The characteristic of the system is it has applied geographical information system to management on marine resource, combine the

marine resources information and geographical information system and realize the management on GIS marine resources information. As well, it put tourism information and geographical characters of island into the system and realize the connection and application between marine resources information and geographical information. This system is based on the island data and makes stimulation operation. The consequence of the test is: all the designed data structure is feasible, and all the resolution of relative technology is correct and feasible.

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Chapter 87
Study of Tourism Information System Based on Android Platform

Fengbo Hou and Xin Du

Abstract To improve the traditional Tourism Information System, provide a full range of services for tourists, and decision support for managers, this chapter integrates the Android mobile platform and Google Maps server into Tourism Information System. The features of the system include: classification of tourist attractions and related resources, query, locate, and trip planning. The system uses the Android Activity as interface design to select the SQLite database as a frontend database. The system uses http protocol to complete the server and client communication. The system is fully in line with the requirements of the tourism information management system. The advanced spatial server Google Maps make the system more convenient, intuitive, and detail.

Keywords TIS · Android · Google Maps · Database

87.1 Introduction

The tourism industry is the most commercial and promising industry in the current world. Because Xushui has not established the tourism information management system, many tourism resources have not been recognized by tourists. To some extent, the absence restricts the development of tourism in Xushui. In order to upgrade the tourism industry and accelerate the development of tourism, Xushui needs to establish a set of advanced, reasonable, and effective tourism information management system. Tourism Information System on the mobile platform using

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the Android system implements the visitors to access the tourist information system easily and greatly improves system operability and convenience [1]. Using as Google Maps API, users will get the tourist attractions and tourism-related resource information on the map, which makes the embodiment of the information more intuitive. In addition, users can also check the map to plan the trip and optimize the trip about the places to visit [2, 3].

A region-based tourism information system covering a variety of tourism resources in the region is very few. These TISs rarely provide statistics, analysis, and decision making for tour operators and managers. The representation of data and selection of the attribute in these TISs cannot meet the tourists and managers. We design the system to enhance the information sharing and using, improve service of self-tourism, the tourism function, and the levels of the tourism management.

87.2 Requirement Analysis

The TIS based on Android is to achieve the following objectives:

Easy to store, query, retrieval, analysis, management, statistics, release tourism resources and related information, as well as input and output;
Comprehensive, multiangle to reflect the characteristics and current situation of Xushui's tourism resources by integrating maps, icons, text, numbers, images, and other multimedia information;
Provide custom tours, travel maps, and traffic guide;
Provide online trading platform, including ticketing, housing, and other reservation services for tourists and tourism enterprises;
Provide support and tourism business decisions for the tourism sector.

The main line of the TIS is to inquire the information of tourist attractions and maps, at the same time adding the information of the hotel, entertainment, traffic, township, dining room, and other travel-related resources in order to improve the tourism industry and the related tertiary industry. Additionally, put the local folklore and folk customs to the system, which makes the tourist pay more attention to cultural landscape. The functions of the system are as shown in Fig. 87.1:

Implementation tools as shown below:

Operating System on server: Windows 2003 server;
Web Server: Tomcat 6.x;
Operating System on client: Android;
Database on client: SQLite3, XML;
Database on server: Oracle;
Develop tools: Android ADT, DDMS, Eclipse, and Power Designer.

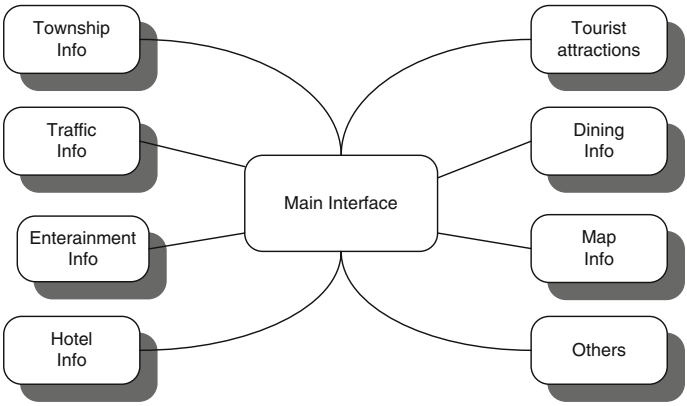

Fig. 87.1 Overview of the system function

87.3 System Design

According to the specification designing hardware and software, the principles to design Xushui's tourism information system based on Android is mainly reflected in the as shown in Table 87.1 aspects [4].

The system is divided into the following five subsystems: system management module, data maintenance module, the module of the operating system platform, the system data module, and system business application modules (Table 87.1).

Table 87.1 Main principles of system design

Principles	Introduction
Advanced	Using mature and advanced technology, according to the latest international IT developments, apply a variety of advanced technologies and products to the system to make the system effective. The technical indicators in construction and development should be consistent with national and industry standards and technical specifications
Stable	The system should have a good stability. Using the current mainstream development tools, to ensure the scalability of the system to better adapt to the future development and changes
Practical	Provide a convenient and flexible user interface and help support for adding maps, modify configuration
Compatible	Support different data formats and different sources of environmental data for processing and sharing. Have a strict uniform interface between the system to ensure the flexibility of the system upgrade and scalability
Standard	Provide standard interfaces to facilitate the access of other system data
Scalable	System architecture, system functions, and system applications with scalability for later adding data, business processes timely and easily to the system
Safe	Own complete error-handling mechanism, access logs, database, and disaster recovery mechanism

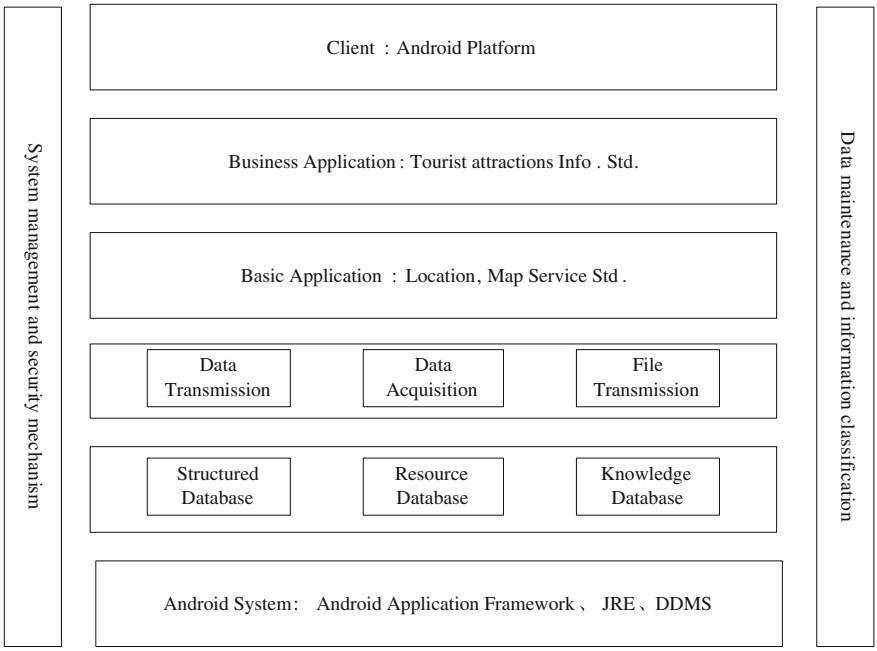

Fig. 87.2 System architecture

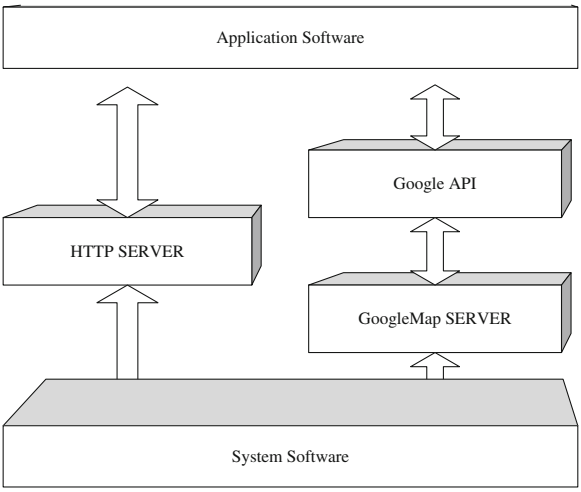

Fig. 87.3 System software configuration

System management, data maintenance, information classification, and coding system are around the entire system. System management and system security module are to protect the system's operation and safety; information classification and data updates are to protect a system of timely updates and maintenance. These components are an indispensable part of system [5, 6]. Various parts of their

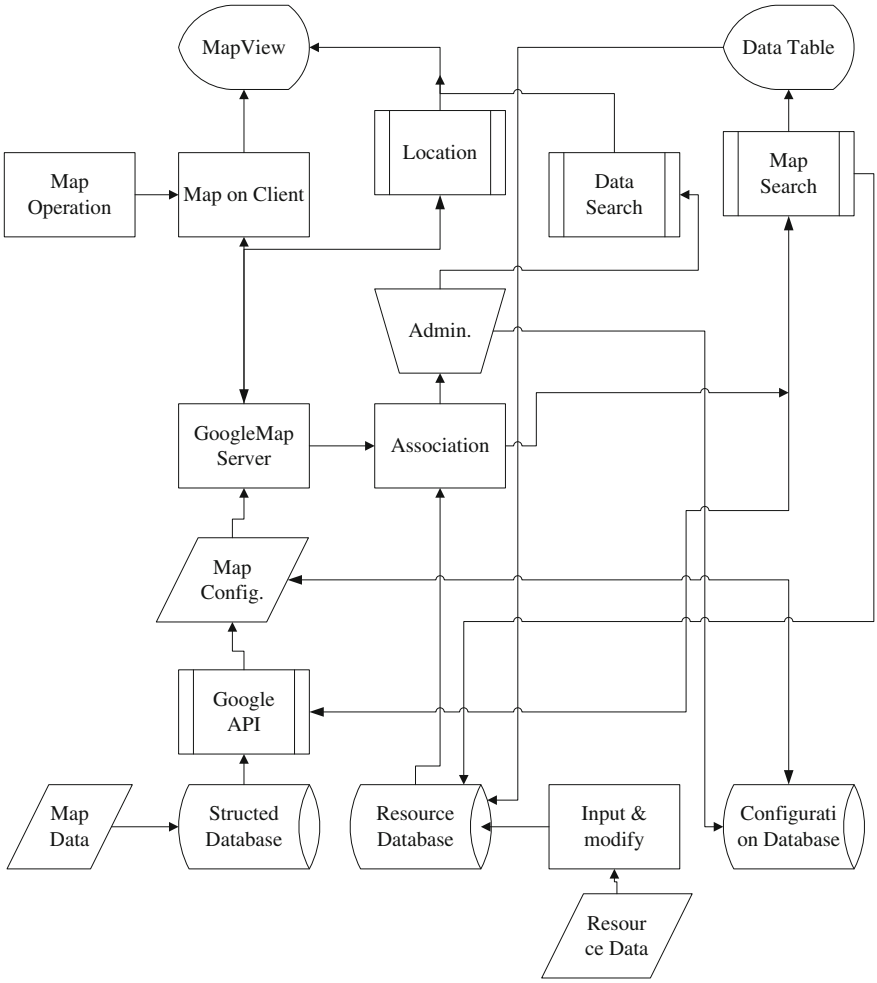

Fig. 87.4 Data flow

respective duties and mutual restraint, so must take full account of these parts when we design the system. The system architecture as shown in Fig. 87.2.

The system uses the Google's Google Maps platform as a map display [7, 8], on which develop Xushui's TIS. The Tourism resources and configuration information are stored in the database on Server. System interacts resource data and map server through the Google Map API [9] (Fig. 87.3).

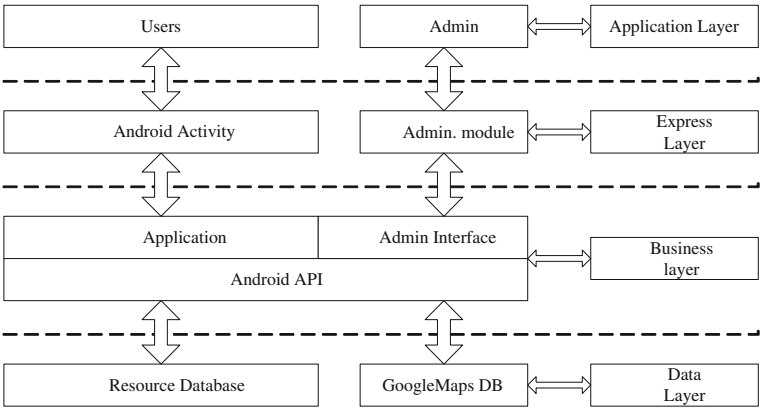

Fig. 87.5 Logical structure of Xushui tourism information system

87.4 Data Flow

The system performance results to the end user include: resources map of the design of the tourism industry, user location [10], and planning and information inquiry forms. These results depend on the map database and resource database [11]. All data and information flows are implemented by the system function. Manifestations of the application use the library configures to provide regularly updated statistics functions. The overall system data flow diagram is shown in Fig. 87.4.

87.5 Logical Structure

The elements of logical structure determine the flow of system data and logic. The system architecture is divided into four levels: the expressed layer, business layer, application layer, and data layer. The logical structure of Xushui tourism information system is shown in Fig. 87.5.

87.6 Conclusions

We have designed and implemented Xushui County's tourism information system with combined traditional TIS and Google Maps on Android platform. The system has perfected the attribute of information of various entities of the system and established the databases of basic tourist attractions and related resource information, such as scenic spots, hotel, dinning room, place of entertainment, nature, folklore, and traffic etc. The system has defined five modules including basic

Information query, resource location, itinerary planning, custom query, and data management and achieved corresponding functions of the above five modules.

The main feature of the system is its operability and convenience. For example, the tourists can use their handheld mobile equipments to click and access the system in time and conveniently. At the same time, the tourism managers can also immediately announce the newest tourism industry information, which achieves the purpose of promoting tourist markets. In addition, by the use of Google Maps API, the tourists can plan their tour routes to their potential scenic spots by looking at the map; this visualized query can provide more detailed information. What is more is the analysis, the evaluation, and the decision can be made by the tourism managers through a time of statistical data. Last but not least, the tourism industry practitioners can schedule the supporting services in the tourist attractions and the income forecasting is online realized for the people in the tourism industry. Tourists can use their mobile phones to access the system, which offers them all kinds of information about tourism in XuShui County such as the places of interest and sightseeing tours as they start to type a query. This system is a full-featured, user convenience design.

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Part IX
Physical Education and Applications

Chapter 88
Happy Education in the School Football Teaching

Dong Bin

Abstract To improve student learning initiative to enhance teaching effectiveness, to attract more students to participate in football, students interested in football. Will be happy to introduce the concept of education to the school football teaching, the reform of teaching methods and means, to communicate the subject of education, advocacy, and proper guidance are discussed in three aspects. Practice has proved that football in the school teaching, the joy of education is widely used, very promising, it is necessary in football teaching caused "happy" thoughts, the implementation of "happy" teaching.

Keywords Happiness · Education · Football · Teaching

88.1 Introduction

Human emotion is always produced in a certain context, good teaching situation produces feelings of students has a significant role, and physical education is no exception [1, 2]. Good teaching situation can not only enrich the students of perception, but also stimulate their curiosity [3, 4]. Strong sense of curiosity is strong motivation to maintain an important factor in successful teaching is an important condition to obtain [5]. PE has its own characteristics, with particular emphasis in each class to create a good atmosphere, so that students in the learning process become friendly, sporty, free, and harmony; thus, effectively improving the effect of physical education.

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In theory, students would be happy to participate in sports activities, physical education depends largely on the behavior of those of the first students to participate in the design. At present, most schools have varying degrees by the pressure from the cultural studies, by contrast, much less physical stress, and there is a greater advantage to enable students to have fun, get involved in the satisfaction. The actual situation may be not so ideal. In addition to external factors, physical education students who participate in sports activities lack the understanding to be happy; teaching methods and specific aspects of the design of the teaching is not mature enough.

And with its unique charm of football, a majority of students like sports, one of the characteristic sport for the school campus, students can develop self-confidence, initiative, and coordination of innovative quality.

However, due to the current existence of the school's football teaching the aging of materials, evaluation methods of a single, and methods in teaching means less flexibility, too much movement of the precision pursuit, ignoring the physical and psychological characteristics of students, resulting in the teaching content in a dry manner, Many students learn to master the small, often school is the training technique, physical training, little experience of football to bring their sense of happiness and success. Former head coach of the Chinese football team advocated by Milou "happy" to start and did not arouse enough attention. However, the Chinese soccer team in 2001 reached the World Cup with excellent record, the "happy" to be reacquainted. Why make a football game many fans ecstatic, overnight, and not football fans who will never understand the behavior, but only the fans themselves clearly felt in football fun, provided it does not need more not mandatory, and all are from the heart, emotion, and motion blending. If the physical education teachers in the classroom enable each student to find their favorite sport, it is the successful education students receive.

To attract more students to participate in football, to enjoy the "happy", it is necessary to introduce teaching in the school football "Happy Education" thinking and the implementation of "happy education."

88.2 A Happy Education in the Application of Teaching Methods

88.2.1 The Improvement of Teaching Philosophy

Some students in the football class teacher teaching technology are too boring, not enthusiastic, physical education teacher therefore believes that respect for the needs of students to technical education should be removed, weakening the skills, it seems that is the subject of education, there is a number of PE teachers Puzzle. Aside the role of the student movement , one of the sports to soccer in terms of the essential factors in order to show what football charms? Viewers watch the

football match is to feel the spirit of sport ? Of course not, football is precisely the charm of football techniques and skills through to the performance, which constitute the essential core of football. The content of the game itself is relatively stable, while the performance of the content in the form of football can be eclectic. The happiness football as a means of education in the school, in the classroom, students should get is the diversity of football experience, as to what form to show football, is carefully designed physical education teachers.

Teaching Soccer Teaching Football However, due to the existence of the current aging of materials, evaluation methods of a single, and methods in teaching means less flexibility, too much movement of the precision pursuit, ignoring the physical and psychological characteristics of students, and resulting in the teaching content boring. To attract more students to participate in football, to enjoy the "happy", it is necessary in football teaching caused "happy" thoughts, the implementation of "happy" teaching.

88.2.2 Update Teaching Methods

Happy students can participating in sports activity to a large extent depends on the activities of teachers to make students to participate in first design. For a long time, the contents of competitive sports is the main material physical education, all teaching activities are underway around the sport. Football is the main content of teaching the basic skills of football action and tactical exercises. The wide range of complex areas, students have a greater difficulty in the mastering of technology, thus affecting the interest of students, it is difficult to achieve the objective of teaching. Therefore, teachers must learn the content of teaching materials for processing and screening, focus on key technologies such as passing the ball, dribbling, shooting, on the boring Daimio, and without the ball may be special education technology; second is to simplify the technical structure link. If pass technology "approach, supporting foot stations, leg swing, foot ball, with the former action" a few links and key master "stations supporting leg, leg swing, foot ball."

Physical education to physical education instructional design should be one of the students eager to participate in the space, become a paradise for kid's sports; more sports have additional atmosphere to students to show them. This movement has brought students to personally experience the fun and satisfaction, a more active part in sports activities, the gradual movement of students to teachers interested in voluntarily into the exercise habit. To match with the training, decreased the standard rules, as in practice and competition do not set the offside, reduce the size of venue, a throw with their feet, etc., so that students in the more relaxed and happy environment for active participation of and devoted myself to football movement, the game's outcome also led indirectly motivate students to improve the teaching quality of teachers and student learning.

88.3 Happy the Subject of Education and Communication

Education is also a pleasure to student-centered education, and teaching materials, teaching methods are just tools and the means of media, education, and self-essence is to perfect a process to others. Students toward sports and physical education educators understand and treat a certain gap between expectations, the main objective is to strengthen the education of students in sports activities in the self-design and self-development. The actual development of students should be like subjectivity is considered in the philosophical level to explore the development of a person, the inevitable philosophical significance of the theoretical level, and the practical significance of the difference between the operating levels. Therefore, in the minds of some teachers it is still hard to get into and positioning.

Football in the implementation of the process of teaching, teaching content, and methods and means are important, but as one of the main teachers, students follow the words and deeds is the object of high and low quality of teachers, and students are to determine the emotional interaction between the key, but also to crucial issue. In football teaching, teachers should participate as much as possible to match students, and students each make a good action, a strike came when the use of language or body language to maximize the students must; Instead, the students make wrong moves or mistakes made because of their race fail, to encourage more students to go on, so as not to lose confidence, and gradually increasing interest in football.

88.3.1 Happy Student Education as the Main

Together, the goal of education is to make the student body to actively participate in sports and enjoy the pleasure of football. Some universities advocate the significance of learning physical education is to promote the subject in the process of self-development can clearly understand the physical education content to grasp the movement and make it as self-survival and development of higher quality services. The ultimate goal of the development of subjectivity as an independent person is to be free to seize his objective world, and make their own behavioral tendencies of individual's positive results. Thus, to enjoy sports, mainly to see whether students really understand and grasp the sport, the real understanding of the sport as he manned his own subjective world object, in this issue, the subject of development and enjoyment of sports has invariably targets.

Happy Physical Model and Traditional Sports The main difference between teaching students to give full play to the initiative to change the traditional physical education teachers simply taught mechanical repetition of the teaching of students, advocated by the injection shift heuristic teaching imitation to create teaching by the "teacher centered to student center". "Heuristic" teaching focuses on active classroom atmosphere, to inspire students to exercise motivation, more integrated method, practice law and to discuss style, dialog and other methods will help students to think independently, and to meet the desire for knowledge of

students so that students know which principles, such as the foot is the shot in the aerodynamics, kicking the ball in the arc of the size of the arc, and the relationship between displacement speed football under the guidance of scientific theory in a reasonable practice, inspired by the students thinking, develop the students practice capacity. And on this basis, method and motivation by demonstrating the law and the creation of scenarios method, bold innovation, so that students exposure to a lively, vibrant scene being fully mobilize the initiative and enthusiasm of students, students from the "weariness" became to learn, will learn and willing to successfully complete the task of teaching science, but also the innovative spirit of the students received training. Basic techniques, such as Instep soccer kick motor learning curve ball for students to think he is the "Beckham"; in the shooting exercise, encourage students after making a successful shot, in all the former enjoy their favorite show celebration, so that the image of teaching is more intuitive, fun.

88.3.2 The Focus on Individual Differences of Students

On the one hand, as different stages of development of the student body, personal qualities and abilities are not balanced, for football's ability to learn and grasp the different, on the other hand, a student at different stages of learning materials, there are different The main capacity. Therefore, teachers and different students according to different materials, different designs of the teaching program, in teaching students to master personality, vary, be treated differently. In theory, students can happily participate in football activities to a large extent depends on the behavior of physical education teachers for students to participate in the first design, which is the difference between teaching design.

Football in the actual teaching process, students should be given higher levels of higher demand, the teacher introduced under the circumstances, some of the stars tricks skill moves to enhance its interest. Treatment of poor students, to give more encouragement, counseling, foster their self-confidence and initiative, and should take full advantage of the competition method, note that with a reasonable, self-esteem, and respect for the rights of students, so that each student has the opportunity to play exercise so that they learn to coordinate with others, communicate, and feel the power through the collective, can make up for lack of personal and get the victory, and more to experience the joy of success.

88.4 Happy to Guide Education and Publicity with the Correct

The goal of physical education should be to make the students fully aware of the movement to meet, so they have to be actively involved in sports activities, training of teachers, and interested in gradual evolution of totally voluntary

exercise habits. But in reality, students may temporarily not realize the growth of sports on his own true meaning of sport as merely a course, just a learning process, and not from the learning process to get a sense of accomplishment. Thus, the experience cannot be happy, so happy education should strengthen the publicity and the right guidance to enable students to appreciate the joy and satisfaction of sports. The right to guide students to enjoy sports and feel happy.

Teachers can explain some of the students in the curricular and outward knowledge of football match in time to introduce several exciting games, introduced several popular football star, to stimulate students interest in viewing, driving students to the football hobby. For example: Every football game enables the football fans ecstatic, overnight, to participate in the fun of competition among the felt, and all are from the bottom of heartfelt words, no regulations, but not mandatory, emotion and movement integration, and participation in the meeting would be sufficient.

If the PE teachers can be a lot of publicity and guidance, to enable students to study in the subtle influence of sports for many years to fall in love with football, to teach students to watch the football match, and then they will unconsciously accept the football all. Those who would like the soccer star groupies, they like all the stars in the game, including their movements and with the wonderful technology, they will take the initiative to learn to imitate. And the game guide technical and tactical those comments can also help students understand football knowledge. Students will bring these fun soccer experience to the classroom to promote classroom learning atmosphere.

88.5 Conclusion

Enhance interest in learning a science, it is an art; learn the highest state of happiness. “Stimulate interest in learning to develop student’s awareness and capacity for lifelong learning”, which is the teacher teaching the concept. If you can “happy” concept carried out, the football teaching students in the classroom truly become free and happy world, it is the liberation of the students thoroughly, make students self-liberation, reflecting the essence of modern education. “happy” the objective of teaching is also in here.

To experience the happiness of football to inspire students to consciously and actively participate in the interest of football, the football-loving attitudes students football skills, and participate in the teaching learning thought. As a teaching ideology, it is the product of the times is the product of the school sports development. To better implement the “happy” teaching, we also need to learn in the teaching practice, observe, and more research, more practice, continue to explore, and summarize to make “happy” integrated thinking and teaching soccer to become a species loved teaching. To the happiness and development, and seeking happiness in the development of teaching objectives.

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Chapter 89
Study of Martial Arts Industry in Henan Province

Yuxi Hu

Abstract With the help of methodologies as the literature review and inductive analysis, this research has investigated the social conditions for development of martial arts industry in Henan province, elaborated upon the development stages hereof from germination and initial development to deepening stage, and examined herein upon the advantages and strategies for development of martial arts industrial zones in Henan province from the perspectives of martial arts population, human resources, technology, and brand development.

Keywords Martial arts industry · Martial arts culture · Advantages · Strategies

89.1 Introduction

With the rapid development of market economy in China, martial arts industry as a compound industry has been given more and more attention [1, 2]. It has become an imperative issue to examine how to develop against the backdrop of market economy martial arts in Henan, which has time honored history and culture [3, 4]. With China's entrance into the WTO and China's successful hosting of 2008 Olympic Games in particular, modern martial arts industry has been given more space for development and hence it is the right time and opportunity for development of martial arts in Henan [5–7]. The development of martial arts industry is significant in the sense it could facilitate spreading of national culture, cultural and ideological progress of the people, and physical mental health and life quality of the citizens

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[8, 9]. In addition, it could help to adjust industrial structure, integrate martial arts resources, stimulate domestic demands, regulate industrial market, and promote the area development of culture and economy. Advantages for development of martial arts industry in Henan have been investigated in hopes of finding suitable development strategies and providing help for area development of culture and economy.

89.2 Germination and Development of Martial Arts Industry in Henan Province

89.2.1 Social Conditions for Germination of Martial Arts Industry in Henan

It is a natural rule that existence and development of an object are indispensible from social conditions and influenced by many great factors including traditional culture, social, political, and economical environment. Likewise, germination and development of martial arts industry in Henan is indebted to joint effects of a great many factors including local culture, social, political, and economical conditions. In the Republic of China (1912–1949), where the first contradiction between Chinese native sports and western sports had occurred, martial arts athletes from Henan ha displayed charms of oriental human body culture in the 11th Olympic Games in Germany in 1936. After the founding of New China, Henan martial arts, as a unique characteristic of Henan province has been given high attention from Henan provincial government and party committee and many great martial arts festival and Jiaozuo Taiji Shadow Boxing Annual Conference have been held, and martial arts of Henan has been enhanced and spread.

Changed Economic Environment. Henan province, whose population has exceeded 100 million in 2009, is the first province in China with more than 100 million people [2]. In recent years, economy of Henan province has witnessed significant progress with its GDP up from 6 trillion RMB Yuan to 10 trillion Yuan in 2005, ranking the fifth highest in China. In 2006, its GDP has reached 12 trillion Yuan, signifying transformation from a traditional agricultural province into an industrially strong province [3]. With rapid development of provincial economy and improvement of people's life in Henan province, people's basic needs have been satisfied, people's consumption mentality has been changed, and more and more attention has been given to enjoyment of life and personal development, laying good economical foundation for development of fitness entertainment industry. Hence, martial arts could meet people's needs in a great many aspects as health keeping, entertainment, physical rehabilitation, illness prevention, and longevity. In addition, it could provide common fitness methods for the public, for it has no specific limitations to occupation, age, gender, and physique of the practitioners, nor location or season of practicing martial arts. Hence, martial arts agree with mentality and traditions of Chinese people's fitness, having great potentials for development.

Effects of Transformation of Culture Model. History of human society is essentially cultural. Biological life exists upon genetic transmission and develops upon genetic variations during transmission. Likewise, human society relies upon transmission of cultural genes for existence and variation of cultural genes for development, which is innovation in other words. Hence, development of human society and social progress are essentially cultural development and progress [5]. In today's world where different cultures merge and culture correlates with politics and economy, culture has played an increasingly important role in global completion. Moreover, it has been integrated with vigor, creativity, and cohesion of a nation, and cultural transmission could decide existence and prosperity of a nation to some extent. With enhanced national consciousness, contradiction of value concepts, and development of means of communication, new requirements are made for the development of martial arts. Martial arts of Henan have been awarded with a great many honors and calls for development through new thoughts and with help of its advantages.

Guidance of Government Policies. It has been stated clearly in the working report of Henan's eighth provincial congress of party representatives that new progress in satisfying people's moral and cultural needs shall be achieved with development of cultural business and cultural industry [6]. Two transformations shall be targeted, from a province with cultural resources to a province with cultural industry and from a province with cultural industry to a province strong at cultural industry. These two transformations consisting of one of the eight transformations proposed by Henan provincial party committee and government are the cultural aspiration and dream of Henan people. Henan martial arts with unique characteristics has not only provided rich cultural resources for modern civilization but also added spectacular element to world culture with its thorough thoughts and unique theories, thus playing a significant role in cultural dialog between the east and the west. Hence, martial arts culture has been nominated as one element of Henan culture and put high on the agenda of development. Traditional Henan martial arts could in accordance with objectives and requirements of Henan cultural development proposed by Henan provincial government play significant role in spreading Henan martial arts culture and building Henan as a culturally strong province. The government policies and measures hereinabove have promoted tremendously the rapid development of martial arts industry in Henan.

89.2.2 Development Stages for Martial Arts Industry in Henan

Germination Stage. After the Third Plenary Session of the 11th Central Committee, China's market economy has been active and the release of Hong Kong movie Shaoling Temple in 1980s has promoted rapid development of martial arts movies in China. The success of Shoaling Temple has not only brought huge profits to Hong Kong Movie Corporation in Henan but also created unprecedented golden opportunity for development of Shingling temple and its surrounding areas.

As a result, shoaling temple has become world famous scenic spot and Henan martial arts have been combined with economic development. Small scale martial arts training centers came into existence, martial arts products have been produced, and martial arts shows and communications are enhanced, all helping the formation of martial arts industry in Henan. China's largest martial arts school with most students, Tagou Martial Arts School, is located in Henan.

Martial arts industries of various categories have come into existence. With development of martial arts, martial arts related tourism, video tapes, and shows together with martial arts products have been developed with certain scale, systematic research, development, and production hereof has been put into execution. In addition, private companies and local enterprises specializing in martial arts industry have been registered legally and economists have participated into planning martial arts activities. Such companies and local enterprises include Shoaling Temple Compound Business Development Corporation, Henan Shoaling Temple Movie Corporation, Song Shan Shoaling Temple Monks Training base, Song Shan Shoaling pharmaceutical research institute in Dengfeng of Henan, Shoaling Tourism Company, and International Teaching Centre of Tagou Martial Arts School. In this way, values and status of martial arts have been demonstrated.

Operas and art programs of various categories have been developed. To answer the call for developing Henan as a culturally strong province, series of operas and programs for developing Henan martial arts have been developed. In 2004, a key TV program named Wulin Wind had been released on Henan provincial television channel, large scale opera named Shoaling Glamour produced jointly by Shoaling temple and China Performing Arts Agency, and large scale operas such as Shoaling in Wind and large scale realistic landscape performances such as Chan Style Shoaling concert have been staged by newly established Zhengzhou Song and Dance Theatre. The operas and programs hereinabove have promoted significantly spreading of ethnic culture and specialties of Henan province and demonstrated glamor of Henan martial arts by developing Shoaling temple as a world famous brand.

Landscape planning has been executed in an orderly manner. In Dengfeng city, Development Program of Dengfeng Municipal Martial Arts Industry had been designed since November of 2005 and had passed through expert testification in 2006. In Jiaozuo city, local government has been trying to development Chen style shallow boxing into a famous brand to promote development of local economy. Hence, Chenjiagou Valley Tourism Development Program with a total investment of 120 million RMB Yuan has been initiated in 2004 by local government of Wen town and application for listing the program as world heritage relics has been submitted in hopes of developing shallow boxing brand and industry. In addition, one of China's top 20 sports landscape projects, Shoaling Martial Arts Cultural Exhibition Centre has been built. Hence, the planning and infrastructure projects hereof have laid sound foundation for the development of martial arts in Henan, aiming at making contributions to communication, exhibition, performance, visit, and training of martial arts and to development of leisure, fitness, and scientific research in Henan.

89.3 Advantages for Development of Martial Arts Industry in Henan

89.3.1 Advantage in Population

Martial arts population is base for sustainable development of martial arts. With a 1,500-year-old history, sound and wide public foundation has been formed for martial arts in Henan, giving large martial arts group. There are more than 100,000 martial arts practitioners in Henan and approximately 50 million and thousands of million people practice Shoaling kongfu and shadow boxing all over the world, comprising of main consumption groups of martial arts industry and providing sound basis for sustainable development of martial arts. With social progress and improvement of people's life quality, it becomes imperative needs of the public to keep healthy, with which martial arts agree quite well. In this way, sound foundations have been established for existence and sustainable development of martial arts and martial arts industry.

89.3.2 Advantage in Human Resources

Martial arts human resource is a predominant factor for development of martial arts industry. According to incomplete statistics, there have been more than 100 and 300 martial arts competition winners in Henan for world and national martial arts competitions respectively, winning more than 4000 medals. With regard to Dengfeng martial arts school only, there are more than 60 and 200 winners for world and national martial arts competitions, respectively, winning more than 3000 medals. Athletes from Henan had won golden medals successively in the fifth, sixth, and seventh National Games. There are a great many remarkable athletes in Henan including Ding Jie, Wang Erping, Yang Jianfang, Chen Baotang, and Sun Xunchang. A total number of eight higher education institutes have opened national physical education major, among which there are three schools and one school is entitled to award master degree and doctoral degree in national physical education, respectively. As a result, a great many scholars and experts on martial arts have been cultivated. With regard to competition between Chinese and foreign martial arts, athletes from Henan have stood out among the participants and won golden medals successively, awing the whole world, showing splendor, and winning honor for Henan martial arts.

89.3.3 Advantage in Technology

Martial arts competition performance as one major theme and element of martial arts industry has received increasing attention from the public. The current martial

arts competition and performance industry in Henan has taken form; independent companies specializing in running martial arts competition and performance have been set up, martial arts competitions and performances of various categories have been organized and social and economic benefits have been achieved. For instance, large scale martial arts entertaining TV program Martial Arts Wind on Henan TV channel designed by combining traditional martial arts and modern communication medium together with Shoaling Glamour, large scale opera jointly produced by Shoaling temple and China Performing Art Agency, and Shoaling in Wind, a large scale dancing opera produced by Zhengzhou Song and Dance Theatre in 2004 have achieved sound effects, earn high receiving, initiated combination of martial arts, arts and media, and enriched essence of techniques of martial arts.

89.3.4 Advantage in Brand

With considerable support from Henan provincial government and party committee in recent years and under the policy of promoting development of golden tourism routes along the Yellow River mainly in Zhengzhou, Luoyang, and Kaifeng, a great many tourism routes have been developed in Henan surrounding. Shoaling Kongfu or shadow boxing, Shoaling martial arts development program has been designed and executed, and the environment around Shoaling temple has been regulated and improved. In addition, Henan Shoaling Compound Business Corporation has been established to protect and develop the cultural brand of martial arts in Henan, which has a time honored history of more than 1,500 years. Moreover, the brands such as Shoaling and Shoaling temple have been registered in the state business bureau so that both tangible and intangible resources related with Shoaling temple could be protected and related brands could be developed.

89.4 Development Strategies for Henan Martial Arts Industry

(1) Concept Of Market Economy shall be developed and updated as per the requirement of the times. Complete martial arts market system shall be established as per requirements of market economy and with optimized allocation of resources. This is the key step to develop martial arts industry in Henan, which is positive to restructuring of martial arts industry and transformation of the operation mechanism hereof. In addition, management of martial arts market shall be enhanced and specialized talents be cultivated with help of higher education in the province.
(2) Martial arts market shall be regulated and related laws and regulations shall be made complete. Promulgation of laws and legislations concerning martial arts shall be accelerated, and physical education laws shall be incorporated into

martial arts industry so that feasible policies, laws, regulations, and management measures could be made in relation with martial arts. In this way, martial arts industry could develop in a healthy, legal, and sustainable manner.

(3) More research shall be conducted on integration of martial arts and entertainment. It is an imperative issue in the research to cultivate a group of publicity staff for martial arts, who are sound in both martial arts and morals, sound in both traditional culture and professional skills.

(4) The proposal of naming Dengfeng city as martial arts city by State Physical Culture Administration shall be finalized and put into practice. Feasible building program shall be designed, application for state sports industrial base be reviewed, and martial arts industrial garden be built in an active manner.

(5) Research and construction in relation with Middle China Martial Arts Museum and martial arts landscape projects shall be enhanced so that martial arts province could be developed. Electronic publicity for martial arts shall be attached with great importance with other key publicity means, and government support shall be sought so that Internet technology could be applied in development of martial arts industry.

(6) Domestic and foreign education on Shoaling Kongfu and shadow boxing together with related publicity shall be attached with great importance. Martial arts training shall be enhanced on teenagers and youth of the entire province so that Shoaling Kongfu and shadow boxing could be included in school education. In addition, Confucius schools all over the world shall be utilized to promote international development of Shoaling martial arts and shadow boxing.

(7) Martial arts industry shall be developed and strengthened with focus on Shoaling Kongfu and Chan culture. Shoaling culture shall be combined with development of Song Shan tourism spot so that centre of international martial arts industry and Chan tourism industry could be established. Henan martial arts movie industry shall be developed with martial arts animation products.

(8) Standardization of development of Henan martial arts industry shall be enhanced; martial arts competitions, performances, products, trainings, and services shall be regulated. In this way, good reputation of Henan martial arts could be cultivated and made known to wider public.

(9) Research institutes on martial arts shall be established. Research resources shall be integrated, financial support won, and research topics set so that influential results could be achieved to fill gaps in development of Henan martial arts and to use scientific theory to guide the development hereof.

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Chapter 90
Study on a User-Defined and Low Cost Fieldbus Technology

Chengshan Zhang

Abstract A low cost fieldbus is defined and its protocol and electric code are elaborated in detail upon which a demonstration project is built. These fieldbus own certain market share in international market and have their own advantages and disadvantages. However, one common disadvantage of these products is their high costs which restrict their application in automatic field. With improvement of life quality, quickening tempo of life, and edification of modern communication technology, it is an undisputable fact that modern management is required in agriculture, industry, and civilian field.

Keywords Bus · Topology · Protocol

90.1 Introduction

Fieldbus technology is a kind of network communication technology which originated in the late 1980s of twentieth century [1, 2]. After decades of development, various typical fieldbus standards and series of products have emerged over the world, among which Foundation Fieldbus, PROFIBUS, LonWork Fieldbus, CAN bus [3, 4], and HART are relatively popular. These fieldbus own certain market share in international market and have their own advantages and disadvantages [5, 6]. However, one common disadvantage of these products is

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their high costs which restrict their application in automatic field. With improvement of life quality, quickening tempo of life, and edification of modern communication technology, it is an undisputable fact that modern management is required in agriculture, industry, and civilian field [7].

In order to address this problem, we define a fieldbus technology, which is especially suitable for low cost automatic field. Below is a brief description of this fieldbus.

90.2 Protocol and Electric Code of User-Defined Bus

90.2.1 Structure of Bus

The units connected by bus consist of one (one and only one) master unit, 0–256 slave units, 0–2 monitor units, and some passive units .

Bus-based topology or tree topology can be adopted as the fieldbus topology. It is recommended to connect master unit to one end of bus-based topology or root of tree topology and connect location of slave unit is open. Monitor unit is needed to be connected between master unit and slave unit, which mean it is not allowed to place slave unit on the bus between the master unit and monitor unit. Total length of bus and all branches is less than 10 km. It is recommended to connect terminal shown in Fig. 90.2 at both ends of bus and end of branch whose length is more than 500 m.

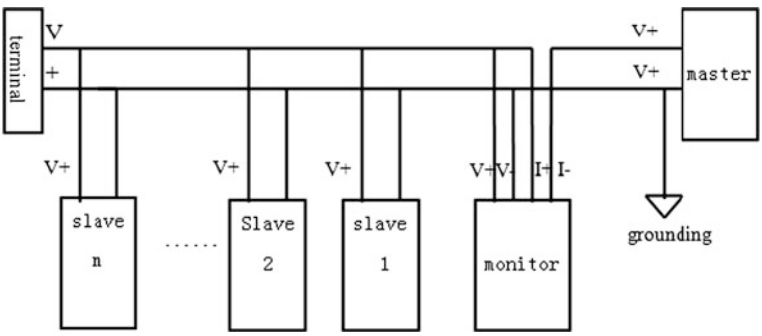
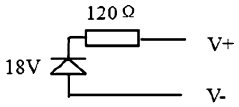


Fig. 90.1 The schematic diagram of bus connection

Fig. 90.2 Total length of bus and all branches is less than 10 km



Shielded twisted pair (STP) or unshielded twisted pair (UTP) is used as a bus media. There is no special requirement for characteristic impedance and sectional area of STP.

90.2.2 Time Sequential Routine of Bus

The circuit structure of slave unit consists of interface circuit and master circuit as shown in Fig. 90.3. Each slave unit of bus has only one unique primary address (recorded as A0–A255) and eight dot addresses (recorded as C0–C7). Primary address is used for gating master circuit of corresponding slave unit and dot address is used for operations such as selecting signal path of slave unit etc. Slave unit can remain in working state, holding state, or power off state.

Addressing and reset: the operation of gating next dot address or primary address is called addressing. Addressing can only be switched from slave unit with low address to slave unit with high address. Once master unit sends an addressing pulse signal, the dot address will increase by one, if the dot address is C7, then primary address increases by one and dot address returns to zero.

90.2.3 Bus Signal and Power Supply Requirement

There exists patrol control signal, slave unit data detection signal, and bus power signal on bus. Bus power signal is 12–18 V DCV, in which embedded undershoot signal used for patrol control. Patrol control signal is a voltage negative pulse and the width of reset pulse is much greater than the width of addressing pulse. Both reset pulse and addressing pulse generate operation at rising edge. Rising edge of reset pulse only produces resetting and rising edge of addressing pulse only produces addressing. The addressing signal can also be used for sending data to slave units. The data of detecting slave unit is sent by current pulse.

Bus voltage waveform includes power on pulse, power off pulse, addressing pulse, reset pulse, and voltage pulse on bus resistance formed by electric current

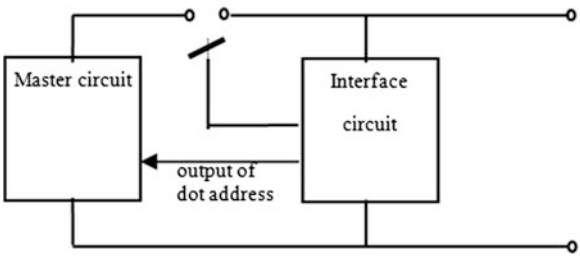


Fig. 90.3 The circuit structure of slave unit consists of interface circuit and master circuit

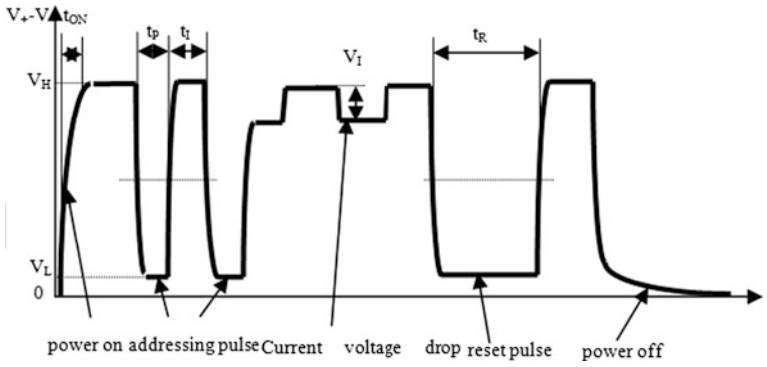


Fig. 90.4 Bus voltage waveform

Table 90.1 Parameter requirement of bus voltage waveform

Name of parameters	Definition of parameters	Value	Unit
Line voltage (VH)	Maximum value of bus voltage	12–18	V
Valley value of patrol signal (VL)		<0.1 VH	V
Power on time	Time interval of bus voltage from 0 to 0.9VH	<100	Ms
Addressing pulse width (tP)	See Figs. 90.1, 90.2, 90.3, 90.4	0.4–0.6	Ms
Addressing pulse interval (tI)	See Figs. 90.1, 90.2, 90.3, 90.4	>0.5	Ms
Reset pulse width (tR)	See Figs. 90.1, 90.2, 90.3, 90.4	4–6	Ms
Amplitude of current voltage drop pulse (VI)	See Figs. 90.1, 90.2, 90.3, 90.4	<4	V
Time of addressing and reset rise	Time interval of pulse amplitude from 10 to 90 %	<0.1	Ms
Time of addressing and reset drop	Time interval of pulse amplitude from 90 to 10 %	<0.1	Ms

pulse (called current voltage drop pulse for short). Bus voltage is shown in Fig. 90.4 and parameter requirements are shown in Table 90.1.

Bus current includes bus interface current of all slave units, master circuit current of gating slave units, and pulse current used for sending and detecting slave unit data. Its waveform is shown in Fig. 90.5, (Table 90.2).

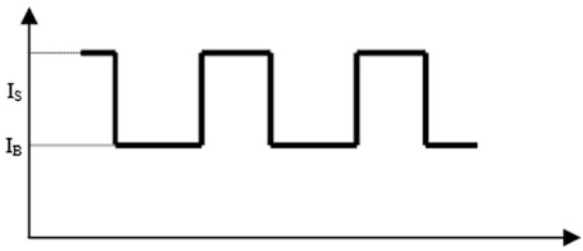


Fig. 90.5 Bus current waveform

Table 90.2 Parameters of bus current

Name of parameters	Definition of parameters	Value	Unit
Range of signal current (IS)	See Figs. 90.1, 90.2, 90.3, 90.4, 90.5	8–10	mA
Base current (IB)	Bus current outside signal current	<20	mA
Change velocity of signal current		>5	mA/μs
Change velocity of base current		<0.01	mA/μs
Cycle of signal current		1–20	ms
Duty cycle of signal current		0.2–0.8	

90.3 Interface Circuit

90.3.1 The Circuit of Master and Bus Interface

The circuit of master and bus interface can provide electrical isolation, the power, check and control pulse, and the signal to check bus electric pulse. The precise design of interface circuit is very important to the work and signal transmission of bus. The circuit of master and bus interface is shown in Fig. 90.6.

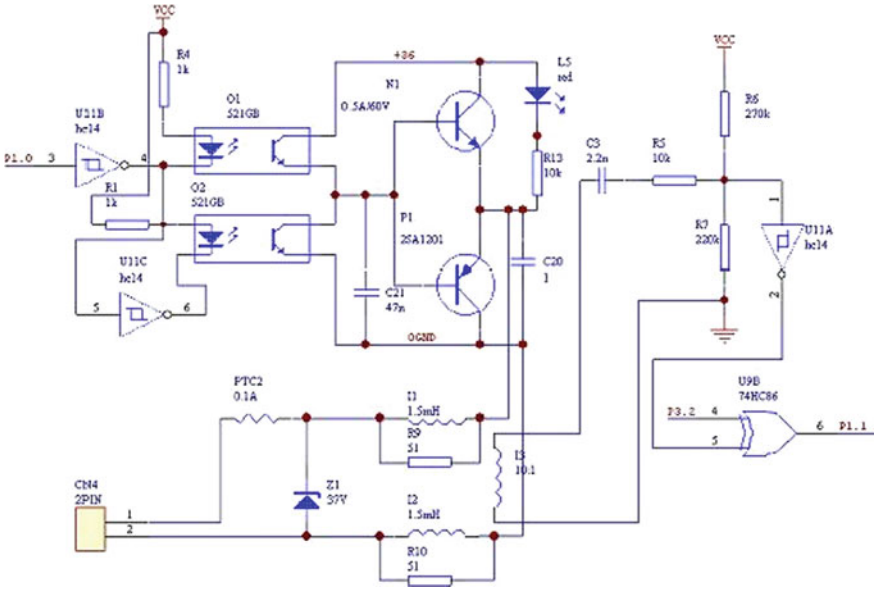


Fig. 90.6 Circuit of master and bus interface

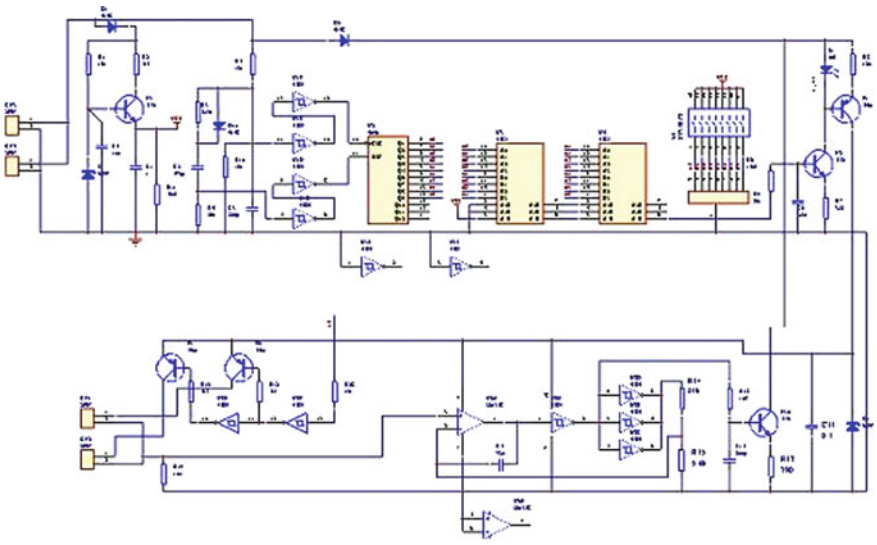


Fig. 90.7 Circuit of slave and bus interface

90.3.2 The Circuit of Slave and Bus Interface

There are the separation circuit of power and inspection signal, the circuit of select and control, and the circuit of power control in the circuit of slave and bus interface. Its circuit is shown in Fig. 90.7.

90.4 Conclusion

In this paper, a user-defined bus technology is introduced. Its most valuable quality is low cost compared with other popular fieldbus technologies and has expansive application prospects. This bus technology has been applied in temperature and humidity monitoring system of grain depot, large-scale concrete work, and various kinds of storage. It also has been used in environment parameters monitoring of breeding and planting shack in agriculture. A total of 17 kinds of slave units have been developed and a demonstration project has been built, which works very well.

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Chapter 91
Study on Education Enlightenment of Olympic Spirit to Competitive Sports Training

Jianping Xi

Abstract Olympic spirit includes five core principles which are participation, competition, justice, friendship, and striving. It is with educational effectiveness, which can be used by educators. Modern sports trainings are designed to develop and enhance the athlete's physical and psychological level and other aspects. In the process of the competitive sports training, Olympic spirit has brought certain education enlightenment to the technical and tactical innovation, ideology and morality, learning and using for reference, and confidence in training four aspects.

Keywords Olympic spirit · Competitive sports · Training · Education

91.1 Reviews in Olympic Spirit

"Olympic Charter" points out that the Olympic spirit is mutual understanding, friendship, solidarity, and fair competition. The essence of it include: participation, competition, justice, friendship, and struggle. "Higher, faster, stronger" is first proposed by the abbot of Acqui el Abbey in Paris, France who is a friend of Pierre de Coubertin, the father of modern Olympics. Later, Pierre de Coubertin borrowed them for Olympic Movement which expresses the striving spirit of constant progress and ceaseless content and indomitable spirit of fearless of danger and difficulty and the pursuit of excellence [1]. At present time, the Olympic spirit is becoming better and approaching perfection day by day with the steps of times development which has become one of the most influential global culture, but also

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had a very profound impact on the vigorous development of sports undertakings around the world. As one of the cultural achievements created by human community, Olympic Games shows massive spiritual connotations, displays good wishes of kindness, beauty and truth, demonstrates indomitable human spirit of struggle, and points out that the important things in life are not a triumphant return but tenacious struggle which let people pay more attention to human health.

91.2 Educational Factors on Sports Training

Physical training is the activity which takes "people" as the main core, in sports training, because of its multilevel nature, multifactor, and multivariability, the training process demonstrates a complicated situation. Exercise training and training subject (people) are as a whole, sports training systems and training subject (people) have a strong self-organizing capacity, the exchange occurs among the training substance in and out of the system, and information and energy are complicated in the exercise training system. Apparently, the training itself is a complex system; complex methods should be applied to deal with the complex system [2]. Nowadays, most of the athletes in competitive sports are young athletes; the Olympic spirit is inspirational for the contemporary youth [3]. Therefore, as an educational factor, Olympic spirit has a very important role to the healthy development of complex sports training.

91.3 Education Enlightenment of Olympic Spirit to Competitive Sports Training

The author believes that the education enlightenment of Olympic spirit in competitive sports training is mainly in the following four main areas.

91.3.1 Enhance the Confidence of Athletes in Training

Spiritual drive shows the attraction or impetus of the spiritual strength. Spiritual incentive mechanism should meet the spiritual needs of contemporary youth and maximally mobilize and inspire their enthusiasm, initiative, and creativity. The reason why the spiritual incentive can stimulate the enthusiasm on many aspects of many young people today is because few will intensify the needs of realizing their dreams, achieving their goals within their power, but also because it mobilizes the enthusiasm of young people at a higher level, the motivation is deep and the

duration is longer [4]. Olympic spirit motivates athletes to enhance their participation in three ways and increases their confidence in participating the training.

One of the important psychological qualities is the sense of competition which needs to be formed by modern athletes in training. As one of the five core Olympic spirit, competition is the soul in competitive sports, while promoting the progress of competitive sports training. It is an ideal to achieve the athletic goal; it is a state of nonstop questing or rediscovering. In the development of the Olympic movement, a mutual ideology and value system was formed in the world. In Olympic training process, the athletes master Olympic spirit, build competition consciousness, and actively participate in the professional competitions, and it can be said it is the self-awareness training in modern competition.

The spirit of hard working and plain living is an important quality in the existence and development of human society, but also one of the greatest inner strength in the formation of human society. Olympic spirit requires athletes to own a strong and unyielding spirit and have heroism of overcoming all difficulties and obstacles. The Olympic spirit "faster, higher, stronger" manifests in the spirit of tenaciously strive to succeed and forging ahead with determination. The important success factor lies in the preparation and willing to accept long-term and long-lasting training, ready to accept the challenge of continuous improvement, and must have perseverance to carry on the training. These conditions are the same with the requirements proposed in the Olympic spirit. In Chinese sports circles, at the mention of Kunming, two national level sports training base here would come into people's mind–Hongta and Haigeng sports training base. Olympic spirit is the spirit of hard working and solidarity, and these two bases, just carrying forward hard working and the spirit of solidarity [5].

91.3.2 Assistant Learning Lessons

On August 15th 2008, when the U.S. women volleyball coach Lang Ping led the defeat of the Chinese women volleyball team led by Chen Zhonghe, there was silence at one moment by the on-site 18,000 audience, then rose with warm applause, reflecting the proper tolerance for big country nationals, indicating that the Chinese have deeply understood the Olympic spirit. Medal is just a sign of the competition, for the athletes, their pursuit is going beyond themselves and chasing higher faster stronger. Because sports are worldwide, whether Lang Ping or the United States women volleyball team, they are all fighting for their own Olympic dreams [6].

In order to improve the skills, to adapt the game environment in China, Mexico archery team decided to go to China next week for nearly 2 months of training. This team has a number of great archery players in Mexico. The silver medalist Se Novello of women's archery in 2006 Central American and Caribbean Games said that the main purpose of this training in China was training with some Chinese

good players and learning from them which is because the achievements of Chinese players are obvious to all.

Sports are without borders, the heart of the Olympic spirit of which contains "participation" and "friendship". Sports talents flow in the international plays an important role to further enhance the level of sports for all mankind. Thus, it can not only complement each other in training, but also enhance friendship and create economic benefits. Athletic competition would certainly arouse the flow of athletic talents. In recent years, China's sports undertaking has a considerable progress, one important factor is the exchange of sports talents, such exchanges including the flow of domestic and international sports talents. The exchange of players in provinces and industries makes a vigorous development for China's sports undertakings; the exchange in sports industry between China and the world makes Chinese coaches, athletes can flow abroad and foreign coaches, athletes into China, which making the Chinese sports circles ceaselessly absorb foreign advanced theoretical knowledge, science and technology, training methods, etc. and help the rapid development of Chinese sports training, laying a strong foundation for marching into the world level. Let "friendship" in the Olympic spirit instructive greatly on the socialization and professionalism of sports training undertakings.

91.3.3 Promote Training Innovation

Dialectical materialism states briefly that the development process of the objects is essentially the process of the new things replacing old things. The emergence of new things must be accompanied by the demise of old things; this gradual process is the metabolism. Innovation in sports training is the same with other social practice, there are many interrelated factors and dialectical relationship in the process of sports training innovation. In specific circumstances, would these interrelated factors and relationship change independently of men's will? Although the metabolism is as the most common irresistible objective law, new things would not emerge without reason, but generated from the internal of old things. Competitive sports are comprised of two parts which are sports training and sports competition. Athletic competition is extraordinarily intense, whereas innovation in the technical and tactical training is often regarded as the magic key to a surprise success which makes it become the core elements of a successful training. Olympic spirit directs "higher, faster, stronger", which is bound to let athletes win and create new tactics, techniques, discard backward tactics and techniques, but also extend the active ingredients in original tactics, so that competitive sports would march to the goal of "higher, faster, stronger" in sports training and competition.

91.3.4 The Formation of Healthy Thoughts

From the chart above, we can know that the operation of harmonious sports cannot proceed without sound legal norms and moral principles.

"Higher, faster, stronger" that promoted in the Olympic spirit inspires athletes and good coaches challenge the extreme, dare to struggle and make constant innovation, but the sport would make sense in the prerequisite of fair competition. Internal factors of pursuing this goal have a change in some coaches and players, those who are not hesitate to take risks to trample on the laws and morality for the pursuit of results.

As one of the cores of the spirit in the Olympic Games just contains justice, equality, righteous, and that everything must be done according to law, just follow the guidelines for maintaining all the advantages against all behaviors that are inconformity with the ethical principles. Just ensures the equal rights of athletes, that is, equality before the rules; the spirit also shows the athletes that the final outcome of this competition depends on their own ability and the degree of effort. Olympic spirit reflects this sense of fairness strongly, in the meantime as the existence of the equality, thousands of people love, longing, and pursue the Olympic movement.

Currently, Chinese sports in many aspects need to be geared to international standards and learn and understand the sports rules of the world sports. Athletes must own the spirit of fair in competitive sports training, regulate their own behavior, and follow the rules, which are the essential qualities to complete various training and achieve the athletic goals. Adolescence is the most valuable stage in the athletic career. Adolescent athletes are vibrant, energetic, with intense sense of participation, have active thinking, and are receptive to new things. Olympic Games fit the young athletes to pursue the self development and self transcendence. Therefore, the cultural connotation of the Olympic spirit and the physical and psychological characteristics of young people, decided that the young athletes are the dream catchers and main educational object in the Olympic Games, young athletes training would certainly be the carrier in the education of the Olympic spirit which provides health security for resource library of backup athletes in China.

In addition, the modern athletic training objective is to develop athletes of all-round development, the athletes development oriented education involves in the overall development in moral, intellectual, physical, and esthetic of athletes. Sound moral character is an important part of player development, and is the guidance for the healthy development of athletes. Olympic Spirits always adhere to the concept of round way development, take respect as the premise, and make understanding as the key, and make performance assessment on this base. Therefore, only the Olympic athletes in training direct themselves by Olympic spirits and form healthy ideological and moral qualities, can shine in the highest level of competition such as the Olympic Games, and be crowned with outstanding achievements in sports history.

91.4 Conclusion

Integrate the physical training and education and take a road of education, harmonious sports development are also the general direction of sports development in China. Competitive sport maximizes the development and improvement in aspects of physical and psychological level for athletes, and on this basis, let athletes do training and competition so as to get outstanding performance. The successful integration of the physical training and education would certainly bring unlimited impact for physical training, the standard of competitive sports of athletes and the fame of sports, and would thus promote the development of our national sports culture. Reunderstanding the education of competitive sports training from the perspective of the Olympic spirit can carry forward the Olympic cultural function, promote the development of the competitive sports and progress the folk sports culture.

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Chapter 92
Research on the Development Pattern for Rural Sports

Jianping Xi

Abstract Taking rural sports development model in Xvchang as the research object, this paper has given an investigation on status of rural sports development in Xvchang with the literature material method, interviewing method, questionnaire survey, and analyzed the influential factors to offer the development pattern, which also provides reference for the rapid development of new rural sports and the relevant departments to formulate corresponding policies.

Keywords New countryside · Rural sports · Present situation · Development pattern

92.1 Introduction

In 2006, the No. 1 file, several opinions on promoting the construction of new socialist countryside from the state council of the communist party (the Opinions for short hereinafter) is the important guiding principle [1, 2], which indicates that we need to construct the system of public cultural services and promote the implementation of sports fitness projects for farmers according to the requirements of to develop production, prosperous life, civilized village customs, neat village, and democratic management [3, 4]. As an important content of the construction of the new socialist countryside, rural sports play an important role of strengthening the farmers' health, improving their health living standards, rich amateur cultural life, transforming social traditions, and forming the scientific, civilized, and

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healthy lifestyle. This paper has taken rural sports development model in Xvchang as the research object and has given an investigation on status of rural sports development in Xuchang with documentary, interview, questionnaire survey, and analyzed the influential factors to offer the development pattern, which also provides reference for the rapid development of new rural sports and the relevant departments to formulate corresponding policies.

92.2 Research Objects and Methods

92.2.1 Research Objects

The research object is the development pattern for rural sports in Xvchang, and people in the countryside of Xvchang are the respondents.

92.2.2 Research Methods

The Literature Material Method. To consult the literature material and books in nearly 10 years about rural sports and new countryside sports to provide the theory basis for analysis.

Questionnaire Survey. To design the questionnaire survey about the present situation of rural sports development in Xvchang, and examine the reliability and validity to make sure it is in accord with the requirement of sociology. With the stratified sampling method, first extract YuZhou, XuChang county, and XiangCheng county and extract Shenhou town, Yulin town, and Fanhu town, at last give out local residents 50, 100, and 50 pieces questionnaires in these towns, totaling 200, and recover 192 copies, the recovery rate is 96 %, containing valid questionnaires 188 copies, effective rate is 94 %, (as Table 92.1) and it is accord with statistical requirements after examinations.

Interviewing Method. Learn about the situation about the farmers' participation in sports fitness facilities, etc. through taking with residents and the government leader who is in charge of sports.

Table 92.1 Recovery situations TAB of questionnaires

	Number of questionnaires	Number of recovery	Recovery rate (%)	Effective number	Effective rate (%)
Shenhou town	50	48	96	46	95.8
Yulin town	100	97	97	96	98.9
Fanhu town	50	47	94	46	97.9

Mathematical Statistics. According to the research needs, inspect and count the data with EXCEL.

92.3 Results and Analysis

92.3.1 Features of Xvchang Rural Sports Development Status

According to the statistics, in this, 200 questionnaires have been given out in this investigation, and recycled 188 valid questionnaires, in which 106 people have once taken part in physical exercise, accounting for 56.4 %.

Diversified Motives of Physical Exercise. We can see in the Table 92.2 that in Xvchang the motives of physical exercise for farmers are successively physical fitness, accounting for 76.4 %; entertain, accounting for 68.9 %; next to prolong life, accounting for 58.5 %, prevention and treatment of disease, accounting for pt 48.1 %; promote exchanges, accounting for 29.2 %, improve esthetic, accounting for 22.6 %, kill time, accounting for 14.1 %. Today the material wealth of society is very rich; people have diversified motives of physical exercise like taking exercise for both body and hearts, which promotes the development of rural sports.

Narrow Limitations of Exercise Programs. (as Table 92.3) The exercise programs that rural residents of Xvchang take part in are mainly: Running, walking (77.3 %); Badminton (59.4 %); Basketball, volleyball, football, and some ball games (39.6 %); Martial arts (25.0 %); Billiards (24.5 %); Gymnastics, setting-up exercise, Fan Dance, and so on (23.6 %); and Mountain climbing (10.4 %). Thus it can be seen that running and walking is the most common way to exercise, and the exercise programs has narrow limitations.

Freedom of Exercise Place. (as Table 92.4) According to the investigation, the main exercise place of rural residents of Xvchang are in highway or street edge, accounting for 69.8 %, their courts, accounting for 62.3 %; in the school, accounting for 46.2 %; Charging sports venues, accounting for only 19.8 %, and fitness club, accounting for only 8.5 %. We can find that rural residents mainly choose the highway or street edge, which is free and has small scale.

Table 92.2 Rural residents' training motivation in Xvchang (MultiSelect) N = 106

The value of exercise	Number of people	Accounting for %
Physical fitness	81	76.4
Entertain	73	68.9
Prolong life	62	58.5
Prevention and treatment of disease	51	48.1
Promote exchanges	31	29.2
Improve esthetic	24	22.6
Kill time	15	14.1

Table 92.3 Main exercise programs for rural residents of Xvchang (MultiSelect) N = 106

Exercise programs	Number of people	Accounting for %
Running, walking	82	77.3
Badminton	63	59.4
Basketball, volleyball, football, etc.	42	39.6
Martial arts	33	31.3
Billiards	26	24.5
Gymnastics, setting-up exercise, fan dance, etc.	25	23.6
Mountain climbing	11	10.4

Table 92.4 The main exercise place of rural residents of Xvchang (MultiSelect) N = 106

Place	Number of people	Accounting for %
Highway or street edge	74	69.8
Courts	66	62.3
Schools	49	46.2
Charging sports venues	21	19.8
Fitness club	9	8.5

Centrality of Exercise Time. (as Table 92.5), the exercise time for rural residents to have exercise are mainly in the evening (48.1 %) and morning (34.9 %), night (12.3 %), and other time(4.7 %). Rural residents are basically busy with farm and jobs, thus most of them choose evening when they have free time for exercise.

Limitations of the Exercise Season. (as Table 92.6), the exercise season for rural residents to have exercise is winter (51.9 %) and at the turn of summer and autumn (26.4 %), early days in spring(14.1 %), and autumn (7.6 %) when less people will exercise. Autumn and spring are the two seasons that are the busiest time for farmers, during which they need to sow seeds and reap crops, and they are tired of the all-day labor which makes them have no redundant energy to take part in physical training. However, in winter and the turn of spring and summer, there will be little farm work, and the peasantry has less production activities so that they have time to do physical exercise, shape body model to cheer their mood, and promote family love and friendship between people.

92.3.2 *Factors Affecting the Development of Rural Sports in Xvchang*

Internal Factors. (as Table 92.7), rural residents' leisure time is distributed as follows. Watching TV at home, accounting for 86.8 %, Playing mahjong, poker, accounting for 66.9 %; Chatting, accounting for 54.7 %; Going to market,

Table 92.5 Exercise time for rural residents of Xvchang (MultiSelect) N = 106

Exercise time	Number of people	Accounting for %
Evening	51	48.1
Morning	37	34.9
Night	13	12.3
Other time	5	4.7

Table 92.6 The exercise season for rural residents of Xvchang (MultiSelect) N = 106

Exercise season	Number of people	Accounting for %
Winter	55	51.9
The turn of summer and autumn	28	26.4
Early days in spring	15	14.1
Autumn	8	7.6

accounting for 28.3 %; Participating in physical activities, accounting for 24.5 %, and Reading books and newspapers, accounting for 11.3 %. The residents spend most free time on watching TV at home, playing mahjong, poker and so on, and actually people who take part in sports only account for 24.5 %. Thus rural residents' consciousness of doing exercise is weak, and their cognitive level of sports function is not high. People just think that labor is equal to sports, in their opinion, the main method to maintain and improve health is enough sleep and to improve eating. On the contrary, physical exercise will only make them feel tired, which is unfavorable to work.

External Factors. (as Table 92.8) There is an investigation for 106 people who take part in sports, in which 89 rural residents proposed lack of facilities, accounting for 84.0 %; No time, accounting for 72.6 %; Too tired of work, accounting for 54.7 %, Economic condition is poor, accounting for 40.6 %; and Having no interest, accounting for 33.0 %. We can find that most rural residents are willing and like to take part in sports, however, as for the restriction of site, time, and other external factors, the development of rural sports is not very good, so we need to perfect site, equipments, and other hardware facilities if we want to develop the rural sports.

Table 92.7 Distribution of rural residents' leisure time in Xvchang (MultiSelect) N = 106

Leisure-time activities	Number of people	Accounting for %
Watching TV	92	86.8
Playing mahjong, poker	73	66.9
Chatting	58	54.7
Going to market	30	28.3
Participating in physical activities	26	24.5
Reading books and newspapers	12	11.3

Table 92.8 Factors affecting the development of rural sports (MultiSelect) N = 106

Influencing factor	Number of people	Accounting for %
No site and equipment	89	84.0
No time	77	72.6
Too tired of work	58	54.7
Poor economic condition	43	40.6
No interest	35	33.0

92.3.3 Construction of the Development Pattern for New Rural Sports in Xvchang

School Sports Development Pattern. School sports refers to make full use of school sports resources and take schools as the main activity places and adults as object, so that make the school sports resources and community sports resource can be both shared, which is an effective way to promote national fitness. As a main manner for rural residents (community), government and related departments should enhance investment to the school sports installations and sites. Third, the school PE teachers can serve as instructors for residents' sports exercise, guiding residents to understand sports information, and the theory and methods for sports fitness, so as to raise residents' sports level and participation.

Festival Sports Development Pattern. Festival sports is a kind of sports culture, which is formed in specific space–time and locations and according to demands of religious sacrificial, farming production, fitness entertainment and so on. First, the organizer and participants of rural holidays and festivals sports activities are mainly peasants, and organization form and activities projects have rural characteristics.

Village Sports Development Pattern. First, to develop village sports in slack farming season when the government and related departments can hold farmers games between villages. Second, in modern society, sports have become one of the important social intercourse forms. Third, as the village sports is backward compared to city sports, we should make full use of the demonstration effect of cities and towns sports to encourage cities, towns to support construction of village sports including human, material, and financial resources and intellective in order to quicken the construction and development of the rural sports.

Family Sports Development Pattern. Family sports means taking the family members as active object and domestic bedroom and surrounding environment as the main activity place, according to a bedroom conditions and hobbies and interests of members, at the same time, using the own time to choice fitness contents and methods in order to achieve the purpose of promoting physical and mental health, harmony of families, and the stability and development of social. The family sports is a new rural sports development model which has great Chinese characteristics, and rural cadres can develop rural family sports competition activities and exchange activities using leisure time, what is more, we can set

up a family sports day or family sports week to promote the development of family sports, which can also lay the foundation for social sports environment.

92.4 Conclusions and Suggestions

92.4.1 Conclusions

The Present Situation and Characteristics of Rural Sports Development in Xvchang. Diversified motives of physical exercise; Narrow limitations of exercise programs; Freedom of exercise place; Centrality of exercise time; and Limitations of the exercise season

Factors Affecting the Development of Rural Sports in Xvchang. (1) Internal factors: rural residents' physical exercise consciousness is still weak, and we need to strengthen sports publicity. (2) External factors: lack sites and equipments, no time, too tired of working and economic conditions, which all affect the development of rural sports in Xvchang.

Suitable Patterns for the Development of Rural Sports in Xvchang. Schools and communities sports development pattern, festivals sports development pattern, the village sports development pattern, and the family sports development pattern.

92.4.2 Suggestions

Strengthen the Propaganda of the Rural Sports Activities and Improve the Villagers' Fitness Awareness. In recent years, the popularizing rate has increased rapidly, and we should make full use of radio, newspapers, TV, display window, and some other communication measures to spread related sports information and strengthen people's attention to and understand on sports. In addition, we still need to carry out rich and colorful sports activities that the masses are glad to see. On the other hand, to organize peasant to watch various types of physical activities is a kind of very good way of propaganda and improving villagers' enthusiasm of participation, which is helpful for building good fitness atmosphere.

The Lack of Fields and Facilities is One of the Conditions to Restrict the Development of Rural Sports. People should formulate related policies about the development of rural sports and use the power of government and related departments to develop rural sports. Second, to strengthen the construction facilities in rural area and sports facilities; to make reasonable use schools, sports venues, and club and such sports resources to meet the demand of rural residents to do exercise.

Highlight the Development of Festival Sports and Traditional National Sports. This kind of sports represents local folkways and customs, and has a great

significance to study sports culture, which is the reflection of Chinese folk culture. Reasonable scientific development can make the rural traditional sports get protection, inheritance, and vigor in development.

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Chapter 93
Study of Citizens Sports Tourism

Lin Guo, Fei Ma and Zhizhang Wang

Abstract In the era of Experience Economy, experience becomes a new value source. By statistical means including questionnaire, data statistics, and the literature review, this paper investigates and analyzes the present situation of tourism consumption in Chengdu, and finds that the experience value of present tourism products is low and their experience space is limited. Urban citizens' inaccessibility to in-depth experience is the biggest barrier to sports tourism development in Chengdu. It concludes that developing tourism products based on experience and abstracting experience themes are important measures to develop sports tourism and promote sports tourism consumption in Chengdu.

Keywords Experience · Consumption · Chengdu · Sports tourism

93.1 Introduction

Sports tourism is a combination of sports and tourism, with the mutual benefit of sports resources and tourism resources; it is a tourist activity in which the major content of is sport. In the era of the Experience Economy [1], as a way of experience, sports is more and more popular for its unique charm and participating

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value of fitness, entertainment, recreation, and excitement. Chengdu is a well-known leisure city in China, with the increasing income and leisure time, as a new consumption pattern and lifestyle, sports tourism comes gradually into the life of Chengdu citizens [2]. Based on the theoretical background of experience consumption, this paper chooses the leisure city of Chengdu as the study model [3]. With the expenditure research and analysis of Chengdu City on sports tourism, provide some suggestions for the development of sports tourism.

93.2 Review of Sports Tourism

The generation of Sports Tourism is synchronized with that of tourism, and with the coming of the experience economy era, it developed greatly. Heather Gibson argues that sports tourism refers to recreation-based travel which involves either viewing or participating in a sporting event or watching attractions associated with sporting event, staying apart from their own home temporarily [4, 5]. And T. D. Hinch and J. E. S. Higham believe that sports tourism is sports-based travel which involves temporary movement of people beyond their own home in a limited time. This paper agrees with Zhang Qiang and Liu Boli's view that sports tourism is a combination of sports and tourism, in which mutual benefit of sports resources and tourism resources are involved, and the sport is the major content. In recent years, different scholars did related researches on sports tourism from different perspectives, in which sports tourism resources, products, market development, and marketing take the major part [6].

93.3 Background Information of Experience Consumption

93.3.1 Experience and Experience Consumption

Experience Consumption comes together with the experience economy. Early in the 1970s, futurist Alvin Toffler predicted the coming of the experience economy era; in his book "future shock" he argues that, for thousands of years [7, 8], the general trend of humans economic development is as follows: products economy, service economy, and experience economy. In the experience economy, people consume because of experience, to get a style of life could not be refused and an unforgettable experience. In experience consumption, the reason why people are consuming is to seek an immediate experience, that is, an expression of a desire and utterance of free feelings; in experience consumption, consumption is a kind of process while the consumer is the "products" of this process. When the consumption is end, what left behind will be an experience of process—experience another kind of identity, experience exotic life, and experience their own creativity

and so on. Consumers are willing to pay for such experiences, because it is fine, nontransferable, and fleeting.

The characteristics of experience make it become a new source of value after goods and services, and the basis for future economic growth. Once experience is engaged in goods or services, it will form a high economic value, so that the quality of goods and services will get a huge boost with the price.

93.3.2 Travel Experience and Travel Experience Consumption

Also known as experiential travel, travel experience simply is to leave the noise of city, the pressure of modern life, back to nature, to get a unique experience. Travel experience comes from the unique satisfaction get from travel activities, that is, accessing to a demand for travel. In travel experience, consumption is the means and process to obtain the experience. Through consumption, tourists gain "experience".

93.3.3 Sports Tourism and Sports Tourism Consumption

Sports tourism is a combination of sports and tourism, with the mutual benefit of sports resources and tourism resources; it is a tourist activity in which the major content of it is sport.

As a kind of tourism, a particular kind of travel activity, sports tourism possesses some essential features of "tourism", such as estheticism, travel to different places, mobility and so on. However, sports tourism has unique features other kinds of travels do not have, including participation, professional, challenging, and fitness. Firstly, the concentrated expression of participation lies in appreciating the inherent fun of sports tourism, tourists need more sports means to participate and experience directly. For example, the lovers of football come from around the world to the site to watch the football game in the Olympic Games, that is, getting a unique experience of this by such immersed participation; Secondly, professional refers to sports tourism participants need to possess professional knowledge, even watching a sports also need some expertise. Taking watching billiards as an example, most of the audiences go to the scene watching it have professional knowledge; Thirdly, challenging refers to the participants of numbers of sports projects, such as rock climbing, bungee jumping, and others, need extraordinary courage and strong will; Finally, fitness expresses functions of sports tourism of health promotion and physical enhancement, enabling tourists to get wholeheartedly exercise in the process of entertaining themselves. Mountaineering is a typical fitness movement.

Sports tourism consumption is an integral part of sports consumption. Sports consumption usually refers to personal consumption expenditures people directly

or indirectly participate in the process of physical activity, which includes not only the spending of participating directly in the indoor, outdoor, and natural areas with different kinds of sports competitions, entertainment and fitness activities, but also watching on-the-spot sports games, and sports performance to achieve the goal of exercising, mediating psychology, cultivating character, celebrating the leisure time, enjoying the beauty, and experiencing tourism.

93.4 An Empirical Study of Tourism Development in Chengdu: From the Perspective of Experience Consumption

Because empirical Research on tourism consumption in the perspective of experience consumption can be carried on from a variety of angles, and due to the restriction of each study methods' paradigm, I chose the famous leisure city of Chengdu as the research object.

The study defined strictly the empirical scope, selected the behavior group as the unit of analysis. On the ground of the great differences in consumption patterns between the rural communities and urban communities, the author chose Chengdu urban communities as the empirical research area; Empirical research methods of data collection are questionnaire and interview; chose the citizens aged from 22 to 55 in Chengdu as the object of occasional sampling; Designed a questionnaire containing 27 variables; Investigated in the Chun Xi Road, Wanda Plaza, Yulin Life Plaza, and Chengdu Book Center; and totally conducted a survey of 200 questionnaires, including 171 valid questionnaires, the effective rate was 85.5 %.

93.4.1 Characteristics and Analysis of Objects

The researchers employ SPSS13.0 to process and analyze the data of the results. As shown from the table above, among the objects being investigated, the proportion of male is higher than female, accounting for 54.97 % of the total sample; The majority of object are young and middle-aged people, and the age distribution is more uniform; so far as the academic qualifications of the objects are concerned, college degree or above occupy the vast majority, the objects in high school record or under only 22.2 %; The occupational distribution of the surveyed people is not very concentrated but diversified, technical staff, business practitioners, and institutions are relatively high, respectively, 15.79, 20.47, and 16.96 %; The monthly average income of the people surveyed mostly are more than 700 yuan, accounting for 94.74 %, including income between 701 and 1,200 yuan only accounting for 0.58 %, income between 1,201 and 2,000 yuan accounting for 3.1 %, income between 2001 and 3000 yuan occupied the most, accounting for 47.37 %.

93.4.2 Analysis of Data

The result showed that among the 171 objects, 121 had experienced sports tourism, accounting for 70.76 %; in the aspect of transport patterns, 107 people chose to travel together with others, accounting for 62.57 %; Of those surveyed in the funding of participation in sport tourism, there are 152 people who chose traveling at their own expense, accounting for 88.30 %; of those surveyed in the sports tourism expenditures, there are 12 people who chose more than 50 % of the total household income, accounting for 7.02 %; of those surveyed, 13 chose 40–49 % of total household income, accounting for 7.60 % respondents, 21 chose 30–39 % of total household income, accounting for respondents 12.28 %, 27 chose 20–29 % of total household income, accounting for 15.79 %, 92 chose 9 % of household income, accounting for 53.8 % of respondents.

As far as motivation is concerned in sport tourism consumption, 139 people chose to bring physical and mental relaxation, takes the 81.29 % of respondents. Among them, 42 chose fitness and entertainment, 16 people excitement experience, 18 leisure experience, 21 people exercise experience, 15 watch the game, 27 chose "other"; and the remaining 32 respondents chose to kill time, occupies 18.71 %.

In the item of the problems faced in the development of sports tourism in Chengdu, 64 selected "participatory is not strong", accounting for 37.43 %; 31 chose "the price is too high", accounting for 18.13 %; 41 chose "there are few sports tourism projects", accounting for 23.98 %; and 35 chose "cultural connotation is not strong", accounting for 20.47 %.

Therefore, based on the questionnaire, conclusions can be drawn as follows: Firstly, to develop tourism, what should be considered first is the spending capacity. To Chengdu, for example, from the factor of the consumption capacity of sports tourism, the sports tourism consumption of Chengdu people belongs to economic consumption, spending for sports tourism is in the middle and lower levels of consumption; secondly, function of experience is the maximum power to promote sports tourism consumption. To Chengdu, for example, the reason why people are favor of fitness and entertainment, experience the excitement, leisure experience, movement experience, and watch the game and other sports tourism activities is the unique experience value of physical and mental relaxation caused by such activities of sports tourism; Thirdly, participatory must be emphasized in the development of sports tourism. For example, "the problems of sports tourism development in Chengdu", the lack of participatory, as well as irrational structure of sports tourism activities, cultural content is weak, and high consumption demand are in descending order. The lack of participatory, the weak cultural connotation is the lack of sports tourism experience features, while consumption demand is the lack of accessibility of experience sports tourism.

93.5 Strategy of Sports Tourism Development in the Context of Experience Consumption: Taking Chengdu as the Example

Based on the above analysis and conclusions of the survey, this paper presents the following Sports Tourism Development Strategies in the context of experience consumption for Chengdu.

93.5.1 Starting with the Point of City Characteristics to Develop Market-Oriented Sports Tourism Products

Because the basis of sports tourism development is city—the unique geographical environment, it is necessary to develop sports tourism projects which have strong accessibility and are in their line with the requirements of urban residents to experience.

Taking Chengdu as the example, Chengdu is a well-known leisure city in China, Chengdu people have always been willing to advocate and practice the lifestyle of leisure. From the survey analysis above, what Chengdu people need is the unique experience value of sports tourism in "Fitness and entertainment, experience the excitement, leisure experience, movement experience, and the relaxation brought about by watching the game", and these four ways of "fitness and entertainment, leisure experience, movement experience, watching games" are marked by a clear nature of leisure, and "experience the excitement" is characterized by the pursuit of excitement, adventure, or the extreme events. So casual, the sports products have a strong nature of leisure are best suited to the requirements of the people in Chengdu, which requires slowing down the pace of development and design sports tourism products, paying more attention to feeling of leisure, and developing the sports tourism product of strong nature of leisure.

93.5.2 Emphasizing on the Strong Participatory of Sports Tourism Projects

From the very beginning of this paper, characteristics of participatory of the sports tourism projects have been repeatedly emphasized. Participation is the most direct and the most effective means to get experience. The famous mass participatory tourism projects around Chengdu, are mainly concentrated in the famous scenic spots, such as the Xiling Snow Mountain's skiing, grass skiing, Hongkou's rafting, etc. These tourism projects are far from the city, so that the costs of participation are relatively high. Also, they are seasonal items and are dependent on the unique natural resources, which greatly reduce the participation of tourists.

93.5.3 The Government Puts More in Infrastructure for the Development of Sports Tourism to Reduce the Cost of the Public

The results of the survey show that, the common problem the majority of Chengdu people faced is the low tourism consumption capacity, which greatly hindered the public accessibility to Sports Tourism. Although with the economic development of Chengdu, Chengdu people will gradually increase in disposable income, under the rules of market economy, the improvement of living standards will also have effect on sports travel costs. Therefore, in order to enable more people to participate in sports tourism, the government should bear the responsibility to promote the development of sports tourism, especially strengthening the construction of infrastructure and facility coordination, and improving sports tourism environment to reduce the cost of public participation in sports tourism.

93.5.4 Enriching the Content of Sports Tourism Product to Build a Reasonable Structure of the Sports Tourism Product

Modern economic theory suggests that, in the commodity economy era, production and consumption are interdependent with each other. Sports tourism product structure is reasonable or not is not only affected the enthusiasm of participants in sports tourism, but also determines the level of their consumption, so construction of the reasonable structure of tourism products is of great importance. Therefore, the enriching of tourism products in Chengdu should be aimed at the products with great market potential, in line with future development of sports tourism. For example, the fashionable and forward-looking products, such as the training programs of yoga and sports dance, should be developed as hot items.

93.6 Conclusion

The Experience Economy is a new form of economy, as the most suitable tool for production and consumption of the Experience Economy, tourism will have unlimited opportunities for business. Therefore, starting from the city features to develop sports tourism and sports tourism market is of great significance.

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Chapter 94
Study on Promotion Development of Shaolin Wushu

Deliang Wei and Yang Liu

Abstract Shaolin Wushu is a famous school of martial arts; with a long history and far-reaching implications the school is an important part of traditional martial arts in modern times. Shaolin Wushu is perceived as an exploitation of our traditional culture model. For study of the Shaolin Wushu development experience to promote and develop sports culture and strengthen the cohesion of the Chinese nation, an important practical role in the development of sustainable achievement in human civilization is an inevitable requirement.

Keywords Shaolin Kung Fu · Development experience · Folk sports · Succession and development

94.1 Preface

Shaolin Kung Fu refers to the traditional cultural system formed in the particular Buddhism cultural environment in the Songshan Shaolin Temple, based on the divine power belief for Buddhism to fully reflect the wisdom of Chan Buddhism and take the major form of martial arts learnt and practiced by Buddhists in Shaolin Temple. It is the extremely precious and exceptional wealth in Shaolin culture; the core factors to constitute "Shaolin brand"; the excellent representative in Chinese martial culture and the treasure and back of traditional Chinese sport culture. It contains extremely rich traditional ancient China's cultural thought [1, 2].

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At present, under the great pattern of State's making more efforts to develop cultural industry, Henan province takes the administrative region as the angle, puts Songshan Shaolin Kung Fu in the first position of eight cultural industry reformation experimental areas. The purpose is to create the cultural creative industries aggregation taking Kung Fu education, performance [3], Zen's experience and other creative industries as the main content. Shaolin culture has gradually become the model of development and application of our traditional sports culture in people's heart [4]. It has an important practical role and reference meaning to uphold and develop other folk sports cultures and strengthen the cohesion of Chinese nation to research and analyze for the developmental experience and disadvantage of Shaolin Kung Fu [5].

94.2 Development and Promotion Experience of Shaolin Wushu

94.2.1 The Policy Guidance Provides the Powerful Guarantee for Development and Application of Shaolin Wushu

In modern world, the culture has increasingly become the important resources of the regional cohesion and creativity and an important factor of comprehensive competitiveness [6]. Developing the folk sports is the important content to uphold traditional Chinese culture, serve socialism civilization construction and build up the fitness system for the entire people. Its key point lies in developing and applying the folk sports resources, while from the point of the concrete operation, manpower and capital are insufficient to develop and apply the folk sports culture resources. However, speaking from more important layer, this work concerning to the national spirit could not enter into leaders' view in many places. It is different from this situation that, based on the profound traditional cultural root, Zhengzhou and Dengfeng Municipal Committee and Government propose the strategy target to strengthen the city with culture relying on the unique Shaolin Kung Fu resources, focusing on integrating resources, creating the brand, and taking the major projects as the core. A series supporting favorable policies have been issued. In 1990, the provincial martial arts schools were standardized; Zhengzhou International Shaolin Wushu Festival was held in 1991; The Secretary Li Keqiang proposed in 2001 to improve the surrounding environment and restore the prospect of "an ancient temple is hid in the deep mountain and Shaolin is locked by blue brook". Until 2005, Zhengzhou City Culture Industry Development and Culture System Reformation Work Leadership Group was established to set up special capital for advertising the cultural development and special capital of cultural industry development, etc. In 2006, it was proposed in "Dengfeng City Wushu Industry Development Plan" to fully create "Kung Fu City". In December 2009, a

series of governmental behaviors are to protect and promote the inheritance of Shaolin Kung Fu to certain extent, including the official listing of Gang Zhong Lv (Dengfeng) Songshan Shaolin Culture Tourism Co., Ltd; Dengfeng Government is presently preparing to construct the performance and heritage base of Chinese Kung Fu culture, Shaolin Kung Fu Standard Formulation Center, the internationalization platform for academic research and communication of Shaolin Kung Fu, Shaolin Kung Fu technological innovation incubator and top talents cultivation base, Shaolin Kung Fu athletics performance stage and "Shaolin Culture Revitalization Project" taking experiencing and sightseeing product of extension of Songshan Shaolin scenic spot as the purpose, etc. It could say that Zhengzhou and Dengfeng Municipal Committee and Government offer great support in various aspects of advertisement, promotion, development, and application of Shaolin Kung Fu.

94.2.2 The Economic Base for Heritage of Shaolin Wushu Benefits from Successful Commercial Operation Mode

Under the Boss, Shi Yongxin's leading thought of "it may not a shortcut to uphold the traditional culture in commercial means", Shaolin Temple's commercial operation mode made the world surprised. Shaolin cultural industry has become bigger and bigger, while packing and upholding Shaolin Kung Fu. The commercial sight of the Buddhist abbot, Shi Yongxin has been revealed in the following aspects: to establish Shaolin Warrior Monk Team in 1987, "Shaolin" Brand Fight in 2003, issuance of new version of TV series "Shaolin Monk Warriors" in 2006; then to establish trans-ownership intensification group across industries and regions including "Shaolin Industrial Development Company", "Chan Essence Magazine", "Shaolin Film and TV Company", "Shaolin Painting Institution", Charity, and Welfare Fund, etc.; until to officially start the reconstruction project of North Shaolin Temple in 2008, bravely mandate four ancient temples in Guandu District and open Shaolin college in the globe, etc. It is reported that a series of commercial operation mode brings rich economic rewards to Shaolin Temple: only the ticket income received from domestic and foreign tourists has the direct revenue of RMB 0.12 billion each year. If the commercial operation is conducted without restriction, the profound thought essence and the Chan sect contained in Shaolin Kung Fu will also lose with it. It is against the State Council's spirit to increase the cultural heritage protection to "the height to be responsible for the state and history" and "the height to maintain the national and cultural safety"; also it is not compliance with the national working policy of "first protection and rescue; reasonable utilization, heritage and development" for the intangible cultural heritage.

94.2.3 Modern Media's Vigorous Promotion Makes Shaolin Wushu World Famous

It is a creative measure to broadcast Shaolin Kung Fu through the film and TV means. In 2003, the online game of Shaolin Legend cooperated and developed with game developing company enables the broadcast of Shaolin Kung Fu into "fast track" on the internet. In July 2005, the opening of English website also broke through the language bottleneck of Shaolin Kung Fu. In 2008, a series of measures further promote the internationalization process of Shaolin Kung Fu including, jointly created the original Kung Fu cartoon works of "Shaolin Mascot" with Shanghai City Cartoon Company. The works take the subject to uphold the hard-bitten spirit of Chinese nation and the traditional virtue to punish evil and reward goodness and the purpose is to guide the teenagers to set up aggressive and healthy life goal. Henan TV designs the program of "Martial Arts Competition" with high enthusiasm, taking the martial arts broadcast as the main content. Nowadays, Martial Arts Competition has become the first TV brand of China's boxing and the TV rating jumps the first of all channels in Henan district and the fourth in the nation at the same time. The designed "Wulin Treasure" selection match gets together Kung Fu talents from all around the world and the "Arena Contest for Common People" provides a self performance stage for the folk boxers.

94.2.4 Open Communication Provides Inexhaustible Motive Force for the Heritage and Development of Shaolin Wushu

Shaolin culture with the essence of "Chan" and "Wushu" is the Chan sect culture with the unique Chinese characteristic formed in the collision process of the foreign Buddhism culture and traditional Chinese culture. Thus, it has greater opening characteristic from its birth date. It could say that the development history of Shaolin culture is an open history merged with the society. It not only focuses to absorb the essence of the martial arts in the world but also pays attention to exchange with the international martial arts. In Five Dynasties and Ten Kingdoms Period, 18 famous martial art athletes gather in Shaolin for the 3 years drill; In Song Dynasty, the children from common families could learn the Wushu and there is the record for Shaolin masters Liu Dechang and Hong Ji to go to each place in the world to learn the martial arts in Qing Dynasty. Until June 2009, Dengfeng Sport Bureau selects more than 130 kinds of boxings in the country to absorb the will boxing, Ba Ji Quan, Cha Quan and introduce into the teaching and training lesson system into the local martial club and school. Also the bureau conducts the centralized training for more than 150 coaches. In Yuan Dynasty, the Japanese monk Da Zhi studied in Shaolin Templeand nowadays large scale of Shaolin masters performance team visit more than 60 countries and regions

including Japan, Korea, America, Russia, and so on. It makes Shaolin Kung Fu famous oversea and bloom everywhere.

94.2.5 The Continuous Innovation Provides Long-Acting Mechanism for the Sustainable Development of Shaolin Wushu

Shaolin Kung Fu is a vast technical system rather than a "school" or "a kind of Chinese boxing" in general sense. It is recorded in Shaolin Boxing that there are 708 Shaolin forms, including 552 Chinese boxing and instruments and 156 kinds of Kung Fu methods such as 72 unique skills, arrest, fighting, bone removing, hitting vital point, breathing exercise, and so on. There are about 200 Shaolin Kung Fu passed down, including 100 boxing, 80 instruments, and about 10 other boxing such as pair exercise. In order to develop and apply Shaolin Kung Fu more reasonably and continue the good reputation of "the Kung Fu under the heaven is out of Shaolin", the Buddhist abbot Shi Yongxin promotes the experts and scholars with influence in religion, culture, history, and martial arts fields to conduct the scientific, meticulous, and systematic classification for the origin, development, and reformation process of Shaolin Wushu. Many related books have been successively published, including "Shaolin Kung Fu Boxing and Instrument Record", "Medicine Secrets of Shaolin Martial Arts" (memorial classics) and "Martial Arts Zen", etc.; the special research institutions have been set up including Shaolin Wushu Book and Video Gallery, Shaolin Culture Research Institute and Shaolin Kung Fu Studio, and so on. It has conducted the research work for many aspects such as Shaolin Wushu international academic seminar, etc. After all, Shaolin Temple is a religious organization; it is hard to reach every aspect for protection, advertisement, processing of data and scientific research, and so on. for Shaolin Wushu culture. It requires the guidance from the experts who are proficient in professional theory and have the practical experiences.

94.2.6 The Establishment of Martial Arts Schools Provides Vast Space for Heritage and Development of Shaolin Wushu

Dengfeng Wushu School is mainly to teach and practice traditional Shaolin martial arts and it is the fertile land to popularize and spread Shaolin Wushu. In order to fully use the martial arts resources, Dengfeng Government optimizes and integrates more than 70 martial arts schools in the city, establishes three martial art education industry groups including Tagou, E'po, and Xiaolong. It is to set up martial arts teaching branches in more than 100 countries and regions in the world,

striving to become the biggest Kung Fu education, performance and sightseeing base in the world. It is different from the martial arts schools in public nature invested by the government in Shandong and Fujian, etc., various martial art schools in Dengfeng all run the school by social power. Through the development, optimization and regulation for more than 20 years, Dengfeng Martial Arts School has formed the mature schooling mode with cultivation of academic and martial arts courses as well as receiving education and practice at the same time. After graduation, the students not only get the martial art diploma certificate but also the academic diploma certificate with the highest of college degree.

94.3 Summary

To sum up, a successful commercial operation mode for Shaolin Wushu plays an important role for the spread, promotion, and popularization of the Shaolin Wushu and traditional Chinese culture in the world and it deserves other folk sports cultures for reference. Whether a kind of traditional culture could survive or not does not lie on whether it has been commercialized or politicized or not, but lies in whether the singing and receipt of this folk song still arouses the cultural memory and emotional approval of certain nation group. Therefore, all thoughts good for the development of Shaolin Wushu could be referenced and the methods to promote the development of Shaolin Wushu could be adopted, after all, the protection and heritage is the first task. Of course, we should also clearly know that, Shaolin culture with the "Chan" and "Wushu" as the essence in China's civilization history is more reflected in the aspect of the martial art spread in recent 20 years. More efforts have been placed on the integration and expansion of the temple's construction as well as development and use of the scenic spot to seek for the economic benefit. It is not insufficient to explore the spiritual culture connotation contained in Shaolin Wushu and recognize the importance of the intellectual property of Shaolin culture. It does not excavate and purify the traditional authentic Shaolin Wushu and form the creative mechanism and core technology. Based on this, Shaolin Wushu must base on the national tradition in the development, use, and heritage and development process and maintain the original national characteristic of Shaolin Wushu with "not losing its authenticity as the limit".

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Chapter 95
Research on Rural Sports Development

Hongxue Zhang

Abstract Our country is at a new stage from being a sports giant to being a sports power. Whereas rural sports development, as an important part of mass sports, does lag behind. Such a situation focuses on the following problems: regional imbalance in sports development, relatively less capital input, shortage of sports playgrounds and facilities, relatively less peasant sports population, outdated sports concepts, lack of professional sports instructors, and so on. Based on the analysis of the causes and uniting the aims of sports power, this paper analyses and elaborates the above problems systematically, and also proposes the corresponding suggestions and solutions.

Keywords Rural sports · Sports construction · Public sports · Sports development planning

95.1 Introduction

For the several generations of sportsmen and sports workers, to build a powerful sports country is not only their dreams, which they have been craving for, but also their goal which they have always been striving for. The development of rural sports is an indispensable part during the construction of sports power. When significant breakthroughs were achieved in the Beijing Olympic Games and Paralympics games, President Hu jintao made a speech in the summary and commendation congresses respectively [1]. Mr. Hu put forward the strategic choices—"to further promote the development of our country from Sport Giant to

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Sports Power" [2]. This is a call of action to accelerate the development of sports in the new periods. Meanwhile, Mr. Hu's speech pointed out the new direction for sports work, and provided a strong spiritual motive for sports development [3].

Our country is a developing agricultural country. Of the total population of 1.3 billion, the rural population is more than 9 billion, accounting for 70 % of the total [4]. The sports problem of rural population is the most important and the most sensitive topic for the launch of "Sports Power" strategy. The farmer physical culture involves the population, which is most in numbers, the poorest in wealth, and the most needed for development. The culture construction of the New Socialist Countryside, based on the enforcement of the rural public cultural construction is to hold various folk culture activities representing local characteristics, to enrich peasants' spiritual and cultural life. With the strengthening of rural economic development, cultural construction should embody the new image and new face of new countryside [5]. After decades of development, as a part of the construction of new countryside culture, can sports adapt to the environment and undertake its advantageous role in the construction of the New Socialist Countryside? These are a series of problems before us.

Consulting the document in recent years, this paper elaborates the occurring problems in the current farmer physical culture, in order to offer solutions to problems for the construction of new countryside sports [6].

95.2 Confusion in Rural Sports Development

Toward sports power, experts have different interpretations according to their own arguments. The consensus for sports power is that the comprehensive strength is obvious ahead of other countries, as well as the overall level of the country's sports development [7]. Simultaneously, the embodiments of soft power of sports power are the spirit of sports, sports prestige, and the international rights of spech [8].

This situation can be specified as follows:

95.2.1 Government's Less Capital Input

As we all know, athletic sports can reflect the government's feat, and the number of golds can reveal the development level of national athletic sports [9]. There is still no guarantee for rural fitness equipments, although in recent years, there is a rapid development in rural economy and also a great increase in peasants' income. The government's capital input is very minimal in rural sports, especially regarding sports facilities and playgrounds. In our country, there are more than 60 million kinds of gymnasiums and stadiums, accounting for 83.5 % of land size. However, vast rural areas, owning 61 % population of the total, account for 20.2 % in all kinds of gymnasiums and stadiums (cited from China's Social Sports

Survey Report). These playgrounds mostly exist in rural primary and middle schools, so that it is very inconvenient for peasants' participation. Peasants have the physical exercises in their own yard, on the road, on the streets, and fields. The government's capital input in athletic sports is 4.8 billion Yuan. However, it is 2.7 billion Yuan in mass sports. Furthermore, urban mass sports occupy the most input of 2.7b. As for the countryside, having the larger population and area, capital input can not meet the need of people's culture and sports. Facing the existing sports facilities, most peasants are stranded or blind because they lack sports knowledge and are very weak in sports consciousness. In addition to peasants' own factors, the reason is that the local sports departments focus only on urban residents and school sports, and also hold less sports activities in rural areas.

95.2.2 Low Peasants' Sports Consumption Level

Since the Fourth Plenary Session of the Thirteenth Central Committee, most rural areas have entered a new stage of building a well-off life. Peasants have has a great increase in their income, an obvious promotion in the quality of their life, and a great rise in the overall consumption level. As far as the vast rural areas are concerned, sports consumption level is relatively low. They mainly spend their money on the materials of production and livelihood and child's education, etc. On the contrary, the input is quite slim in sports. Sports population is an important index to measure the development of a country's sports undertaking. It is quite crucial for us to study the sports development level in a region, or a country. Survey and Research on the Status Quo of Mass Sports in China revealed that 51.23 % people take part in sports exercise in cities, while in rural areas, 28.97 %. In different age brackets, the proportion of participants in rural areas is obviously lower than that in the urban areas. In addition, with the age growth, the gap is larger and larger.

95.2.3 Unbalanced Regional Development

Restricted by geographic environmental factors and influenced by the level of economic development, the difference in sports development is very great between "the urban and rural, the east and the west, and the developed and underdeveloped", according to work report of General Administration of Sport. In some provinces, rural sports is almost nil. In rural areas of china, the population of 58 million is still not rid of poverty. Most peasants still strive for survival. Restricted by economy, culture, and consumption level, peasants' sports activities are scare and monotonous; the sports market is sluggish and is hard to develop. As we know, economic imbalance will certainly bring peasants' sports imbalance in various aspects. Every level presents the uneven development phenomenon. The difference

in sports development degree can be seen between coastal areas and inland, as well as between inland and remote areas. The development has both advanced and backward sides.

95.2.4 Limitations

The professional sports instructors have to slow down their steps to rural areas because of the bad working condition, law salary, behindhand basic sports facilities, and some other reasons. For the development of rural physical exercise, social sports instructors, as the organizers of sports fitness, direct the bodybuilding scientifically and popularize sports fitness knowledge on the one hand, and train the reserve peasant social sports instructors and expand the team of sports instructors on the other. Through training sports instructors to help develop sports propaganda, to guide the bodybuilding in good methods and to form consciousness of body soundness among peasants. In July 2005, State Physical Culture Administration promulgated the "Proposals on Further Strengthening Social Sports Instructors Work." After the Proposals are issued, the rank of social sports instructors has been developing so rapidly that the number of social sports instructors has grown to over 500,000. However, China, because of its huge population, the social sports instructors are far enough to meet the practical demand. And meanwhile, the existing social sports instructors mainly live in urban areas, and the people who do service for the rural sports cause are very few.

95.3 Countermeasure

For the purpose of turning China into a sports power, we should create a good fundamental environment, which is the goal to fight for and also the dream pursuit of sportsmen for several generations. We can better pool the wisdom and efforts of everyone to create a favorable environment for rural sports which is an inseparable part of building a sports power, and take actions that suit local circumstances in order to make rural sports viable.

95.3.1 Develop Different Kinds of Ethnic Sports Activities

The development of rural sports bears the sign of ethnic and cultural identity. China covers a vast territory and is abundant in natural resources. The contents of the rural sports are rich and colorful. Rural sports have such a close relationship with the rural natural conditions that it may be influenced considerably by climatic conditions and geographical environments. The fact that the climate in China is diversified characterizes rural sports by seasonal diversity and region diversity.

Seasonal diversity expedites the diversification in ethnic sports activities, which is shown by the nationality in rural sports. In China, several hundreds of ethnic minority sports items are unique and rare in the world. Combining innovations with inheritance, the local government should exploit and develop the regional and ethnic folk traditional sports in order to give a new lease of life to the dying sports culture activities. To the nationality of sports as an opportunity, the local government should exploit the immense potential capacity in all nationalities and have ethnic sports activities to promote the development of the tourist industry. For example, "the firecracker ball" in the Dong nationality, "the flaming rope skipping" in the Yi nationality, "the vaulting horse or camel" in the Man nationality, the Mongolia wrestling, sheep-chasing on horseback in the Uyghur nationality, the pearl ball in the Man nationality and the bowl in Hui nationality. The sports management should improve to standardize and methodize the competing policy of these items to lay stress on national and local style. So the "the Guidelines for Our Sports Industry Development" will be implemented, and the rural ethnic sports will be push to a new high.

95.3.2 Develop Different Kinds of Simple Sports Activities

With the farming mechanization, peasants have more spare time. The demand for the sports in rural areas is becoming stronger and stronger, and the content of the sports activities need to be richer and richer. Peasants can choose their favorable sports freely according to their interests and practical conditions. Due to the organizational form of the rural sports is flexible, sports activities can be played by an individual or an institution entity, can be organized by the village committee, the country government, an individual or several villagers without a fixed form. In term of the form of physical exercise, it is so rich and personal that it varies from person to person and peasants can take actions that suit local circumstances. The local sports management should respect the flexibility of the rural sports and make a lot of easy-operating sports activities. For instance, in Chungmou County, Honan Province, peasants have a match of clinging watermelon each year. In Heze, Shandong Province, peasants have a match of picking up apples in the harvest season every year. All these activities are free from body-building apparatus and exercise yard. Having their sports activities in fields, peasants not only enrich their life but also enjoy themselves. Even if their prize is only a sack of fertilizer, they may jump in with both feet.

95.3.3 Spontaneity and Season Different Rural Sports

Sports in the rural area is a basic form of sports entertainment for the local people for the purpose of improving their quality of living. The farmers take the exercise during the farming times or while they are taking a break.

The operation forms of these activities can vary sometimes, well-organized by some leading person or most of the time it seems to be spontaneous behavior retaking a break. Generally, this spontaneous behavior will be restrained by the productive seasons. Consequently, in the busy time of the year there will be less sports activities. Various sports only happen in the free time or important festivals. Local authorities should express approval officially and hold colorful sports events providing the farmers a stable front stage to participate in and to perform, such as

95.3.4 Carry out Sports Activities

Our economy has developed at a great pace after reform and opening-up. Rural sports activities which have the distinctive flavor of the times also advance with the times. In addition to their own sports of ethnic minority, modern recreational sports activities also covered the countryside, in billiards, mahjong, and ball games to yoga, aerobic, hip-hop. Rural sports which advance with times have various forms. With the organization by national and local sports departments, enthusiasm of people is running high. The local sports departments should guide the farmers to actively participate the new cultural recreations and regularly hold diverse forms of sports to provide farmers with the chances of exercises and participation.

95.3.5 Increase Investment

The spirit of the 17th session of the General Assembly, the official action guide of sports, is to launch organized national fit-keeping activities and district farmers sport games combining the rural status of the fit-keeping, and arouse the farms' initiative for participation to propagate the knowledge of scientific health. Broadcasting is regularly carried out in the local radio station by radio and television, the Internet, posters and leaflets, propaganda should be carried out in the community, which rural workers are occupied intensely in the market and square. Build the atmosphere of the fitness to a maximum range to make every farmer understand the advantage of fitness and conscientiously and voluntarily participate in the rural sports activities.

According to the scale of the rural area development, certain number of professional sports instructors should be appointed and training should be developed regularly to expand the team of professional instructors. Pay attention to the identity of the farmer's sports instructors during the training, Only the sports instructors who are fit for the model of rural area sport development can make the most of the advantages to appeal farmers to participate in sports to the maximum by exploiting the present conditions in rural area.

95.3.6 Learn from Foreign Experience

In the new rural construction of the experimental unit, study and implementation of sports development plan should be paid attention. Learn from foreign experience of sports development of rural communities, our model of new rural sports development should be specifically made according to our own national conditions. Start the competitions according to the different ages by the committees in village and schools. Guide the participant actively and scientifically in the competition by their hobbies to lead a gradual transition to a professional sports training and competition in order to find sportsman with potential talent and reservation of human resources for China's sports comprehensive development. When organizing rural sports, the peculiarity of rural sports participants should also be considered. Aiming at attended children and women, provide recreational activities, which are fit for their participation to promote the development of the rural area sports and play the role of sports in the new rural construction.

95.4 Conclusion

Rural sports is an important part of mass sports, but it also meets with great perplexity in its development and self-improvement. Therefore, in the process of development from a sports great country to a strong country, we must increase the investment proportion in sports; carry out various kinds of sports activities according to the characteristics to publicize the knowledge of sports development of science; train professional sports supervisor teams regularly; make the advantage of the villagers' committees and rural schools, establish the experimental unit for rural sports development to ensure the implementation of the rural sports by utilizing the experience of rural sports construction from the foreign countries. Only when those problems are solved can our process of transition from a great country to a strong country better and faster.

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Chapter 96
An Adolescent Physical Exercise Ability Evaluation Method in Sports Training

Xiaokun Zhang, Cheng Tao and Yan Liu

Abstract This paper describes an evaluation index system, on the basis of youth sports exercise ability, and on the basis of four—using biological resistance electrodes technology and sine constant-current. There is a strong relationship between the different size and shape of the impedance measurement parts including shaped body. The relationship between a parameter, this is equivalent series resistance index live analysis. We proposed the evaluation mode operation mode using impedance waveform and the stability of movement using reproducibility of impedance waveform. We expect to find all kinds of sports training application, rehabilitation, and related fields.

Keywords Adolescent · Physical exercise ability evaluation · Sports training

96.1 Introduction

Although recent leisure activities have transferred to the high aging society as the background, there are more and more attention to all kinds of sports and fitness to promote health preservation. As the quantitative evaluation method of physical fitness have a positive health diagnosis of applications not only in schools but also in the business environment.

We put forward an evaluation youth sports exercise ability in sports training and related field using human body impedance. This idea originates from the following reasons: first, in the fact that the reason of human movement impedance

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variations. Second, impedance method satisfies measuring conditions and suitable for daily use. Need measuring conditions as follows:

- The measurement must be as nonrestrictive as possible and easily done.
- The information of movement must be gotten instantly from the results of measurement.
- The measurement system must be at a low cost.

In the traditional way to measure in youth sports exercise, some kinds of equipment have been employed detector, electromyography, cameras, and video cameras was written. Each piece of equipment has unique advantages, but there are still some problems, in relation to each piece of equipment. Some examples below [1, 2]: (a) detector is not suitable for complex or rapid movement, it is not sustainable, and it restricts the campaign theme, because it has a structure of mechanical parts. (b) The results are very difficult to answer, electromyography remember was kinematics and dynamics parameters. (c) The data are from a camera, because it cannot be quickly handled on film. (d) A video information in analysis video analyzer, in high cost and not simple, is needed. Measurement of the space camera is limited.

Impedance method has the following advantages: it can be used with the telemetry system, no space limit for measurement. Data can be compressed and measuring continuous time is very long. The results can be displayed in the simple life. Different analysis methods can do get, superimposing cycle sport is one example. This topic, that spreads in his body, small electrodes in the movement and almost no limit have not given mental pressure.

This paper describes an evaluation index system, using the basis of electrical youth sports exercise bio—four—electrode impedance spectroscopy technology and based on sine constant-current. This method USES a human body itself as a part of the sensor. First, we show people limb impedance characteristics. Second, we put forward on the basis of the detection principle, youth sports exercise corresponding size, morphology and stable movement impedance waveform. So we can let you use this method to assess the ability to exercise youth sports with impedance characteristics. Finally, we show two applications and agility evaluation gait gripping assessment test bar—use.

96.2 Measuring Method of Electrical Impedance

96.2.1 Impedance Measuring Device

Figure 96.1 shows a block diagram of the human body impedance measurement device. The measurement method, using four—electrode impedance technique based on constant current (50 KHZ, 500 mu A) [3, 4]. Measuring device by generators, voltage current converter, differential amplifiers, and amplifiers and

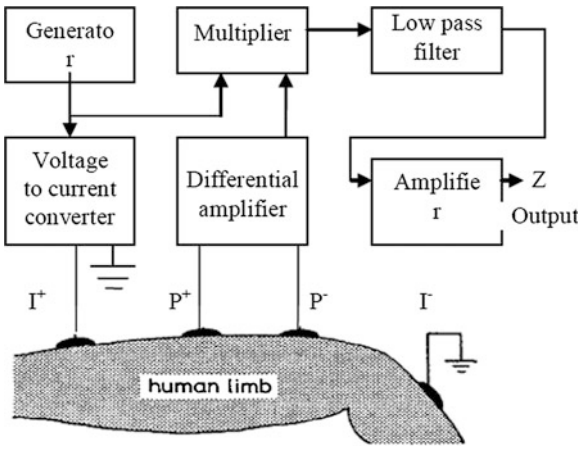

Fig. 96.1 Block diagram of impedance measuring device

low pass filter (cut frequency: 350 Hz). The output signal proportional to the impedance equivalent series resistance.

Four electrode technology in four electrode method is put on in a line, constant electric current flows through two outside electrode (the current electrode: I+, I−) and potential difference, between electrodes produced within the potential electrode P+, P− is detected. Electrode polarization silver/non—AgCl skin surface types of 10 mm diameter. We defined equivalent series resistance as impedance Z this placed electrode; when we modified, and the obtained impedance waveform changes. Impedance is a sufficient change to get each action and conditions among the subjects is as far as possible to keep unity.

96.2.2 Evaluation System of Adolescent Physical Exercise Ability

Figure 96.2 shows the evaluation index system, and on the basis of using the youth sports exercise ability bio-electrical impedance. We mainly use impedance data from the impedance measuring device and this type of exercise use other auxiliary sensor. These sensors switch acceleration sensors, microphone, etc. Combined body part of measuring and sensor, it is possible to analyze various motions.

96.3 Principle of Detection of Adolescent Physical Exercise

96.3.1 Mechanism of Impedance Change

The human body is composed of complex structure of bone, muscle and fat, blood and skin. A constant current frequency of 50 KHZ flows through the organization

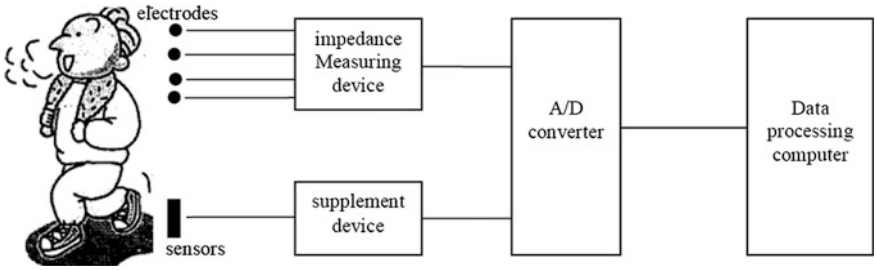

Fig. 96.2 Block diagram of evaluation system of adolescent physical exercise ability using bio-electrical impedance

Table 96.1 Correspondences of human movement to impedance waveform

Human movement	Impedance waveform
Magnitude form	Pattern
Stability	Reproducibility

almost in muscles and blood resistance rates lower than others [5]. Changes in the cross-sectional area of the muscle tissue and volume of the change of blood impedance in some types of sports, we tried to measure and analyze human movement impedance of change.

96.3.2 Correspondence of Human Movement to Impedance Waveform

It is very important to assess the true. We suggest you to use impedance analyzing youth sports exercise, because the human body impedance characteristics and human vane motion [6]. We tried to evaluate operation mode using impedance waveform mode (model) and the stability of the closed impedance mobile, using reproducibility of impedance waveform as shown in Table 96.1.

96.4 Applications for Rehabilitation Field

96.4.1 Gait Evaluation

Crus impedance Z is mainly by the magnitude of the ankle joint, angle size, and a moment's ankle, as Mr. Ma do not affect feet power that is knee angle. Of the waveform Z is as shown in the diagram. For example: the case that subject is standing straight at first, began to normal gait for about 30 meters, and stand again

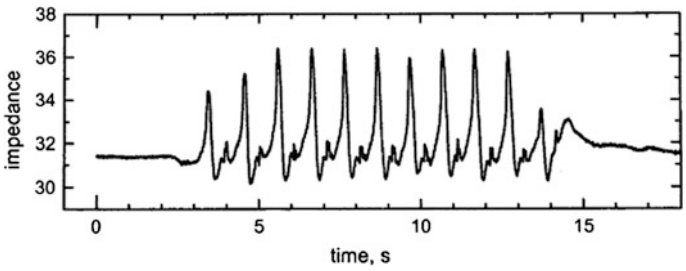

Fig. 96.3 Lower leg impedance during gait of normal subject

[7, 8]. Gait can be characterized by two stages, a Z is the change in the impedance mode, the impedance levels, and dZ means that other ZL. Therefore, $Z = dZ + ZL$. Because of the thoughtful discussion, the model is one of the important dZ, horse in static conditions rarely [9].

For different theme, wave impedance and phase of gait were measured with a foot switch. This project is young normal subjects, baby, old theme, and hemiplegic patients. In each of the waveform Z is very different from the other team. The patient's waveform characteristics are as follows: (1) waveform has various appearance, (2) dispersions gait cycle time is big, (3) impedance has changed little, (4) change impedance is slow. According to these characteristics, six parameters are defined as follows:

Sim: Each impedance waveform similarity average impedance waveform pattern, pattern normal subjects.

ST: Gait cycle stable time, and this is the standard deviation of gait cycle time divided by the average of the gait cycle time.

Sz: Stability of impedance level, which is the standard deviation of impedance level divided by mean value of magnitude of impedance waveform pattern.

Zp: Change impedance, which is the average value of different size, divided by mean of impedance waveform mode impedance levels.

Zsp: Change value of impedance in stance phase, which is the mean value of magnitude of impedance in stance divided by mean value of impedance level.

Sp: Sharpness of impedance waveform pattern, which is the ratio of power spectrum of higher frequency (Fig. 96.3).

Figure 96.4 shows hexagonal of 10 patient's hemiplegic patients value to be normal and 10. These parameters value represents six coordinate axes, which established a connection with the hexagon six vertexes fixed its center. Each axis of the scale of the outermost location decision, mean 10 cases of normal and inside each parameter is not in normal direction. Hexagonal normal subjects and similar to the regular large hexagon; however, hexagonal patients reduce and distorted significantly. These two kinds of hexagonal babies and the old man was distorted, but their forms with each other in.

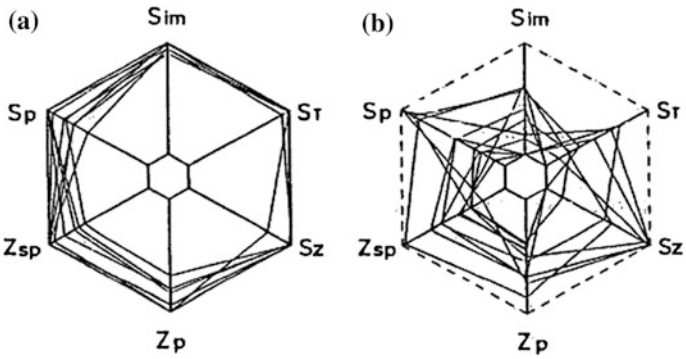

Fig. 96.4 Hexagon displays of lower leg impedance **a** 10 subjects of normal, **b** 10 subjects of patient

96.4.2 Agility Evaluation

We explain bar-gripping test in agility. The subject sits on the chair, and places his forearm on the table at approximately 75 cm above the floor. He prepares himself to grip the vertically hanged bar. After warning, the bar starts to fall in 2–6 s. The subject grips the bar as quickly as possible when recognizing that the bar started to fall. In the traditional methods, the bar has the scale of mm, and the agility is evaluated by the fall distance of the bar, while, in this method, the reaction time is measured based on the forearm impedance.

Figure 96.5 is a measurement example of the bar-gripping test. The figure shows the impedance Z of the forearm, the derivative dZ/dt of the impedance, the acceleration a of the acceleration sensor attached to the third finger, and pulse signal P indicating the start of the fall of the bar. Point E is the time when a pulse is produced as the output when the bar starts to fall. Point A and C are the times when waveform changes.

The total time of reaction is calculated also from the fall distance of the bar (TT-bar). EA interval is defined as RT-imp (reaction time by impedance), EB interval is defined as TT-imp (total time by impedance), and AB interval is defined as MT-imp (movement time by impedance).

There is a strong relationship between TT bar and TT—correlation coefficient is the imp. Total owners cannot be separated into the areas in a context. The benefit the put a bar, the methods to while strong relations, TT—imp TT—bar. Curve and the correlation coefficient are 0.90. Therefore, we can draw the conclusion: TT—imp and TT—bar are almost the same. Another thing is total time cannot be separated into the reaction time and exercise time in the traditional methods using only the bar, although we probably put method. This test is a gripping bar—motion of the small muscles. Therefore, make sure the reaction time is mostly nerve and sensory functions. In the traditional method, however, the reaction time can not be

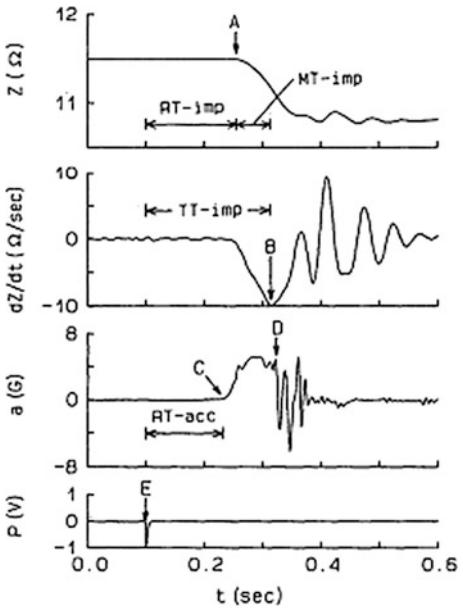

Fig. 96.5 Measurement example of the bar-gripping test

sure, and the effect of the nervous system on the results of the tests of gripping bar—is still not clear.

Curve and the correlation coefficient are 0.90. Therefore, we can draw the conclusion: TT—imp and TT—bar are almost the same. Another thing is, total time cannot be separated into the reaction time and exercise time in the traditional methods is using only the bars, and the following results in guiding by this method. Four subjects drink 2 large bottle (633 milliliter) beers bar—gripping 30 min.

The reaction time is clearly seems to be increased from 3 min drinkable? We can find nothing to change athletic time, when the reaction time greatly increased. The reaction time does not come back, before drinking it in the original value, even 3 hours after drinking; prominent reflects limit nerve and sensory functions. The results have not obtained the traditional methods which show the effectiveness of this method in separation and reaction time and running time.

96.5 Conclusions

Although recent leisure activities have transferred to the high aging society as the background, there are more and more attention to all kinds of sports and fitness to promote health preservation. We put forward an evaluation youth sports exercise ability in sports training and related field using human body impedance. The measurement method using four—electrode impedance technique based on constant current (50 KHZ, 500 pa). This method uses a human body itself as a part of

the sensor. We also put forward the—flying detection based on the communication of youth sports exercise, morphology, and size of the sports impedance waveform stable. We mainly use impedance data from the impedance measuring device and this type of exercise use other auxiliary sensor. We showed two applications and agility evaluation gait gripping assessment test bar—use.

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Chapter 97
Study on Physical Education of Vocational Colleges Based on Outward Bound

Qiang Wei, Yali Liu and Xiaomei Zhao

Abstract This paper conducts an in-depth study on the subject that Tangshan vocational colleges introduce the outward bound projects into the physical education through the investigation analysis, expert interview and teaching experiment, and other scientific research methods.

Keywords Tangshan · Outward bound · Experimental study

97.1 Research Objects and Methods

97.1.1 Research Objects

The feasibility of the introduction of the outward bound in physical education of vocational colleges in Tangshan is studied.

97.1.2 Research Methods

The documentation, investigation, experimentation, mathematical statistics methods, and other scientific research methods are mainly adopted.

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97.1.2.1 Documentation Method

Through the online research and retrieval on www.cnki.net with the keyword "outward bound", there were 510 results on related papers in total, among which 139 papers had connection with higher learning schools. After the purposeful selection, the collected information were necessarily analyzed and studied which could provide and consolidate the theoretical foundation for the study of this paper.

97.1.2.2 Expert Interview Method

Hebei University, Yanshan University, and Beijing Sport University which have introduced the outward bound into the physical education as well as the Shijiazhuang Kuangyu outward bound company and Tangshan branch of Genesis Education Group were interviewed [1]. These two companies provide professional outward bound trainings. Also, discussions were conducted among related experts, teachers, students, enterprise coaches, and principals. And the fields, faculties, and facilities of the above schools and companies and their educational contents and effects were investigated.

97.1.2.3 Questionnaire Method

The design of the questionnaire: the author visited the professors with professional outward bound teaching experience and the professional psychological experts. Under their elaborate instructions, the multiple questionnaires necessary to carry out the outward training field projects of Tangshan vocational college physical education were designed and verified by experts and professors, and also their reliabilities and validities were examined.

(1) Validities

In these questionnaires, the expert experience validity evaluation method was used for the examination; 15 experts and professors were hired to examine and evaluate their objectivity and authenticity; and the effective percentage of the examination reached 86.7 % (See Fig. 97.1).

(2) Reliabilities

The "test-retest reliability method" was applied to examine the reliabilities of the questionnaires. The specific methods were that the preliminary survey was carried out among the investigated students; after 2 weeks, retest on the same group of students and contents was conducted; and the results obtained from the two tests were analyzed relevantly and examined obviously to gain the stability coefficient of the questionnaires, and it finally showed that the coefficient related to the reliability of the student questionnaires was $Rs = 0.88$ ($P < 0.01$), which

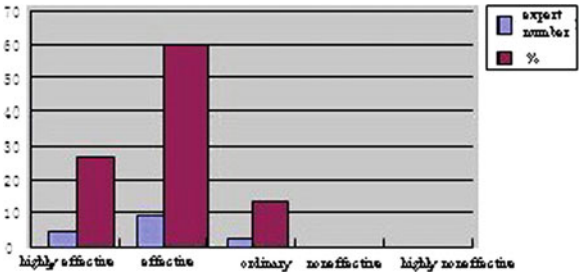

Fig. 97.1 Evaluation on the effects of questionnaires (N = 15)

indicated that the reliabilities of questionnaires were highly significant and the questionnaires survey met the requirement of the investigation [2].

(3) Distribution and Return

The post mails, helps from friends, or personal giving forms were adopted for the distributions and returns of the questionnaires. A total of 90 questionnaires were distributed to the students participating in the outward bound, and 90 questionnaires were returned, among which 86 pieces were effective and the effective rate was 96 %. A total of 400 questionnaires were given to the students participating in the experiment study, and 400 were returned, among which 200 pieces were effective and the effective rate was 100 %.

97.1.2.4 Experimentation Method

Experiment design plan:

(1) Name: The teaching experiment of Tangshan college east campus introducing the outward bound field project into the physical education courses;
(2) Objective: the outward bound project exerts an excellent role in the improvement of student mental health; and the introduction of outward bound field project courses in Tangshan vocational colleges is feasible;
(3) Object: The students admitted by Tangshan College in 2009 were the researched objects in this paper;
(4) Date: 02/2010–06/2010 (18 weeks in total, 2 h in a week, and 36 h in total);
(5) Place: East campus of Tangshan College;
(6) Content: Outward bound field project course was planned for the experiment group; and the common higher learning school physical education course was adopted for the reference group;
(7) Method: The self-calibrated method and comparative method were used, respectively, before and after the experiment for both the experiment and reference groups;
(8) Condition control: The Irrelevant variable control was used in the experimental process; and a same teacher undertook the teaching of both the experiment and

reference groups; also, the teaching time was the same; and the another two groups of students were also the same in the major, gender, and age;
(9) Test index: The physical indexes were based on the "Students' Physical Health Standard", while the mental indexes were based on the "Symptom Checklist SCL-90" and " Social Adaptability Rating Scale";
(10) Specific Steps: During the week before the experiment, the questionnaires were distributed to survey the mental qualities of the two groups of students and also their physical qualities were tested; during the last week of the experiment, the mental and physical qualities of the two groups of students were examined with the same methods; also, the data from the results of the questionnaires and tests were analyzed and processed;
(11) Data processing: The data collected from the experiment was processed through the scientific method; and the results were analyzed and concluded objectively and also the relevant conclusions were obtained.

97.1.2.5 Results and Analysis

The spss17.0 social statistics software was adopted to analyze and process the conclusions of questions, investigation, visitation, and questionnaire collection and the effective data tested before and after the experiment on the basis of the research objective and content classification through the sports statistics and the principle and basic methods of the social investigation statistics [3].

97.2 Thoughts on the Countermeasures to the Problems in Interior Design

97.2.1 Necessity for Tangshan Vocational College to Introduce Outward Bound Projects

97.2.1.1 Outward Bound Keeps Consistent with the Principles, Process, and Objective of Physical Education

To make trainees gain an experience and understanding of the outward bound, the specific plots and environments were designed purposefully, allowing them to think and conclude again through commonly participated activities, and hence discovering some problems which are not realized usually.

97.2.1.2 Introduction of Outward Bound Projects to Improve Tangshan College Physical Education

The outward bound, with the completely new training modes, powerful mental health control functions, and multiple educating functions, is adopted successively by all higher learning schools, and has reached the purpose to promote the cultivation on the high mental maturity, quality, and ability of students.

97.2.1.3 Significances to Deepen Tangshan Educational Reform and Promote Opened Quality Education

The outward bound always meets the standards and requirements proposed by the opened quality education in the training forms, contents, or functions.

97.2.2 Feasibility of the Introduction of Outward Bound Projects in Tangshan College

97.2.2.1 Rich Outward Contents and Low Requirement on Field Equipments

The outward bound field projects have low requirement on fields. For instance, the information transfer, mine array, making a speech at higher stages need only a flat field of about 10 m^2 to implement the trainings.

97.2.2.2 School Teachers Totally Meeting the Requirements of the Outward Bound Qualified Teachers

The higher learning school teachers possess foundations to completely undertake the outward bound field project courses. However, based on the unique form of the outward bound project to use the scenes or plots to guide the students to think, apprehend, and conclude and its outstanding psychological suggestion and control functions, the physical educational teachers at higher learning schools are capable generally after receiving purposeful trainings and learning before the outward bound [4].

97.2.2.3 Increasingly Well-Improved Teaching Materials for Outward Bound

The book "Psychological Outward Training at Schools", chiefly edited by Beijing sport university professor Mao Zhenming and Wang Changquan, gives introduction from theory and practice, and provides valuable teaching materials data for schools to develop the outward bound projects.

97.2.2.4 Outward Bound Arousing the Enthusiasm of Students to Attend Classes

From the above table, it is easy to see that 97.8 % of students like the outward bound project; students at higher learning schools hold very high evaluation on it and accept it universally [5].

97.2.3 Experiment Study and Analysis on the Introduction of Outward Bound in Tangshan College Physical Education

97.2.3.1 Results of Outward Bound Influencing Student Physical Qualities and Analysis

To ensure the persuasion of the collected data, five physical quality test indexes were purposefully selected as the experimental contents, including the standing long jump, sit-and-reach, chinning, etc. Therefore, the physical condition of the tested students can be fully mirrored through the measurement and assessment on the above indexes.

97.2.3.2 Statistics of Outward Bound Experiment on Student Mental Health and Analysis

After a semester of the experiment, the test statistics before and after the experiment for both the experiment and reference groups were conducted, respectively: Experiment group had highly significant differences in the hostile and interpersonal relations ($P < 0.01$) after they experienced a semester of the experiment in the outward bound field project. Besides, the importance of the teamwork in the collective activities and the individuals in the cooperation was definite [6].

97.2.3.3 Result Statistics of Outward Bound Experiment on Student Social Adaptability and Analysis

Through the analysis on the results (see Table 97.1), the experiment group had highly significant differences in the social adaptability ($P < 0.01$) after they experienced a semester of the experiment in the outward bound field project. However, the reference group did not receive the outward bound field project, so their social adaptabilities ($P > 0.05$) tested before and after the experiment did not reach the significant difference. Therefore, it is easy to see that the improvement of outward bound projects on student social adaptability was more significant than the common physical education.

Table 97.1 The comparison on social adaptabilities of reference group before and after the experiment (N = 50)

Project	Social adaptability($\overline{x}$ = SD)		*t*	*p*
	Before experiment	After experiment		
Experiment group	8.82 = 11.00	13.46 = 5.24	−7.050	0.000
Reference group	11.80 = 10.53	12.22 = 7.71	−0.657	0.512

97.3 Conclusions and Suggestions

97.3.1 Conclusions

(1) The investigation and feasibility experiment have proved that the introduction of outward bound is the supplement and improvement for the physical education of vocational colleges in Tangshan, and has significant meanings to deepen Tangshan educational reform and promote the opened quality education.
(2) The outward bound projects only require simple fields and equipments. The physical educational teachers at vocational colleges have rich teaching experiences plus the purposeful trainings are generally capable to undertake the teaching of this course.
(3) The outward bound exerts a significant role in the improvements of the mental health and social adaptability of students at vocational colleges, meeting the needs of educational concepts and developments of vocational colleges absolutely [7].
(4) There is a definite effect between outward bound and traditional physical education to enhance the physiological functions and physical qualities. Thus, the design related to the outward bound must be strengthened.

97.3.2 Suggestions

In this paper, it suggests that vocational colleges in Tangshan must change their concepts and offer the outward bound courses based their actual conditions, aiming to enrich the selective course contents for students. Then, the leaders in schools must pay much more attention for the outward bound course and give a certain fund support for the outward bound at the premise of the permitted finance, hence promoting the team outward bound projects able to grow continuously at schools and be progressively expanded. Also, the introduction of new mode puts forward new requirements on teachers who must seize the training features, pay attention to the role transformation in the actual implementation, and receive related professional trainings before the actions, so that they can be much more experienced to

ensure the smooth and safe implementation and achieve the actual effects. Next, the selection of the training contents must be arranged based on the actual situation of schools. Finally, the vocational colleges in Tangshan should go out to observe, learn, and introduce more things before the outward bound is offered, ensuring the smooth implementation at the first time.

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Chapter 98
Social Sports Connotation and Occupation Mechanism

Keke Bao

Abstract On the relationship between physical culture and social system, the sports society system holds the view that sports contribute both in the construction of social development system and its cultural value. Physical denotation and connotation based on society and occupation differentiation, produced sports sociology connotation and occupation mechanism. In this paper, research answers the core problem of sports technology engineering.

Keywords Social occupation · Mechanism of sports · Sports engineering

98.1 Socialization and Occupation Change

Sports are a study of the physical activities organizations and competing arena. Sports observed in the angle of social enterprise could then break the confinement of study on body, competition and economy, fully absorb the essence of physical culture, and establish the social identity of physical culture. Therefore, a complete physical culture, being an integral part of the generalized culture, is a domain, a law, an institution or physical facilities that seek to enhance people's biological and mental potential through physical exercises. Socialization and occupation change, we try to discuss the sports awareness in the whole society, and we found it a characteristic of modern social sports that group physical activities are more suitable for modern social physical life [1]. As Marx has pointed out that we

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interpret labor or the ability of labor as a living human body, namely the existence of inner body of a living human [2]. Whenever one person comes into value, he is making a combined use of his strength and intelligence. With the construction of sportsman group society, sports have been consistently endowed with social development influence. This is the action-activities-relation mode theory that we have been studying on social physical system [3].

We have achieved the occupation change study by referring to the action-activities-relation mode [4]. The social action dimension reveals that the dominating pattern of sports society has the features of sports society system. Sports events shall have strong occupation change, sports relation dimension is derived from the sports creativity, sports impetus, organization inheritance force and appreciation ability—the so called physical culture construction. Thus, we attempt to find cases from the two angles—big sports events, as a sports society system, determines the social force of cultural enterprises, and sportsman as an individual, his lifestyle determines the base of sports society enterprises. This is our motivation of carrying out the case comparison [5].

98.2 Analysis of the Connotation of "Social Sports"

We then carried out a case study in the action-activities-relation mode according to the three dimensions mentioned above.

98.2.1 Social Sport: Large Events Bring Society, Culture, Enterprises Together

Modern social sports as systems engineering, China is also gradually mature in recent years. Studies of sports sociology in China started late in the last century 1980s began to dabble in this field, the earliest is Peking University Lin Qiwu prepared "sports sociology" notes, in a small range to the domestic sports theory introduces the sports sociological framework. The western end of nineteenth century, Herbert Spencer Max Weber, have begun to sports as a sociological topic to research, such as Spencer discussed the sports education, Weber also wrote about Puritan interested in sports. In 1898, American scholar C· Zueblin and S· Americon through to the sports sociological research, wrote the earliest sports social science papers. In 1921 the sociologist stuffed published the first "world of sports sociology" monographs, so far, sports sociology as an independent discipline was born.

To the modern "occupation social" hypothesis as the basis, "sports socialization" as economics, sociology, ethics, psychology that emerging cognitive science are very concerned about the study object. This hypothesis is the core content of: (1) human nature is must work; work will give a person with the full market value

realization. (2) As a result of the cooperation of occupation, for the vast majority of people must be forced, controlled, command, to propel him to organizational goals to work. (3) Because the person in addition to the material factors, there are social, psychological factors, so the need for physical and mental condition. (4) As the productivity, the interpersonal relationship in enterprises and staff's family and social life, so the need for industry, the industry body movement. (5) As part of the social culture, the social impact of informal organization than the formal organization of the economic incentive for employees to have more influence; at the same time, the sports meet people's needs of society. (6) Drives people to work is the biggest motivation in social, psychological needs, rather than economic need, people pursuit is to maintain good interpersonal relationships. So, to arouse people's enthusiasm for work, must make employee social and psychological needs to be met, and physical education is one of the basic means to. Therefore, social sports in division of occupation to the social and historical development, productivity, science and technology to strengthen the exploration. Because of the occupation differentiation is rich, to define the concept of "social sports", the connotation of angle involved, more and more rich. Regardless of technology, economy and society are based on "be mode, and special working experience related to human relations". Cited in Hu Kanzhi. "The career guidance and career education" the first chapter quoting Taylor "occupation sociology", that is to say, the social sports reveals "occupation" and "physical" variables, related to how humans learn to participate in social activities and how to make its members to contribute to the normal functioning of society manner, in order to obtain in social activities must quality, value, belief and social praise, recognition behavior.

Thus, sports have an internal congeniality with social development. The most entertaining opening ceremony, the most advanced venues, the most enthusiastic spectators, the most hospitable citizens, the most comfortable Olympic village, the most excellent arrangement, the most perfect service, the most world records breakings and the most incredible evolution of China. Such big events drive the universal pattern of sports and promote the sports social communication between the working classes. Such events include the Olympic Games, the World Cup, various championships and some inter-continental events with a lot popularity. Sports sociology indicates that people gather legal sports right and apply it in particular sports organization. This could only be completed by social institutions. Through mass participation, exchange and communication, we could achieve resonance and coexistence in sports events, cross the country border, and complete the construction of sports social system from physical, psychological and social dimensions. These are all valid proofs of sports social activity mode. Sports are no longer a means of individual body building or training mode. Individual physical activities are not a survival mode any longer. Modern sports consist of many social construction aspects. The construction is a brand-new social culture system, going beyond the ordinary social politics attributes.

98.2.2 Sports Approach: Individual Lifestyles Determines the System Integration of Social Sports Enterprises

"Socialization" is a historic, cosmopolitan concept. On social sports "socialization" path, scholars at home and abroad it is uncertain. Some people think that the physical education, socialization path is progressively and thorough in all areas of society, schools, industrial, and mining enterprises, from the rural areas, and deep into the cell of the society—family to go; sports population expands, the people are increasingly involved in sports activities, active in the sports team not only has the majority of teenagers, and there are many elderly and infirm or disabled. And the establishment of the occupation of social science based on the conclusion is "by the enterprise, organizations to sponsor sports teams and sports competitions and other forms of sports". The general social scholars think, sports socialization refers to as the whole society is increasingly open and its effect on sports participation sports constantly from closed to open in physical development, physical function and physical education reform in the aspects of society and in close contact and continue to expand their social function. Sports highlights, sports system itself between each part, and sport and society in various fields between the interrelation and interaction are close day by day, more and more integrated development trend. The educational circles pay close attention to social consciousness and education departments responsible for physical task, the media should be through social guidance, social norms, social interaction, and other activities to social influence in order to make students form good sports consciousness and sports behavior.

98.3 Sports Linkage Mode Innovation of Sports Organization and Authorization Consignation

98.3.1 Sports "Socialization"

Sports "socialization", as the object of study, first of all is "social system" to the "occupation" of system conversion intermediate, physical mechanism and occupation mechanism is not possible "into", therefore, need to "socialization"—a high degree of identity, such as social organizations, competition, resorting to compulsion and institutionalized and so on. Social sports in China in 1992, the State Council of the Central Committee of Communist Party of China "on accelerating the development of the tertiary industry 's decision" and in 1996 eight people adopted by the four conference of "national economy and social development" Nine Five "plan and 2010 compendium of distant view target", around "sports should be socialized, industrial development of the road", the State Sports General Administration developed the "1995–2010 China sports industry development program", made clear the connotation of social sports from the original

"public welfare" to "industry of commonweal" change, as sports industry China's burgeoning sunny industry, China is gradually becoming a new economic growth point.

According to the analysis on the problem of sports "socialization", generally corresponding to physical property ownership socialization, management and operator power socialization, service socialization. In general terms, the interest in modern market background of the social relations of the highly permeable, sports also put a great deal of interest related propositions. As a result of modern elements into the contract, interpersonal relationship, utilitarianism is more and more apparent, individual intake amount of social resources depend largely on their social network quality, seek to build social networks by people as the possession of social resources shortcut, physical occupation of showing a new trend of the capital.

98.3.2 Sports Capital Considerations: "Service" and "Security"

Sports, as the base of social life, embodies the innate human life attitude, is a modern social system and the modern social mode of production; as a comprehensive community sports system, modern system of physical education is both a history of primary speciation of the inheritance and development of the mass sports, and it fully modern significance form element, basic characteristics and function of system. Social sport and as whole society on behalf of the country has modern members of society to provide physical security can not shirk responsibility. The society also makes the state in social sports in the dominant position with more extensive social consensus.

Obviously, the traditional sports is through the "competitive" made their own social needs, and different modern, sports is no longer a "competitive" and more "confrontation", but "adaptation" ,"reasonable", "whole" a state of existence. Modern social sports is the embodiment of social security mechanism, the basic principle is based on the social sports resources mobilization and organization, form a kind of social health level, due to the health needs of the integrity of the community, so when the majority of people, and the social sports were used for each person's survival provide the basic health security, social sports resources mobilization and organization ability to make its form. Therefore, modern sports must be based on the modern society sports foundation, social sports institution, only in the social organization establishment and implementation under the occupation, is to realize the socialization of sports management the fundamental guarantee.

98.3.3 Sports Economic Development

Based on the physical attributes of the breakthrough are expanding sports proposition. The old sports proposition although there are philosophical, cultural, social proposition, however, belong to the old social system of the product; the socialization of sports research, to today, has been from the traditional sports pattern gradually return to society. In modern society, the social sports subject will be formed, with "sports economic development" as the form,"social sports" covers technology, industry, business, along with the sports industry from the processing technology development to technology development, trade pattern and the system, restrict, in industry, downstream and peripheral support industry booming.

Social Physical Education in occupation is more and more important role in the organization, how to understand human nature, how to mobilize the enthusiasm of people, give full play to the creative, through mass fitness activities of scientific guidance, training in the field of progressively implementation technology training integration, forming the occupation of results, personnel training results, innovation, competition of mass sports activity results. At the same time, the social sports management thought is the core of social sports system standard, is to respect people, understand people, trust people, help people, train people, including the development of social sports, social sports care, social sports attribution. Therefore, based on the theory of social sports in modern sports, must hold to from life, from the side, the social sports awareness promotion, strengthen the modern people's "pragmatic" and "dare", embodied in the "social person" the fundamental attribute based on "Sports", reflect the social representation and national culture mental characteristics.

98.3.4 Sports Social-Affective

Sports social morphological maturation was also performed for the large-scale capital and personnel input, and technology transfer, strategic alliance mode, combine social planned construction, from the aspects of stimulating the development of sports. Sports industry sports social services for the main carrier, formation of stadiums opening operation, the development of sports intangible assets and the sports competition market development as the focus, especially the community sports facilities as the district must have public service facilities will have bigger breakthrough. Cultivation of modern sports development, competition form a breakthrough, relying on the occupation of trans-regional individual sport competition will gradually replace the original single comprehensive sports games, masses spontaneity for self-entertainment competitions quite frequently, sports competition basically according to the social and economic regulation, competition in commercial color and more strong.

In conclusion, sports as human kinematics explain, gradually expanded to survival, for the development of cultural patterns, therefore, need to popularize sports, sports to meet the needs of the public work, life needs. As modern society and occupation as the main body of the historical stage, expanded Sports Science Research of historical materialism perspective, our sports science study not only the exercise demand, but also to pay attention to adult body inner contradiction and law of development. Marx in the study of man's subjectivity and the viewpoint of historical materialism, from "dependence" to "substance dependence based human independence" and then to "free personality" three stages, China scholars in sports research, the traditional culture existence and modern self emancipation were established as a modern Chinese sports spirit hard course. Through human occupation subject and social subject research, we established and in age, culture and social sport between the main spirit of education system. This system breaks the school teaching independent, free and rational thought of subject, further in the life, survival, development background, explore the new physical education subject history, culture, social significance, out of the ivory tower of sports errors, the main spiritual needs, occurs in subjective and objective interaction, it is the main meaning acquisition process, and such a "Sports" proposition for us to establish the new physical mental and social patterns of the category.

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Chapter 99
Research on Socialized Mechanism of the Gymnasium and Stadium Inside School

Ju-xia Sheng

Abstract At present all schools of higher learning are conducting project-based teaching and learning targets which require building a base, platform, and cooperative teaching and learning system inside the classrooms, gymnasiums, and stadium. First of all, what needs to be solved is how to transform the gymnasiums and stadium inside the school into entrusted teaching and learning units. Therefore, this paper defines the estimated entrustment to teaching and learning units, entrusted teaching and learning, entrusted gymnasiums and stadium.

Keywords: Gymnasiums and stadium · Teaching efficiency · Entrust mechanism

99.1 Introduction

The properties of sports gymnasiums and stadium are classified into socialized gymnasiums and stadium and entrusted gymnasiums and stadium [1, 2]. They belong to different categories. For instance, there is specialized assurance for the facilities of competitive sports. Since it is called specialization, clearly it is not the sports of socialization [3, 4]. The definition of school sports has entrustment property. However, the nature of sports teaching and learning is a socialized sports operation system and a capacity for obtaining modern sports mode [5]. Therefore, the specialization of school sports ensures that it has both the property of the construction of sports facilities of sports gymnasiums and stadium and the property of socialized mode. Therefore, once the sports research transforms the teaching

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and learning mode, the research mechanism will also be transformed to the new one. The main mode of the entrusted sports gymnasiums and stadium is socialization inside schools.

The selection of sports items which have been conducted since middle 1980s has the following defects: the profession of sports teaching and learning is not so prominent; course construction and reform as well as the competitive sports items and training items are not separated obviously; the course research lags item division. The reasons from outside are that the teaching and learning items and the gymnasiums and stadium are not so directly linked and gymnasiums and stadium mechanism restricts the widespread operation of the sports courses. It promotes the gymnasiums and stadium's full management, target-based, item-based, and realization of the entrusted effect of teaching and learning, item selection, and management to have a research and analysis of item selection teaching and learning and its requirements for comprehensiveness and breakdown of the gymnasiums and stadium, comprehensiveness and intensification, and specialization and team work.

99.2 Objects and Methods

With the gymnasiums and stadium of Zhejiang Textile and Fashion College as study objects, some sports item selections and clubs are involved in the process of study. With the operation of some high level clubs inside school as cases, based on the analysis of sports sociology, this paper makes use of the combined methods of reference analysis, questionnaires, and mathematical statistics.

99.3 Results and Discussion

99.3.1 The Form of the Social Functioning

Through the perspective, I did some questionnaires with sports selections (including sports club) and made some studies on it in Zhejiang Textile and Fashion College. Through the questionnaires, we can see whether the distribution is balance or not. We chose a more balanced major and found that what the students chose is related with the stadium.

As you can see from the Table 99.1, the selected subjects fit the venues. All the subjects are selected except badminton and table tennis because these two subjects are for the sophomore students to select. In the last 3 years, the "Sunshine Physical Education" is widely carried out in our college. The connotation and the way of the "Sunshine Physical Education" are the sports venues. Therefore, the stadium is related with the life habits of the students and the total physical quality, and can be

Table 99.1 For freshman "subject—venues" distribution ($N = 52$)

Subject	The number of the students	Occupied by the total number (%)
Basketball	12	23.1
Volleyball	5	9.6
Football	9	17.3
Gymnastics	4	7.7
Aerobics	6	11.6
Track and field	9	17.3
Martial art	5	9.6
Badminton	0	0
Table tennis	0	0
Others	2	3.8
Total	52	100

used to study the relationship of sports life and physical quality. Table 99.1 reflects that the venues basically fit the requirement of the college sports. The organization of the sports also runs in a certain mode; entrust mode makes teaching a diversification trend.

At present, the school physical education pays more attention to the students. Since "Sunshine Physical Education" was carried out, more and more students are actively involved in sports. Sports become the students' needs. Physical education has expanded from "teaching" to "selection", especially after school and in the holidays. Therefore, in order to play the role to teach the students, we should train the ability of self management both the teachers and the students. Students play the most important role in the education, and they are the main role in the training and other activities. Therefore, we should hold the concept that the students are the most important in the selected teaching. Therefore, the department of physical education and sports management should sign the agreement of safety. Both sides should make clear the duty of education and management. This is the problem which should be totally solved. How to solve this problem? We should legally reexplain the running of the venues. And we should combine the systems of the social physical education and the college club. And we should put the physical education into the system of the college club. And we should set up the appointment of the teachers, sports operation, and school–enterprise joint venture to show the function of the college venues, to have adequate sports management group, and to make full use of resources of the school venues.

99.3.2 Internal Commission Operation

At present the health, safety, and management of school sports venue still adopt the school budget model. There are special staffs in schools. That is to say, the school is still the subject of the management of sports venue. The school is

responsible for repairing the housing, fields and facilities, purchasing equipment, and personnel expenditure. Even at present, most of our public sports venues adopt the operation mechanism. The management approach of National sports venue maintenance special subsidy funds is a legal definition of the national investment mechanism. According to statistics, there are 49,654 college sports venues in our country, accounting for 9 % of the total number of national sports venues. Generally speaking, gym, field, and pool are the places for students' physical teaching, training, competition, and the mass sports activities. Others outside the schools cannot use them without permission. The faculty and student groups need to handle the relevant approval procedures when they organize activities in gym, field, or pool. On this premise, the departments using sports venue are actually that commission operation of teaching projects can be embedded into the venue management system.

Therefore, the commission of school sports venue needs to redefine their functions. The main functions of the school sports venue include physical education, sports training, sports games, extra-curricular activities and so on. At the same time, the ancillary functions of the school sports venue refer to fully developing the potential of gymnasium except its main functions. According to the characteristics of school gymnasium, project settings, resource allocation, and inputs of services should open to our society, which serve the society and promote the development of school physical education. Only if we pay attention to these two functions, school sports venue adopts the social sports mechanism we can get better access to social support and understanding of school physical education and promote the school sports to fulfill the essential function of education better. Besides, socialization promotion of the sports venue can introduce socialization projects to expand the educational resources and make students develop sports resources. Sports education and social sports organizations should be combined in order to increase the college sports resources sharing, to straighten out the relationship between functional departments better, to promote the integration and the specialization of school resources, and to avoid the repetition of functions of teaching units and assets management departments. With the development of social production and modern education, the complex structure of sports and the relationship between sports and all aspects of our society, we need to establish the students individual sports socialization to provide people with social behavior and the spirit of cooperation, to develop good sports social attitude, and to have influence on students' sports autonomy and sociality in school life.

99.3.3 The Promotion

Physical education is an important part of the core competencies for vocational college students. As vocational colleges aim at fostering practical talents, physical education in those colleges plays a role in helping students better adapted to the society, developing working capabilities, and improving public fitness. Good

Table 99.2 Socialized items in school sports stadiums in china ($N = 1185$)

Subject	Paid open	Proportion (%)	Free open	Proportion (%)
Badminton	117	11.46	18	10.98
Tennis	104	11.17	0	0
Swimming	103	10.09	2	1.22
Table tennis	70	6.86	15	9.15
Basketball	28	2.74	55	33.54
Football	35	3.43	45	27.43
Tae kwon do	76	7.44	0	0
Equipment fitness	74	7.24	0	0
Latin dance	70	6.66	2	1.22
Rock climbing	67	6.56	2	1.22
Yoga	67	6.56	1	0.61
Roller skating	60	5.88	4	2.44
Martial arts	54	5.29	8	4.88
Snooker	38	3.72	2	1.22
Others	48	4.70	10	6.10

sporting manners, habits, and consciousness must be comprised in socialized sports mechanism. Therefore, utilizing sports stadiums in institutes of higher learning to cultivate students into practical talents acting as sports instructors is a vital component of the guideline of the moral, intellectual, and physical education. With abundant top-class sports stadiums and facilities, institutes of higher learning are beneficial to conducting social sports. Sport stadiums and facilities in schools and colleges open to the public is a significant measure to solve the problem of inadequate sports stadiums in public sports activities in many countries. In the report of the National Sports Meetings in 1981 and 1983 endorsed by the State Council, "advocating and supporting relevant departments, industries, large factories, mines, enterprises and institutes of higher learning to conduct various amateur sports training for teenagers and form high-level athletic teams." Thus, only social mechanism can help form elite sports teams. For example, American athletes taking part in Olympic Games mainly come from colleges and universities, and the case is the same with the coaches in NBA in selecting players. The Chinese University Basketball Association has gained great success, and the social benefits generated from it are no less than professional league matches. As shown in practice, forming athletic teams in institutes of higher learning is conducive both to the education and the development of national athletic sports (Table 99.2).

99.4 Conclusion

"The interaction between the society and sports is the core of the most fashionable research in sports sociology". As Chinese scholar Lai Kaide points out in modern society and school sports, sports clubs is an important form in sports socialization,

which locate their organizations mostly in stadiums and gymnasiums. Whether a club focuses on developing students' sports specialty or aims at bodybuilding and entertainment, or in fitness, there is a social mechanism. This mechanism is to ensure that the students themselves participate, organize, manage, and finally can combine activities to school sports. Classroom sports and extra curriculum sports activities are brought into the purpose, choices, content, and organization of sports socialization system, which endows students' stadium with students characteristics, school orientation, and with a totally new socialization managing system. We should understand the mechanism and influences of sports on human socialization, see school sports as a form of social activities, and study it with sociological theories and methods. What goals of sports education do vocational colleges want to achieve? Is it prior to develop students' professional skills or capabilities? On which basis should sports education train students has long been the focus of physical education theory circle. Happy sports or competitive sports, there is no good classification criteria and no good attribution path. From the perspective of enhance health, strengthen physical fitness, and develop competitive sports level, sport is an evolutionary history; from the school sports to life-long sports, we can see it is a history for physical education to cultivate students' characteristics and encourage diversification. The development of the school's sports concept should be closely linked with social needs.

The economic boom stimulated the construction of gyms. The construction of gyms is based by social sports mechanism. Human is one of the essential factors of the construction of gyms. The space of sports presents a process of sociality. Generally speaking, compared with elemental PE, the content, form, and scale of vocational PE changes a lot. The aim of vocational school is to cultivate the people who can meet the need of social life. Likewise, PE should meet the need of individuation and diversity to develop the internal association of social PE and promote the social projects of individuals.

Reference to the foreign practices, we see that there have been perfect social sports mechanism in PE of developed countries. That is, the entrust system of gyms was associated with optical courses and individual event club. The construction of gyms reflects the autonomy and selectivity of socialization operation. Student can select his favorite subject according to his interests or strengths and there is autonomy in sports form. At present, the subject education has been put into effect by some colleges for nearly 10 years. But the offering of optical subjects is not on the basis of socialization mechanism and cannot bring the educational goal into play. The reformation of the vocational school's gyms should attach the importance to the development of socialization mechanism and meet the need of popular. Finally, it should benefit the social development.

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Part X
Intelligent Evolutionary Algorithms

Chapter 100
Multi-Product Kanban System Based on Modified Genetic Algorithm

Liang Huang

Abstract Kanban system plays an important role in many manufacturing systems. The design of a Kanban system addresses the selection of two important parameters, i.e., the number of Kanbans and the lot size. This problem has been tackled in a number of studies using simulation models. But in the absence of an efficient gradient analysis method of the objective function, it is time-consuming in solving large-scale problems using a simulation model coupled with a meta-heuristic algorithm. In this chapter, a gradient-based heuristic is applied to a genetic algorithm for the design of a multi-product Kanban system. Several case studies in different sizes have been tried out and solutions from the modified genetic algorithm were compared to those from the classical genetic algorithm. Notable improvements in computing times or solutions by the modified genetic algorithm can be observed.

Keywords Kanban system · Simulation · Genetic algorithm · Gradient-based heuristic

100.1 Introduction

Kanban system has been widely used in many manufacturing systems. In a Kanban system, the main design parameters are the number of Kanbans and the lot size [1]. A variety of methods by means of analytical or simulation modeling have been used to tackle the problem.

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Stochastic process models have been used to model many Kanban systems. Yoichi et al. [2] have designed a single-stage Kanban system based on a queuing model. The objective of this work is to determine the number of Kanbans, when a change of load to the system is planned. Nori and Sarker [3] have modeled a Kanban system using Markov Chains to determine the optimum number of Kanbans between adjacent work stations. The methods based on queuing models or Markov Chains can effectively simplify the description of Kanban systems, but the assumptions of the queuing rules, such as first come first service (FCFS), limit the scope of application of these papers in practice.

For finding the required number of Kanbans and lot sizes in a complex Kanban system such as a multi-product Kanban system, simulation models can offer a number of advantages. Berkley [4] has simulated a two-card Kanban system with multiple part types to determine the effect of container size on average inventory and customer service levels. Shahabudeen et al. [5] have set the number of Kanbans as well as lot size at each work station using genetic algorithm (GA). In another work of them [6], they have set similar parameters using simulated annealing algorithm (SAA). GA or SAA start with an initial solution and tried to reach the optimum solution using neighborhood search. They examine many alternatives by simulations in the search procedure. This causes the algorithms to be time consuming in solving large-scale problems. Huang et al. [7] have presented a modified SAA to design a multi-product Kanban system. In the modified SAA, convergence is accelerated through a gradient-based heuristic and the computing times of the search procedure are reduced.

In this paper, a gradient-based heuristic is applied to a GA for the design of a multi-product Kanban system. Several case studies in different sizes have been tried out and solutions from the modified GA were compared to those from the classical GA. Notable improvements in computing times by the modified GA can be observed. In some cases, a better solution is obtained within a given time limit.

100.2 The Kanban System Model

The Kanban system considered in this paper is a multi-product and single-card Kanban system. As the objective of this paper is to introduce the application of the gradient-based heuristic in a modified GA for the design of multi-product Kanban systems and for the sake of clarity, we will restrict our attention to Kanban systems having work stations in series and each type of product goes through the same sequence of work stations. However, it is worthwhile emphasizing that most of the findings of this paper can easily be extended to more complicated structures such as assembly systems or manufacturing systems with parallel work stations. These studies will be introduced in other papers.

The Kanban system considered in this paper can be described as follows:

The system consists of a sequence of work stations. Each work station has a fixed number of machines. Multiple types of product are produced in the system. All the products must be processed in all the work stations.

From the current work station j, each product is withdrawn by its succeeding work station $j + 1$. The flow of products throughout the product line is controlled by dedicated Kanban cards, which means there is a fixed number of Kanban cards associated with each type of product at each work station. The type of product with the maximal number of unsatisfied demand will be released in priority but must be in a fixed lot size.

The distance between the consecutive work stations is very short and a single buffer is made available between the work stations. This buffer acts as both the outbound buffer for the current work station j and inbound buffer for the succeeding work station $j + 1$, respectively.

In the above Kanban system, the number of Kanbans and the lot size are fixed but different for each type of product at each work station. Setting these parameters is a pioneering work in this field. A solution vector s is used in this paper to denote the different settings of the parameters, which is a linear array containing the number of Kanbans and lot sizes for each type of products at each work station. The following is an example of s for an n product types and m work stations system.

$$s = [x_{11} \quad x_{12} \quad \cdots \quad x_{nm} \quad y_{11} \quad y_{12} \quad \cdots \quad y_{nm}]^{\mathrm{T}} \tag{100.1}$$

where x_{ij} and y_{ij} are, respectively, the number of Kanbans and the lot size for product type i and work station j ($i = 1, 2, \ldots, n$; $j = 1, 2, \ldots, m$). Denote N^+ as a set of $2 \times n \times m$ dimensional vectors in which the elements are positive integers. Then, s belongs to N^+.

For a given customer demand, the performance of the system will be deferent under deferent solution s. In this paper, two performance measures are used to combine a bi-criteria objective function for the optimum design of the Kanban system. They are weighted tardiness and weighted work-in-process (WIP). Hence, the objective function is

$$z = \sum_{i=1}^{n} w_i^{\mathrm{t}} t_{is}^{\mathrm{t}} + \sum_{i=1}^{n} \sum_{j=1}^{m} w_{ij}^{\mathrm{w}} t_{ijs}^{\mathrm{w}}, \tag{100.2}$$

where t_{is}^{t} is the total tardiness of product type i in solution s, w_i^{t} is the penalty per unit time for the tardiness of product type i, t_{ijs}^{w} is the sum of the processing time, the set up time, and the waiting time of product type i at work station j in solution s that is used to measure the WIP, and w_{ij}^{w} is the WIP cost per unit time of product type i at work station j.

Then, the problem can be formulated as an optimization model

$$\min z \tag{100.3}$$

$$\text{s.t.} s \in N^{+} \tag{100.4}$$

A simulation model has been developed to compute the objective function value z for each given solution s. Typical assumptions are made in the simulation model:

- Each type of product has its own demand inter arrival distribution and lot size distribution.
- At each work station, each type of product has its own processing time distribution and setup time distribution.
- At each work station, the performances of the machines are similar and products are assigned to machines averagely. Machines never break down.
- There is an infinite supply of raw material at the input of the system. Material handling resources are unrestricted.

The distance between the work stations is not substantial. Transportation times are very small compared to processing times and setup times. They can be negligible.

100.3 The Modified Genetic Algorithm

GA is a heuristic combinatorial search technique based on the concepts of natural genetics and Darwinian survival of the fittest, which was originally introduced by Holland [8]. GA has became one of the most powerful and popular algorithm to solve many optimization problems. But most GA does not use the knowledge in the related field completely. This often causes GA to be time consuming in solving large-scale problems. In this study, a time-consuming simulation is performed at iteration in the neighborhood search. It is necessary to find a convergence acceleration method in solving large-scale problems.

An effective crossover method or an effective mutation method is very helpful in accelerating convergence and controlling the computing time of the neighborhood-search procedure in GA. In the field of Kanban design, in order to find an approximate gradient of the objective function, a number of researchers have recognized the importance of capacity constrained resource at the bottleneck work station to the performance of a Kanban system. This critical resource determines the throughput rate of the entire system and therefore the ability to satisfy the customer demand. To ensure throughput rate, it needs to be protected so that variation and uncertain will not limit production. In this study, there are two ways to protect the critical resource at the bottleneck work station:

- Adding the number of Kanbans at the bottleneck work station in priority to reduce the variation in demand arrivals.
- Adding the lot size at the bottleneck work station in priority to reduce the setup times.

Therefore, the position of the bottleneck work station will be a guide to generate new solutions in the neighborhood search. Based on the analysis above, the modified GA with a gradient-based heuristic is summarized as follows:

Step 1: Initial population size n_p, probability of crossover p_c, probability of mutation p_m, upper bound of generation times n_g, and accept limit β. Generate a starting population of size n_p. In this study, the starting population consisted of n_p randomly chosen values of the feasible parameter space N^+. Call the simulation model and perform simulations to compute the object function value in each initial solution.

Step 2: Detect the bottlenecks in the Kanban system. In this paper, we define a bottleneck as a work station that has the largest effect on slowing down the entire Kanban system. Therefore, the work station with the longest uninterrupted active period is the momentary bottleneck at any given time. And the average bottleneck in any given period of time can be measured by the percentage of the time that a work station is the momentary bottleneck. For studies dealing with dynamic bottleneck detection using simulations, the reader is referred to Roser et al. [9]. Denote the percentage used to represent the average bottleneck as b_j for work station j. They can be got through the current simulation.

Step 3: Two solutions are selected from the population as parents according to their scaled fitness values. The roulette wheel strategy is used in this paper, in which the parents are selected randomly by weighting their relative fitness. The fitness in this context means the value of the objective function.

Step 4: The selected two solutions exchange a certain percentage (p_c) of digits so as to reproduce two new solutions. Crossover helps to explore new regions of the search space. A probability is defined to determine whether a position x_{ij} or y_{ij} in each parent solutions should be crossed or not:

$$P_c(j) = \frac{(b_j - b_{\min})^2}{\sum_{i=1}^{m} (b_i - b_{\min})^2}. \tag{100.5}$$

While $b_{\min}$ is the minimum in $b_j (j = 1, 2, \ldots, m)$. In this way, the digits at a position, which has a larger effect on reducing the objective function value, has a higher probability to be exchanged. These may helps in accelerating the convergence of the search procedure.

Step 5: Though selection and crossover effectively search and recombine extant notions, they occasionally lose some useful genetic features; therefore, mutation is needed to protect against such a harmful loss. Mutation can also increase the genetic diversity and improve the global nature of the search. The two new solutions produced by step 4 alter a certain percentage (p_m) of digits by being modified by +1 or −1 in the ordinal number of the solution space. A probability given in (100.5) is defined to determine whether a position x_{ij} or y_{ij} in each parent solutions should be crossed or not. In this way, the digits at a position, which has a larger effect on reducing the objective function value, has a higher probability to be altered. These may helps in accelerating the convergence of the search procedure.

Step 6: Replace the selected two solutions by the new reproduced and modified solutions. If the generation times reach n_g or the best solution in the population has not been improved for too many consecutive generations to overstep β, stop the search; otherwise, go to Step 2.

Step 7: Report the best solution in the population as the chosen solution.

In the above algorithm, the crossover operators and the mutation operators is according to a probability obtained by bottleneck analysis, which is different from the traditional methods at completely random or by tracking the search history in the classical GA. It will be a useful way to accelerate convergence and can find the same good solutions with fewer generations than the classical GA. So, the search procedure can be stopped earlier controlled by accept limit β and the run time is reduced.

100.4 Numerical Experiments

We have applied our proposed algorithm to three case studies denoted as Case 1, 2, and 3. They consists of three product types and five work stations, five product types and ten work stations, and ten product types and 20 work stations, respectively. In this paper, space constraints permit only the data of Case 1 to be given in detail.

In Case 1, there are three machines at each of the five work stations. Inter arrival times of product orders, processing times, and setup times are generated from exponential distributions; product lot sizes are generated from normal distributions; upper bound of lead times, tardiness penalties per hour, and WIP costs per hour (same at every work stations but different for different product types in this case) are set to be fixed values.

The data is shown in Tables 100.1 and 100.2. Following notions are used in the tables:

MITO Mean inter arrival time of product orders;
MLS Mean product lot size;
VLS Variance in product lot size;
UBLT Upper bound of lead time;
TP Tardiness penalty per hour;
WIPC WIP cost per hour;
MPT Mean processing time per unit;
MST Mean setup time per lot

Table 100.1 Demand requirements, tardiness penalty, and WIP costs in case 1

Product type	MITO (h)	MLS	VLS	UBLT (h)	TP (RMB)	WIPC (RMB)
1	80	10	3	75	12	1.2
2	40	5	2	35	15	1.4
3	60	5	2	40	20	2

Table 100.2 Processing times and setup times in case 1

Product type	Work station	MPT (h)	MST (h)	Work station	MPT (h)	MST (h)
1	1	2.25	2.00	2	3.00	2.50
	3	2.00	2.00	4	1.75	1.50
	5	2.50	1.00			
2	1	1.25	0.75	2	1.00	0.50
	3	1.25	0.75	4	2.00	1.50
	5	2.00	1.50			
3	1	1.75	1.00	2	3.50	2.00
	3	1.25	0.75	4	1.75	1.50
	5	2.25	1.00			

Using pilot runs, two different settings of control parameters are used to both the modified GA proposed in this paper and the classical GA using a random crossover method and a random mutation method. The four algorithms are denoted as A1, A2, A3, and A4 in this paper. Their control parameters are shown in Table 100.3.

For each of the three cases, the four algorithms shown in Table 100.3 were performed ten times. The mean objective function values and the mean computing times of the three cases are shown in Table 100.4. It can be found that the mean computing times of the proposed GA (A1 and A2) are much shorter than those of the classical GA (A3 and A4). And the objective function values from the proposed GA are also better than those from the classical GA in Case 3.

Table 100.3 Control parameters of the 4 GA

	Type	Control parameter values				
		n_p	p_c	p_m	n_g	β
A1	Modified GA	5	0.3	0.1	500	20
A2	Modified GA	5	0.3	0.1	500	10
A3	Classical GA	3	0.5	0.3	100	20
A4	Classical GA	3	0.5	0.3	100	10

Table 100.4 Results of solving the three cases using the 4 GA

	Mean objective function value (10,000 RMB)			Mean computing time (min)		
	Case 1	Case 2	Case 3	Case 1	Case 2	Case 3
A1	94.95	152.94	311. 45	9.65	14.28	33.89
A2	95.11	152.87	312.77	7.01	12.55	30.07
A3	95.27	153. 67	343.65	37.89	70.29	225.52
A4	95.54	154.24	365.62	28.14	45.70	72.61

100.5 Conclusions

In this paper, a modified GA is proposed and used as an optimization tool to set the parameters of a multi-product Kanban system. The new crossover and mutation method based on a gradient-based heuristic can make a great effect on convergence acceleration in the neighborhood search.

The proposed GA has been compared to the classical GA under different control parameters using a number of numerical experiments. Although the final solutions of all the algorithms are the same in some moderate-scale cases, the results show that the proposed GA needs less computational efforts and its computing time is obviously shorter than the classical GA. For its high efficiency, the proposed GA can find better solutions in the other large-scale cases under the same limit of the generation times. These experiments show that the gradient-based heuristic plays an important role in improving the speed and quality of the design of Multi-product Kanban systems.

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Chapter 101
Image Feature Selection Based on Genetic Algorithm

Liang Lei, Jun Peng and Bo Yang

Abstract Image feature selection is formulated as an optimization problem. When traditional genetic algorithm is used for selecting image feature, it may bring problems of local convergence or precocious puberty because of using a fixed probability of crossover operator and mutation operator. First, the paper gave a brief introduction to image feature selection regarding the purposes, tasks, and commonly used algorithms. Then, the paper improved genetic operator of genetic algorithm, and parallel computing was used to genetic algorithm, to enhance the performance of image feature selection. Finally, experiments show that the improved genetic algorithm is convergent and effective, and applied to image feature selection is successful.

Keywords Features optimization · Feature selection · Genetic algorithm

101.1 Introduction

With the development of network technology and the improvement of computer performance, digital cameras, surveillance cameras, and satellite remote sensing systems are getting more and more visible, coming along with a large number of image data, which has fuelled the intense research in the area of digital image technology. However, people tend to carry out the data acquisition on this information as much as they can, leading to a high dimension of image features. This can be a "dimension disaster" in terms of image retrieval. In order to improve the

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efficiency of image retrieval, optimization for the selection of image features appears to be quite essential.

This paper is designed to give a brief introduction to image feature selection regarding the purposes, tasks, and commonly used algorithms. Based on the existing genetic algorithms, further improvement is made on the crossover and mutation operators, and its applications are explored in the optimization for the image feature selection.

101.2 Optimization of Feature Selection

Basically, the image feature selection optimization is mainly targeted at the idea of dimension reduction, where the original image is projected from a high level feature space to a low-dimensional feature space with low-dimensional image features for the best response of the image nature or for images to distinguish. Or, to put it on the other way round, feature selection means that from a known feature set, a subset is selected to achieve the optimal evaluation criteria.

When it comes to a specific task on feature choice, d of D ($d < D$) features may be selected from a pattern space, and these d features are most effective for the classification. Obviously, this method of selection may encounter a total of C_D^d combinations. What choice is best in the end requires the evaluation of the classified features. According to the studies by Dash and Liu, existing evaluation criteria can be divided into five categories [1]. Distance measure, information measure, dependence measure, as well as consistency measure, and classification error rate measurement. The commonly used distance measures include Euclidean distance, S-order Minkowski distance, Chebychev distance, squared distance, nonlinear measurements, Bhattacharyya distance, as well as divergence, Chernoff probabilistic distance, and the Mahalanobis distance. Information measure was proposed by Almuallim and Dietterich in 1992, and it is used to select relevant features [2] based on the following assessment criteria: information gain, the minimum description length, mutual information. Dependence measure is essentially called the Correlation Measure, which involves the use of the concept of relevance in statistics to calculate the proximity between two variables. Consistency measure is widely used in the FOCUS feature selection, with an aim to find out the minimum possible feature subset that may have classification capability equivalent to a complete set. Classification error rate measure is used to evaluate the function, also called the Wrapper method. This is a method that is accompanied by classification error rate characteristics directly as the selection criteria. Alternatively, these features may achieve the minimum classification error rate. So the selected feature should be on the top of list, regardless of its particularly large amount of computation [3]. Bhattacharyya distance, divergence, Chernoff probabilistic distance, and Mahalanobis distance are all created on the basis of Probability and Statistics, as part of the probability distance criterion functions.

Feature selection is formulated as an optimization problem, where the search algorithm can be as simple as feature-by-feature comparison. Specifically, each feature is calculated independently on the value of criterion function J, all of which are organized in descending order, and finally, the top d features are taken as a selected feature combination. Nonetheless, this method does not take into account the interaction between the various features, and the selected d features are not necessarily the best among them. According to the computational complexity, the feature selection algorithm can usually be divided into three categories: index search algorithm, sequential search algorithm, and random search algorithm. Index-type search algorithm includes exhaustive search method, branch and bound search method, and cluster search method, all being classified as $O(2^n)$ in terms of computational complexity. Sequential search algorithm is performed by using the sequential and gradual expansion in search of the addition and subtraction features that are forwardly aggregated, including sequential forward search, backward sequential search and the improved generalized sequential forward search method, and generalized backward search method. Such algorithms are given a computational complexity of $O(n^2)$. Random search algorithm is comprised of the genetic algorithm (GA), simulated annealing algorithm and neural network algorithm. As in probability, the GA converges to the global optimal solution, and it is thus adopted in this paper to design the feature selection.

101.3 Improvement on Genetic Algorithm

GA is an imitation of biological optimization algorithm, and it is today the most influential one of a wide range of evolutionary computation. However, when chromosome crosses and mutates, the two individuals generally use a fixed probability of crossover operator, mutation operator, it may bring problems of local convergence or precocious puberty. Therefore, it is necessary to carry on certain crossover and mutation strategy improvement, design a new crossover recombination and chromosome mutation strategy in genetic algorithms to meet the needs of the population diversity.

101.3.1 A New Self-Adaptive Genetic Algorithm (NAGA1)

In the course of the practical application of the traditional GA, crossover and mutation operator was used as a fixed probability operator. Normally, crossover operator pc is considered as from 0.4 to 0.99, and mutation operator pm is considered as from 0.001 to 0.1. In order to meet the need of the diversity of GA, it is necessary to improve genetic operator (described as NAGA1), which crossover

probability P_c and mutation probability P_m can be adaptively adjusted according to the following formula [4].

$$P_c = \begin{cases} P_{c1} - \frac{(P_{c1} - P_{c2})(f' - f_{avg})}{f_{max} - f_{avg}}, f' \geq f_{avg} \\ P_{c1}, f' \leq f_{avg} \end{cases} \tag{101.1}$$

$$P_m = \begin{cases} P_{m1} - \frac{(P_{m1} - P_{m2})(f_{max} - f)}{f_{max} - f_{avg}}, f \geq f_{avg} \\ P_{m1}, f \leq f_{avg} \end{cases} \tag{101.2}$$

Here, f_{max} is the population's largest fitness; f_{avg} for the average fitness of the population in each generation; f' is the larger fitness in the two individuals to get crossover; f for the fitness of an individual to get mutation. Usually, P_{c1} is considered as 0.9, P_{c2} as 0.6, P_{m1} as 0.1, and P_{m2} as 0.01.

Which f_{max} and f_{avg} can indirectly represent current generation state; it is correspondingly improved performance of P_c and P_m of excellent individual group of P_c and P_m, not to be trouble into a stagnant state. So, self-adaptive P_c and P_m can provide the best P_c and P_m of individual solution. The improved chromosomal crossover operator and mutation operator can ensure the diversity of the population, at the same time; it can ensure the convergence of GA.

101.3.2 A New Self-Adaptive Genetic Algorithm (NAGA2)

In NAGA1, crossover probability and mutation probability are variable based on the average fitness and the maximum fitness of every generation group, however, the P_{c1}, P_{c2}, P_{m1} and P_{m2} remains fixed. Therefore, this paper again improved crossover and mutation operator, proposed a new bilateral random operator based on adaptive genetic algorithm (NAGA2) [3], to make the crossover and mutation operator be bilateral randomly changed in a certain range, but also have the ability of adaptive changes.

$$P_c = \begin{cases} \text{rand}(P_{c1}) - \frac{(\text{rand}(P_{c1}) - \text{rand}(P_{c2}))(f' - f_{avg})}{f_{max} - f_{avg}}, f' \geq f_{avg} \\ \text{rand}(P_{c1}), f' \leq f_{avg} \end{cases} \tag{101.3}$$

$$P_m = \begin{cases} \text{rand}(P_{m1}) - \frac{(\text{rand}(P_{m1}) - \text{rand}(P_{m2}))(f_{max} - f)}{f_{max} - f_{avg}}, f \geq f_{avg} \\ \text{rand}(P_{m1}), f \leq f_{avg} \end{cases} \tag{101.4}$$

Here, $0.75 < P_{c1} \leqq 0.9, 0.6 \leqq P_{c2} \leqq 0.75, 0.05 < P_{m1} \leqq 0.1, 0.01 \leqq P_{m2} \leqq 0.05$.

The NAGA algorithm can make the crossover probability and mutation probability automatically change with individual fitness, but also P_{c1}, P_{c2}, P_{m1}, P_{m2} bilateral random variation, which can enhance the performance of the crossover probability and mutation probability of excellent individuals, and easier to make the algorithm jump out of local optimal solution.

101.4 Image Feature Selection Based on Genetic Algorithm

GA is a search algorithm that is applied to multiple targets and complex system optimization, featuring not only the robustness, adaptability, but also the independence of domain knowledge and convenience for implementation in parallel. It is widely cited by scholars, and used to solve those large-scale complex data, and those high-dimensional complex problems beyond the reach of many other traditional methods, proven to be significantly effective. Additionally, genetic algorithm is especially suitable for multi-objective optimization problems, while in theory, it is characterized by the probability of convergence to the global optimum. Thus, GA applied to the image feature selection can be one of the ideal options to find out the selection optimization.

We chose the Corel database in the experimental data sets, including coastal areas, dinosaurs, horses, roses, churches and cars, a total of six image categories, each of 100 similar images.

As for the evaluation of algorithm performance, while taking care of the relevance of similar images, then the conventional "recall" and "precision" are not longer the matched evaluation indicators to retrieve the number of similar images returned. This paper introduced Normal Precision (P_N) and Normal Recall (R_N) proposed by Tan Kian_Lee [5]. They are defined as Formula (101.5) below.

$$P_N = 1 - \frac{\sum_{i=1}^{L} (\log r_i - \log i)}{\log \frac{N!}{(N-L)!L!}}, R_N = 1 - \frac{\sum_{i=1}^{L} (r_i - i)}{(N-L)L} \tag{101.5}$$

where: N is the representative of the image number returned by the retrieval system; L is the number of images relevant to the target image in the retrieval results set; r_i shows the sorting of the images related to No. i Image [6].

In this experiment, the retrieval system returned 30 images. By using the above-mentioned NAGA2 algorithm, following the steps of feature selection based on genetic algorithms, one image is randomly selected from the six images, respectively, as the target image to perform the image retrieval based on image class. Comparison is made on the retrieval performance of the image features before and after optimization, and the experimental results are shown in Table 101.1.

From the above experimental results, the "church" category after optimization of image feature shows the retrieval performance that is not as good as that before optimization. This may be caused by the NAGA2 algorithm that involves the use of crossover and mutation operators featured with bilateral random probability. But in general, NAGA2 algorithm being used in the selection of image features can be successful for image retrieval on the standard recall, precision, and the standard running time.

Table 101.1 Experimental results

Image type	Before image characteristics optimization			After image characteristics optimization		
	Standard recall precision (%)	Standard recall rate (%)	Run times (s)	Standard recall precision (%)	Standard recall rate (%)	Run times (s)
Coasts	75.63	88.01	13	82.89	93.72	10
Churches	78.45	84.18	15	63.15	78.34	11
Dinosaurs	92.32	100.00	11	100	100	8
Horses	77.90	96.23	12	87.29	96.03	8
Cars	71.45	85.04	14	84.12	92.34	11
Roses	93.45	100.00	11	100	100	8

101.5 Summary

This paper starts with the introduction to image feature selection regarding its purposes, tasks, and commonly used methods, followed by discussion on GA with a particular focus on its working principle, and the design of crossover and mutation operators. Meanwhile, two times improvement are made on crossover and mutation. From the experimental results, the randomness of the initial population may cause the case where NAGA2 algorithm fails to perform as good as several other improved algorithms. Also, the fact that the images on the Internet are often highly dimensional with multiple features, making it possible for the improved GA to be successfully applied to optimize the choice of image features. This provides a reference for the studies on the image feature extraction and selection.

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Chapter 102
Weather Forecast Based on Improved Genetic Algorithm and Neural Network

XueMei Meng

Abstract The neural network has slow convergence speed and is easy to fall into the local minimum, while the genetic algorithm is suitable for global search. The genetic algorithm late is easy near optimal solutions shocks problem and puts forward the method of fitness value of calibration, and so optimizes the purpose of the genetic algorithm. This paper will present both together. Using the improved genetic algorithm to optimize the BP neural network of weights and threshold value, and a combination of the two algorithms is applied to the weather forecast, the experiments show that the improved genetic neural network compared with the standard genetic neural network has certain advantages for improved neural network prediction ability.

Keywords Genetic algorithm · Neural network · Weather forecast · Model

102.1 Introduction

With the development of artificial neural network, a lot of domestic and international atmospheric science researchers application of neural network to the weather forecast, and made some achievements. Jinlong through the genetic algorithm to optimize the connection weights and the network structure of the neural network, short-term climate prediction model for forecasting has high accuracy, good stability characteristics [1]. However, many researchers have found

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that neural network in the forecast of the process, the network weights of the threshold and network of other parameter setting is difficult to determine. Only by constantly repeated training and with some experience to determine, and this leads to over fitting problem. Therefore it also influence the network generalization ability, to some great extent also limits the neural network in the actual application of the weather forecast.

102.2 The BP Neural Network

The BP neural network is a network algorithm [2], the input layer, hidden layer, output layers, in which hidden layer can be one layer also can be a multilayer. BP algorithm is based on the network with least sum of square error as the objective function, based on the gradient descent method batch mode to modify weights and thresholds, the algorithm consists of signals in the forward propagation and error back propagation with two stages. The network structure is shown in Fig. 102.1.

BP learning algorithm is the most widely used neural network learning algorithm. It is based on supervised learning, which has strong nonlinear mapping ability, to solve the complex problem of internal mechanism has good applicability. Multi-layer BP neural network can be theoretically infinite approximation of nonlinear continuous function, has very strong robustness and fault tolerance, and self learning and adaptive ability is very strong. At the same time, it has wide adaptability and effectiveness. Neural network is more and more applied to function approximation, image processing, pattern recognition, adaptive control, etc. But the neural network also has its own disadvantages such as: (1) Slow learning speed. (2) Is not guaranteed to converge to the global minimum. (3) The network does not converge [3].

Because the BP neural network has its own cannot break through limitations, many researchers now proceed with other algorithm to optimize BP neural network, in which the simulated annealing algorithm, but often used is genetic algorithm.

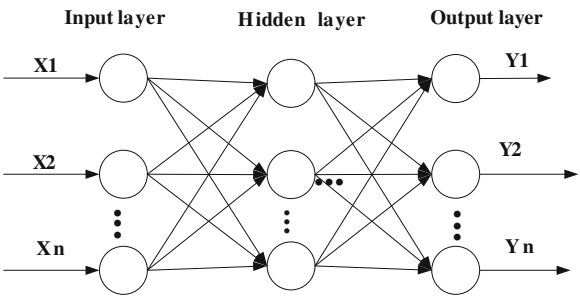

Fig. 102.1 Three-layered BP neural network model

102.3 The Improved Genetic Algorithm

Genetic algorithm (GA) is proposed by Holland professor a bionic algorithm the 1975 [4], the algorithm to the solution of the problem is expressed as a genetic string, realize from performance to genotype mapping coding in genetic algorithms applied to job. Genetic algorithm is a global stochastic searching algorithm. It can use its effective information processing which has been encoded string. Basic genetic algorithm flow chart, as shown in Fig. 102.2.

When initial the population may exist some individuals adapted to spend. Their later reproductive process will cause its domination of the groups into local optimum. In addition, the genetic algorithm later gradually converge, the individual fitness comparison approach, continues to converge more difficult, resulting in near the optimal solution swing, which makes the whole network performance. At this time, we should increase the fitness value selection; improve the ability to select [5]. Therefore, the definition formula is:

$$f' = \frac{1}{f_{\max} + f_{\min} + \alpha}(f + |f_{\min}|) \tag{102.1}$$

Among them: f' is calibrated fitness value; $f_{\max}$ is upper bound of fitness, $f_{\min}$ is lower bound of the fitness values, f for the current fitness value, and $\alpha \in (0, 1)$ is random number. Take α which is mainly to increase the genetic algorithmic randomness and prevent the denominator which is zero, because the fitness value cannot be negative, and through $|f_{\min}|$ to ensure.

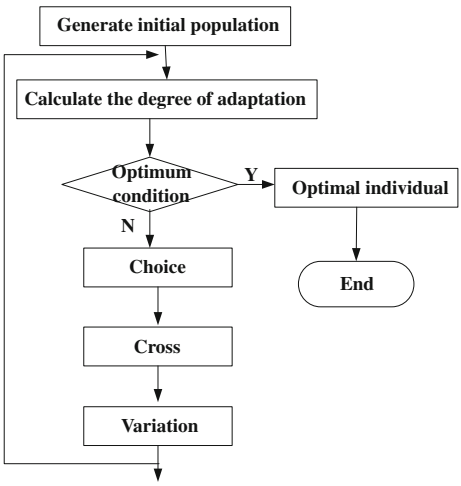

Fig. 102.2 Genetic algorithm flowchart

102.4 Construction of Genetic Neural Network Model

Genetic algorithm and neural network are applied to the principle of biology then to science bionics theory results, due to the genetic algorithm and neural network has very strong ability to solve problems. Genetic algorithm in the learning process has strong global search ability and neural network with self learning ability. Combining neural network and genetic algorithm can make full use of the advantages of both, complement each other; enhance the ability of solving problems, in order to find a better way to solve the problem.

102.4.1 Neural Network Setting Portion

Neural network topology structure design is include the design of network layer, design of hidden layer nodes and input layer output layer nodes design. Practice shows that, four layer network than the three layer network it is easy to fall into local minimum, so in practical application, we can choose three layer network structure, which contains only one hidden layer network structure. In this paper the experiment of network model node numbers of hidden layer design for 13.

102.4.2 The Part Setting of Genetic Algorithm

In the improved genetic neural optimization BP neural network weight threshold algorithm, initial population of genetic algorithm for encoding is actually on the network's initial weights and threshold coding. As a result of genetic algorithm on computing, network design and learning have a very important role. The binary coding is not conducive to high-dimensional solution of high accuracy, and the weights of neural network learning is a complex continuous optimization problems [6]. Computing is also the need for binary coding and decoding for the real numbers, this to a certain extent Influence the network learning speed, this paper adopts real coding scheme. Using three layer neural network, input layer, hidden layer and output layer nodes, respectively 2, 3, 2, adopting real coding example as shown in Fig. 102.3.

102.5 Genetic Neural Network in Weather Forecasting Application

This paper is based on Beijing in 2008 August temperatures make a prediction, data selection of Beijing city in 2006 6–10 months, 2007 July–August, 2008 August, a total of 246 data as training samples. In 2008 August a total of 31 data as

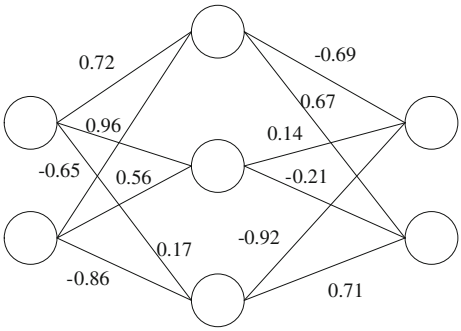

Fig. 102.3 The encoding of learning neural network

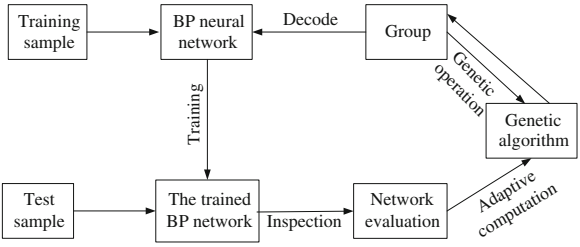

Fig. 102.4 Genetic algorithm and neural network integration model

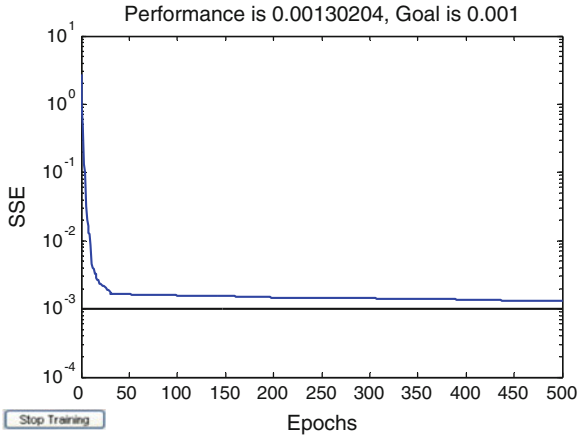

Fig. 102.5 The GA-BP model training results

test samples to predict that month 31 days maximum temperature and minimum temperature. Application model based on genetic neural network as shown in Fig. 102.4.

Respectively by genetic neural network model and the improved genetic neural network model training network as shown in Figs. 102.5 and 102.6

Through the Fig. 102.5 shows, using genetic neural network model to satisfy the predetermined network error 0.001, number of iterations to terminate the algebra of 500 generations, in terms of the number of iterations within can not meet the network target error.

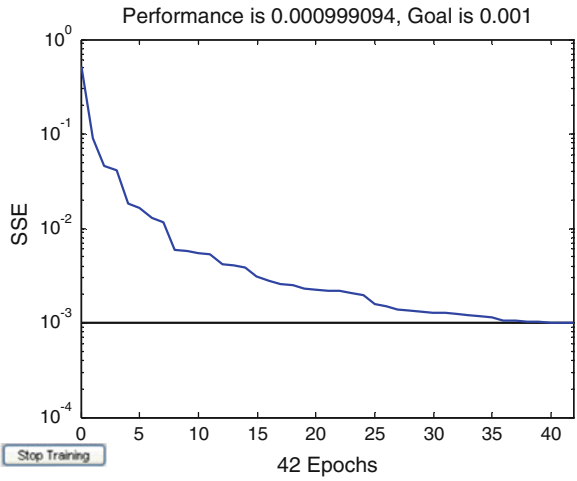

Fig. 102.6 The improved GA-BP model training results

Through the Fig. 102.6 shows, improved genetic neural network model design requires only after 42 iterations can satisfy a predetermined condition, namely the network error reaches 0.001, in the absence of a termination of iteration times before they have reached the target network error. But from the trained network curve, Rate of convergence is speed.

102.6 Conclusion

The paper combined with genetic algorithm and neural network, using improved genetic algorithm to optimize BP neural network weights thresholds, and with optimized weight threshold for training the BP neural network, and then the trained neural network is application in weather forecast.

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Chapter 103
A Digital Watermarking Method Based on Particle Swarm Optimization and Contourlet Transform

Jia Mo, Zhaofeng Ma, Yixian Yang and Xinxin Niu

Abstract As a key technology for digital content copyright protection, digital watermark often sees a dilemma between imperceptibility and robustness. In view of the problem, this paper suggests a CT-SVD-based intelligent watermarking scheme that embraces three major algorithms including the watermark preprocessing, the watermark embedding, and extracting. The host image is first decomposed by contourlet transform to get the low frequency subband images on which the SVD decomposition is then implemented before embedding the preprocessed watermark. The watermark extracting is an inversion of watermark embedding. To maximize the watermark robustness while maintaining its imperceptibility, particle swarm optimization (PSO) is applied to have heuristic searches for scaling factor. The experiment has demonstrated that this scheme is capable of resisting frequent image attacks with better imperceptibility and robustness.

Keywords Digital image watermarking · Particle swarm optimization · Contourlet transform · Singular value decomposition

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103.1 Introduction

The dramatic development of multimedia and telecommunications has facilitated the transmission and dissemination of digital contents and accordingly highlighted the copyright issues. Thanks to its efficiency, digital watermarking plays a significant part in copyright protection and anticounterfeiting contents. Considering the insensitivity of human seeing and hearing senses for specific information and some possible redundancy in digital contents, digital watermarking allows the necessarily added information hidden in the contents by a certain algorithm. The added watermarks are expected to neither exert side effects on the original contents nor easily identified. By examining the mentioned information, the watermark can be extracted from the data for the sake of confidential transmission, copyright protection, products identification, and authenticity verification and so on.

Watermark is generally categorized as the spatial and the frequency ones. The former does not function effectively in resisting the frequent attacks so that the latter one is preferred under most circumstances. Frequency watermarks make use of such transformations as DFT, DCT, and DWT to transform the host image from the spatial domain to the frequency domain. The DFT algorithm is complicated but less efficient, while DCT is reluctant to stand up to attacks of filtering and noises. In the DWT, the two-dimensional wavelets are not optimized in that they only indicate singularity in the horizontal, vertical, and diagonal directions. By contrast, contourlet transform integrates the merits of wavelet transformation and enjoys multidirectional bases, which offers easier access to geometrical features of images and helps to capture the directional interest in images and allows sparser representation of two-dimensional images.

Reference [1] designed watermarking algorithms in contourlet domains and Ref. [2] suggested two algorithms that embedded watermark into the coefficients with bigger absolute values. To better the watermarking designs, some intelligent algorithms are introduced. For binary watermarking, Tsai and others applied PSO to the wavelet domains. Reference [3] designed a DCT-DWT-SVD-based algorithm, using PSO and genetic programming (GP) to modulate singular values of the host image. Reference [4] employed hybrid particle swarm optimization (HPSO) to estimate the multiple parameters. Reference [5] proposed the watermarking based on DCT and DWT, using PSO to calculate the appropriate embedding strength.

This paper designs an intelligent watermarking based on the singular value decomposition (SVD) [6] in contourlet domain, performing heuristic searches for the optimized scaling factor using PSO, evaluating the watermark imperceptibility via peak signal to noise ratio (PSNR) [7] and structural similarity index (SSIM), and testing the robustness by normalized cross-correlation (NCC) [8]. The experiment has demonstrated that the scheme betters the watermark robustness and imperceptibility as well as the information security.

The rest of this paper is organized as follows: Sect. 103.2 introduces the involved principles, Sect. 103.3 the suggested scheme, and Sect. 103.4 the findings while the last the conclusion.

103.2 Background

103.2.1 Contourlet Transform

Contourlet transforms images from the spatial domain to the frequent domain by the two-filter set. It first uses Laplacian pyramid (LP) to capture the point discontinuities and then connects the points into the linear structure via directional filter bank (DFB) before finally producing the image presented by the basic elements of Contour segments.

In terms of image processing, contourlet transform enjoys the following advantages:

Given the vital attributes of anisotropy and directionality that are not shared by wavelets, contourlet is much superior in many image processing.

With the richer set of directions and shapes than wavelets, contourlet functions more efficiently in capturing smooth contours.

Considering the stronger capacity of hiding edges, contourlet is more appropriate for data hiding applications in high frequency regions without perceivable distortion of the original image.

103.2.2 Particle Swarm Optimization

PSO [6], initiated by Kennedy and Eberhart in 1995, is a stochastic global optimization method that derives from the artificial life theory and the swarm behavior of birds and fishes. From the perspective of social cognition, PSO get ideas from the following principle: Each individual in a swarm benefits from the findings and experiences of its neighboring individuals. The fundamental theory consists of three basic elements including the stimulus evaluation, the comparison with its neighbor, and the simulation of the leading neighbors. The basic workflow of PSO is as follows:

Step 1: Randomly initialize the location and speed of the whole particle swarm in search space.
Step 2: Calculate the fitness value of each particle in its present location.
Step 3: Update pbest and gbest.

Where, pbest represents the optimized value the i particle has ever reached, gbest is the optimized value the whole particles have reached.

Step 4: In each iteration, each particle updates the location ($x_i = (x_{i1}, x_{i2}, \ldots, x_{iD})$) and the speed ($v_i = (v_{i1}, v_{i2}, \ldots, v_{iD})$) in accordance with the following formula:

$$v_{id}^{n+1} = \omega v_{id}^{n} + c_1 r_1^n (p_{id}^n - x_{id}^n) + c_2 r_2^n (p_{gd}^n - x_{id}^n), x_{id}^{n+1} = x_{id}^n + r v_{id}^{n+1} \quad (103.1)$$

where, $d = 1, 2, \ldots, D; n = 1, 2, \ldots, N; i = 1, 2, \ldots, M$, D represents the dimensions of the key, along with N the maximum allowable iteration number, M the size of the swarm; ω the momentum factor, c_1 and c_2 two positive constants that are, respectively, called as cognitive and social parameters and r_1^n and r_2^n two random sequences uniformly distributed in [0, 1] as well as R the constraint factor.

Step 5: The algorithm comes to the end if all satisfied and otherwise skips to step 2.

103.3 The Watermarking Scheme

103.3.1 The Watermark Preprocessing

To reduce the relevance of the watermarking image pixels and enhance the robustness, the primitive watermark needs to be preprocessed. The two-dimensional reversible area-preserving formula is used to scramble the watermarking image:

$$\begin{pmatrix} x_{i+1} \\ y_{i+1} \end{pmatrix} = A \begin{pmatrix} x_i \\ y_i \end{pmatrix} (\text{mod } N), A = \begin{pmatrix} a & b \\ c & d \end{pmatrix}, \begin{vmatrix} a & b \\ c & d \end{vmatrix} = \pm 1 \quad (103.2)$$

Where, (x_i, y_i) is the pixel position before the transformation while (x_{i+1}, y_{i+1}) is the transformed position. With its chaotic mapping, the equation can employ the matrix A and the number of scrambles as the keys, thus broadening the key space and bettering the capability of resisting exhaustive attacks.

103.3.2 The Watermark Embedding

Step 1: Read the host image I and the scrambled watermarking image W.
Step 2: Implement the contourlet transform on I to get a low pass image and directional band pass images.
Step 3: Get the low pass image A and implement the SVD decomposition.

$$A = U_a S_a V_a^T \tag{103.3}$$

Step 4: Embed watermark according to the following formula:

$$I_w = S_a + \alpha W \tag{103.4}$$

where, α is the scaling factor.

Step 5: Implement a further SVD decomposition over I_w.

$$I_w = U_{iw} S_{iw} V_{iw}^T \tag{103.5}$$

Step 6: Update the low pass image by

$$U_a S_{iw} V_a^T \Rightarrow A^* \tag{103.6}$$

Step 7: Apply the inverse contourlet transform to get the watermarked imageI^*.

As an inversion to the embedding process, the watermark extracting is herein omitted due to the length limitation.

103.3.3 Finding Scaling Factor Using Particle Swarm Optimization

For image watermarking technologies, Scaling factor (SF) is the key element for the robustness and imperceptibility. The bigger SF means the stronger robustness and the degraded imperceptibility and vice versa. Theoretically, SF is often preset as the normal number before embedding the watermark whose value is smaller than 1, but in reality SF is dynamic and it is not easy to find the appropriate SF. In this view, the calculation of SF is regarded as an optimization by using PSO to have heuristic searches of proper SF. Based on the PSO principle introduced in Sect. 103.2.2, SF is defined as the particle while the optimized objective functionf_{obj} is defined in formula 103.7

$$f_{\text{obj}}(\text{SF}_j) = w_1 \text{PSNR}(I_0, I_w) + w_2 \frac{1}{n_{\text{attack}}} \sum_{i}^{n_{\text{attack}}} \text{PSNR}(W_0, W_i^{*j}) \tag{103.7}$$

where, I_0 and I_w (W_0, W^*) are the host image (original watermark) and watermarked image (extracted watermark), respectively.

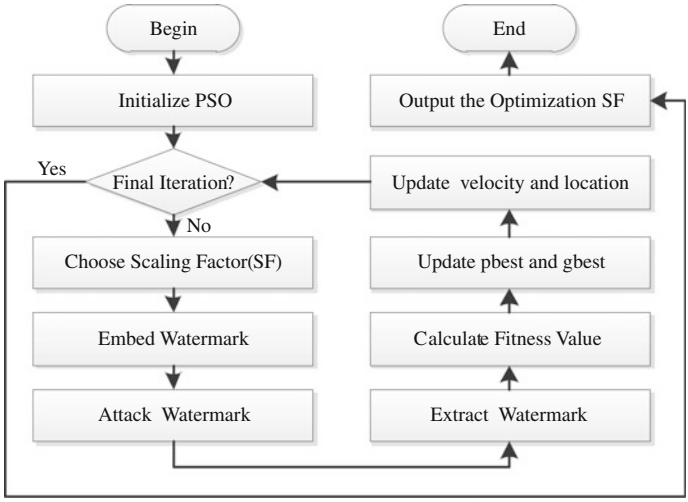

Fig. 103.1 Flowchart of finding scaling factor with PSO

The algorithm of the best SF is illustrated in Fig. 103.1.

103.4 The Experimental Results

The host image used in this paper is lean of 256 × 256 as in Fig. 103.2a, cameraman of 256 × 256 as in Fig. 103.2b, and peppers of the same scale as in Fig. 103.2c as well as the gray watermarking image of 64 × 64 in Fig. 103.2d.

In this experiment, parameters for contourlet transform are defined as follows: the decomposition progression is 3, the pyramidal filter and directional filter are "9/7" and "pkva", respectively, the PSO parameter $c1 = c2 = 1.4962$, and the inertia weight ω in formula 103.1 in the way of linear decrease with the speed change range of $(0, 1)$. In addition, the number of particles is defined as 50 with

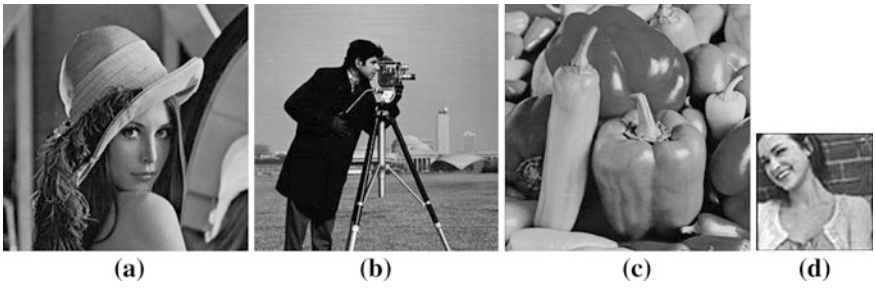

Fig. 103.2 Host image: **a** Lena **b** Cameraman **c** Peppers and original watermark

Table 103.1 The optimization scaling factor and imperceptibility for watermark

Host image	Optimal scaling factor	PSNR	SSIM
(a) Lena	0.43794590	34.9123	0.9859
(b) Cameraman	0.27742214	38.2471	0.9813
(c) Peppers	0.69154803	29.7303	0.9549

100 iterations, 1 particle dimension, 0.7298 constraining factor, and the objective function weight $w1 = 0.5$, $w2 = 0.5$.

The SSIM and PSNR are applied to test the imperceptibility of the watermark. The best scaling factor found by PSO is 0.43794590 (Lena), 0.27742214 (Cameraman), and 0.69154803 (Peppers), while the PSNR for the watermarked image and the primitive host image when not attacked is 34.9123(Lena), 38.2471 (Cameraman), and 29.7303 (Peppers), and the SSIM is 0.9859(Lean), 0.9813 (Cameraman), and 0.9549 (Peppers) with better imperceptibility as manifested in Table 103.1.

Table 103.2 The NCC values of the watermark extracting under JPEG compression attacks

Host image	QF						
	10	20	30	40	50	70	100
(a) Lena	0.9996	0.9998	0.9999	0.9999	1.0000	1.0000	1.0000
(b) Cameraman	0.9980	0.9990	0.9993	0.9996	0.9997	0.9998	1.0000
(c) Peppers	0.9995	0.9997	0.9999	0.9999	0.9999	0.9999	1.0000

Table 103.3 The NCC values of the watermark extracting under geometric attacks

Host image	Attacks						
	Cropping ¼				Scaling	Mirroring	
	Left-bottom	Right-bottom	Left-top	Right-top	0.5	Horizontal	Vertical
(a)Lena	0.9726	0.9787	0.9875	0.9557	0.9991	0.9996	0.9998
(b)Cameraman	0.9751	0.9734	0.9773	0.9798	0.9978	0.9986	0.9990
(c)Peppers	0.9739	0.9709	0.9642	0.9657	0.9992	0.9997	0.9998

Table 103.4 The NCC values of the watermark extracting under filter and histogram equalization attacks

Host image	Attacks						
	Average filter			Histogram equalization	Median filter		
	3×3	5×5	7×7		3×3	5×5	7×7
(a)Lena	0.9960	0.9869	0.9743	0.9928	0.9991	0.9945	0.9891
(b)Cameraman	0.9947	0.9840	0.9661	0.989	0.9971	0.9906	0.9847
(c)Peppers	0.9973	0.9885	0.9773	0.9948	0.9993	0.9956	0.9895

Table 103.5 The NCC values of the watermark extracting under common noise attacks

Host image	Attacks						
	Salt and peppers noise			Gaussian noise			
	0.005	0.02	0.2	0.001	0.005	0.02	0.2
(a)Lena	0.9999	0.9988	0.9797	0.9999	0.9991	0.9955	0.9544
(b)Cameraman	0.9993	0.998	0.9652	0.9994	0.9971	0.9889	0.9398
(c)Peppers	0.9998	0.9994	0.9896	0.9998	0.9995	0.9980	0.9714

This paper adopts the NCC to examine the robustness of the watermark. The bigger NCC indicates the better only certainty of the watermark.

To evaluate the robustness of the proposed scheme, the watermarked image was tested against common image processing operations such as average filter, median filter, cropping, and salt and pepper filter JPEG compression as displayed in Tables 103.2, 103.3, 103.4, and 103.5.

103.5 Conclusions

Combining with contourlet transform, this paper suggests a PSO and SVD decomposition-based watermarking scheme that consists of the preprocessing, embedding, and extracting algorithms. The experiment finds that the method not only satisfies the fundamental requirements of digital watermarks but enjoys a good ability of resisting frequent image attacks such as filtering, noises, compression, and cutting.

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Chapter 104
Mixed Recommendation Algorithm Based on Commodity Gene and Genetic Algorithm

Zhang Hao

Abstract To solve the problems of "new user" and "sparseness", we introduce the concept of commodity gene. Through coupling the commodity gene database, users' purchasing historical records, users' content of online browsing and the data of neighbors' behavior, we can form the module of candidate sets of customer preferences, and then use genetic algorithm which has been improved to make the selection and polymerization to the model, so that we can complete the best selection of neighbors. Finally, we can get the recommended sets according to the recommended module. Experimental results show that the algorithm we suggested can improve the accuracy of the recommendation and achieve good quality of recommendation.

Keywords Commodity gene · Recommendation algorithm · Genetic algorithm

104.1 Introduction

Recommendation algorithm is the heart of personalized recommendation system; it generally includes collaborative filtering, association rules and the recommended algorithm which is based on content [1]. Collaborative filtering algorithm based on the evaluation of neighbor users. It has some problems about the cold startup, special user and sparseness, so it exists some defects in recommended efficiency and quality. Association rules algorithm is based on the relation of all users' purchasing habit [2, 3]. With the increasing of web structure, complexity of the

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content and the number of users, the existing recommendation algorithms have difficulties in showing good performance.

Viewing the existing problems, this article introduces the concept of commodity gene. Through combining commodities' gene, the library of users' historical action, the preference set of users' interests and the best sets of neighbor users, we propose a personalized recommendation algorithm which is based on the commodity gene and heredity algorithm.This algorithm is better than the later recommendation algorithm in recommended accuracy, efficiency and recommendation to clients timely. At the same time, we use genetic algorithm to study the candidate sets of customers' preference, get the best neighbor users and make the definite increasing of recommended commodities' coverage rate.

104.2 Mixed Algorithm Based on Commodity Gene and Genetic Algorithm

104.2.1 Formalization Description of Recommend Problems

Recommend problems can use the following methods to expounded [4]. C is the collection of all customers; S is sets of all the subjects that may be recommended. u as a utility function of measure s to c, the definition of u is for:

$$u : C \times S \rightarrow R \tag{104.1}$$

R is the collections of all users' evaluation. For every user of user zone, our aim is to find the commodity program that can benefit the user from the commodity subject space, namely:

$$\forall c \in C, s_c^{'} = \max_{s \in S} u(c, s) \tag{104.2}$$

104.2.2 Algorithm Model

104.2.2.1 Commodity Gene

Selection of merchandise are based on objective and identified description, it matches the gene in commodity gene characteristics sets, for example, commodities' types, brand, price, color, the number of clicks, etc. Using vector expressed as: $P(n) = (f_1, f_2, \ldots, f_m), P\_(no) = (f_{11}, f_{12}, \ldots f_{ik} \ldots, f_{im})$ N for a solid commodity, such as notebook computer, f_m is the m numbers of the notebook computer's genes. P_no is the number of the product, f_{ik} is the value of k feature gene of gene. Each gene expressed in binary value, for example, if a product has a characteristic gene, its value is 1, whereas for 0.

104.2.2.2 Users' Preference Degrees for the Commodities Gene

According to the user's personal transaction record during a time and combined with commodity gene pool, we analyze the process of preferences to the commodities gene and use this preference to assign these characteristics gene. Then we can get the current users' preference for characteristic gene level to become the recommended basis of system. The method that making the commodity characteristics of gene according to the preferences of customers are as following:

$$\mathrm{UIP}_k^i = \frac{S_i}{\sum_{j=1}^{n} S_j} \tag{104.3}$$

UIP_k^i is the customer k's degree of preference for goods characteristic gene, we statistics the main good's commodity characteristics gene which is in the whole goods that customer k bought over a period of time. And UIP_k^i is the ratio that one feature of the goods customer bought in the general features of all commodities purchased. The larger the ratio is, the more preference the customers have. n represents the number of statistical goods characteristic gene and S_i is the quantity of one feature gene which is included in the goods that customer k bought for a certain period. Taking Table 104.1 as an example, then $\mathrm{UIP}_{001}^1 = 0.624$, $\mathrm{UIP}_{001}^2 = 0.237, \mathrm{UIP}_{001}^3 = 0.418$.

Through the analysis of the log customer bought, we use the formula (104.3) to calculate the various characteristics of preference degrees, and then based on the preference degrees to sort. In order to get accuracy calculation, in actual recommend, we can only take the feature that its' preference degrees in top i to recommend. Take an example, if the storing results that we calculated according to its' preference degrees value is: brand, price, weight… The preference degrees of the corresponding feature is 0.418, 0.624 0.2…After having the preference degrees those customers to one commodity's feature, we can produce the customer's products preferences mode.

$$\mathrm{UIP}_k = (\mathrm{UIP}_k^1, \mathrm{UIP}_k^2, \ldots, \mathrm{UIP}_k^n) \tag{104.4}$$

Finally we combine the customer's products feature preference mode, customer transaction record and customer individual archives then integrating and calculating them. At last building customer preference degree and preference mode candidate set.

$$C_k = (\mathrm{UIP}_k, CI_k) \tag{104.5}$$

Table 104.1 Products buy sheet of customer 001

C_no	*P_no*	F_{11}	F_{12}	F_{23}	…	F_{43}
001	A001	1	0	1	…	0
001	A002	1	1	0	…	0
001	A005	1	0	1	…	1

Table 104.2 Customer's candidate preference

	1	2	3	…	15	…
C_no	UIP^1_{001}	UIP^1_{001}	UIP^1_{001}	…	UIP^1_{001}	…
001	0.624	0.237	0.418	…	0.132	…

$$CI_k = \left(CI_k^1, CI_k^2, \ldots, CI_k^n\right) \tag{104.6}$$

C_k represents customer *k's* preference model, including UIP_k and CI_k, UIP_k is user *k's* product preferences mode (number *1–15*), CI_k is customer *k's* basic material and transaction record (numbers *15–21*), shown in Table 104.2. Customer transaction record is in the Table 104.3, its *C_no* for customer numbers that corresponding to the product number *P_no*, as well as the trading amount of products number *B_qty*, product transaction amount *B_mny* and transaction date *B_day*. Table 104.4 is customers' individual archives. it stores customers' personal information, including customers Numbers *C_no*, customer age *C_age*, customer member level *C_lv* and customer gender *C_sex*.

104.2.2.3 Selection of Best Neighbor Based on GA

When customers glance and buy things, the method will remember the kinds of goods which people are looking through and find the goods that people like in the sorts where the goods in. So that it can recommend to us. First, the method uses the *GA* to calculate the feature weight of customers. The importance of it is the work of improving the calculation and matching the mode. The main steps are as follows:

The Selection of Sample. Because the data in model library of customer preference is very large, and it will be uneconomical and inefficient if we put all of it to computer. Most systems choose the part of samples to random calculate. And the size of stocks is based on the features and the time cost of the problems because the large the samples are, the more the time which meets the convergence will be used.

The Aggregation of the Mode. Due to the difference of customers' age, sex, professional and so on, people have the different importance in feature weight about which goods they like. This article uses the *GA* to calculate the feature weight. K for the customer its feature weight is $W(k)$

$$W(k) = (W_{f1}, W_{f2}, \ldots, W_{fi}) \tag{104.7}$$

$W(k)$ is the collection of *K's* feature weight. W_{fi} is the feature weight of products. The status of its gene is expressed by binary. Every collection include i genes. $\text{pred}'(A, j)$ is the suitable function in this article. First, according to customers, we divide information into training group and test group. For each person in test group, we predict that its likeness to the product is as following:

Table 104.3 Customer record transaction table

C_no	*P_no*	*B_qty*	*B_mny*	*B_day*
001	A001	1	260	2008/11/03
003	A002	3	850	2009/02/06
005	A005	2	570	2008/10/07

Table 104.4 Customer registration information sheet

C_no	*C_age*	*C_lv*	*C_sex*
001	30	2	0
003	27	3	1
005	20	1	0

$$\text{pred}'(A,j) = \sum_{k=1}^{n} \text{similarity}(A,k)\text{vote}(k,j) \tag{104.8}$$

$$\text{pred}'(A,j) = \begin{cases} 1 & \text{If} \quad \text{pred}'(A,j) \geq 0 \\ -1 & \text{otherwise} \end{cases} \tag{104.9}$$

N is the neighbor number, vote *(k, j)* is customer *K's* likeness in purchasing to the product j. If K has bought the product, its value is 1, otherwise is -1. The similarity between A and K is following:

$$\text{Dist}(A,k) = \sqrt{\frac{\sum_{i=1}^{n} W_{fi} \times \left(C_A^i - C_k^i\right)^2}{\sum_{i=1}^{n} W_{fi}}} \tag{104.10}$$

$$\text{similarity}(A,k) = 1 - \text{Dist}(A,k) \tag{104.11}$$

A represents the customer online, K is the customer which mode selected and $k \neq A$. W_{fi} represents customer *A's* feature weight of its preference. When $W_{fi} = 0$, the feature will be ignored. C_A^i is a degree of likeness of the feature i which is involved in online customers' preference. And C_k^i is for the customer k. when calculate dist *(A, K)*, C_A^i and C_k^i must be treated normally.

According to the predicted likeness, we next calculate the predicted error:

$$\text{diff}(A,j) = |\text{pred}(A,j) - \text{vote}(A,j)| \tag{104.12}$$

This article selects some random products and calculates the customers' average predicted error diff (A) in every text group. We can view the average predicted error functions as customers' suitable function. If one person's suitable function is large than the critical value we defined, his feature weight will make further evolution and restart to figure out the value of his suitable function until it is smaller than critical value.

The Best Selection of Neighbor. After having customers' feature weight, we can use the formula (104.11) to know the degree of the similarity between one person and other customers and choose *N* neighbors who are most similar with him.

Recommend Products According to Preference and the Best Neighbor Group. According to the front of the individual user preference and commodity characteristics database, we get the recommend groups that meet users' interesting so that finish the personalized recommendation. At the same time, we use *GA* to discover near neighbor user to complete the socialization of the grooming process. For every customer, the strategy we adopted is to recommend the product that he never buys but has been bought by the *N* neighbors who is most similar with him. The more a product is purchased, the higher chance it should be to recommend. These products in accordance with the recommendations in order to score points, the recommended calculation is as following:

$$\mathrm{rec}(j,K) = \sum_{i \in TN(K)} \mathrm{similarity}(K,i) \times pc(i,j) \tag{104.13}$$

$$pc(i,j) = \begin{cases} 1 \\ 0 \end{cases} \tag{104.14}$$

Rec *(j, K)* is the recommended scores that product *j* for customer *K; TN* represents *N* neighbors who are the most similar with customer. We can use the way of fixed number of recommended or set a minimum recommended score to screening.

104.3 Experimental Results and Analysis

The data sets of this experiment used are provided by *M* company and the whole experimental data sets need to be further divided into training set and test set. Therefore, we introduced variable x said how much percent the training set has in data sets. For example, $x = 0.6$ says 60 % of the data collection as the training set and 40 % as the test set. In this paper, all the experiments using $x = 0.6$ as experimental basis.

In order to verify the function of the algorithm, we compare experiments with other algorithm in recommended shooting accuracy and the accuracy of user similarity algorithm. Main products are: commodity characteristics database, customer transaction records feature database, user personal information database, and user preferences model candidate database.

Use a single point for mating and its crossover is 0.7 and mutation rate is for 0.02. Per gene encoding uses binary of 8 bits to the experiment. We select pred' *(A,j)* as the adaptable function of this artic. After getting the customers' best feature weights, Similarity *(A, K)* is the Similarity between customer *A* and *k*. We can use the formula (104.11) to get the Similarity between one customer and other

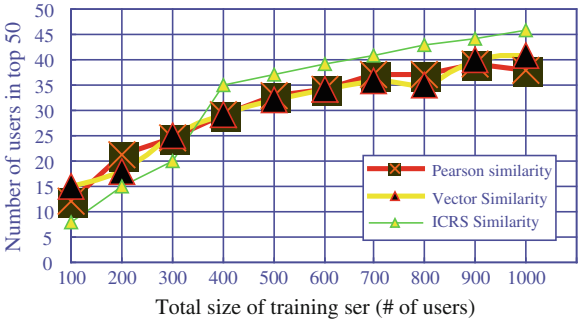

Fig. 104.1 The situation of the best user neighbor under the three algorithms

customers, and choose the most similar N neighbor. Finally, by (104.13) and (104.14), we can sure the recommended score of the product j for customer K. Then, according to the score points from high to low, we can have before i recommend commodities of results. We set the near list neighbor value which is greater than 0.5 as the best selection of standard. Under the same test samples and environment, comparing the *ICRS* algorithm, *Pearson algorithm* [5] and *Vector* algorithm in this paper, the ability about getting neighbor algorithm on the quantity and quality of users is as shown in Fig. 104.1.

In order to analyze the result of recommended, we introduce the concept of recommend shooting, defined as following:

$$\mathrm{RSP} = \frac{\sum_{i=1}^{n} C\mathrm{sum}_i}{\sum_{i=1}^{n} R\mathrm{items}_i} \tag{104.15}$$

Among them, i represent to recommend for i time, $C\mathrm{sum}_i$ represent the time that user click the recommended commodity in the recommend for the i times, $R\mathrm{items}_i$ said the number of recommended commodities for the i times, n represent the times for the current users recommended.

Comparison of traditional collaborative filtering algorithm *CF* and *ICRS* algorithm in this paper, after the recommended which is based on customs 'different number of purchasing records, we should statistics the recommend shooting of client. The results are in Fig. 104.2.

By analyzing the Fig. 104.2 we can see, with the increasing number of purchasing log and the users, the accuracy of two kinds of recommended methods is improving. But after 200, the accuracy in *ICRS* algorithm is obviously better than *CF* algorithm. When it is more than 800, the increasing trend of recommend shooting is not very obvious. It can be used as a reference when setting recommended parameter. On the other hand, with the increasing number of foundation recommendation of the reference group, the recommended accuracy has improved, but the rate of increase of it is also relatively small. By analyzing the causes, we know it is due to the increasing of the foundation recommendation of the reference

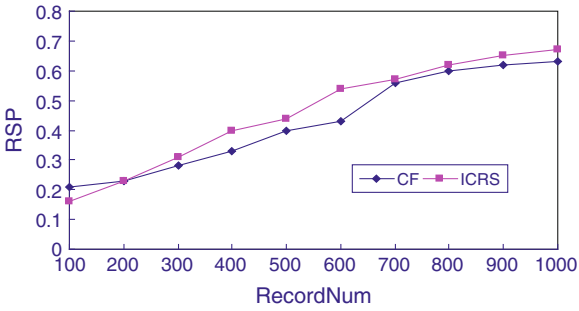

Fig. 104.2 Recommend shooting curve

group, which leads to the expanded of the feature scope and improve the precision of the recommended. Besides, it also expands the type of commodity in a certain extent and influences the precision of the recommended.

104.4 Conclusion

In the whole experiment, we make recommendations based on the commodity gene and see users' history data and current behavior of browsing as the part of the recommended basis. It perfects the shortcomings of the traditional recommendations. For example, new goods can be recommended to customers in time and the recommended accuracy is higher. At the same time, because of variations in customers' age, gender, profession, etc., there is difference in feature weight of certain goods' habits. This feature weight is influenced by users' preferances. This paper uses genetic algorithm to calculate its feature weights and decides on the best feature weights of individuals to respond to the different degrees of preferance for the goods. It reduces the effects of the above factors effectively. The genetic algorithm is used to determine the best features of individuals in response to different weights and to discover the importance of preferance characteristics of users of the optimal near shopping behavior patterns, carries on the relevant recommendation. It increases the coverage rate and the accuracy rate of the recommend results.

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Chapter 105
Improved Algorithm Based on Gaussian Mixture Background Model

Wei Wang, Xinyuan Yang, Sui Zong and Chenhui Wang

Abstract Aimed at the disadvantage that Gaussian mixture background model is seriously affected by the sudden light change, this paper presents an improved algorithm based on Gaussian background model. By adding two steps which are light judgment and background update into the algorithm, the algorithm can eliminate the affects of sudden light change. The results show that this algorithm can extract the actual background in sudden light change environment.

Keywords Background modeling · Gaussian mixture background model · Sudden light change

105.1 Introduction

Intelligent monitoring systems are often only interested in the foreground. To analyze the foreground accurately, we must first extract the foreground objects of interest. The foreground target detection separates a single or multiple moving targets from the complex background image in the image sequence. The Detect effect is important to the post-processing, such as target classification, tracking, and behavior understanding [1].

There are several methods to foreground target detection, such as frame differential method [2], Optical Flow [3], background subtraction [4], and Gaussian mixture background model [5]. Although the frame differential method meets the requirements of real-time moving objects, it is difficult to split moving object and

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it is not conducive to further analysis and recognition of objects. Optical flow computation formula is complex and amount of calculation is large, so it is not suitable for real-time demanding occasions. Background subtraction and Gaussian mixture background model method is susceptible to the influence of light.

To solve the above problems, this paper presents an improved Gaussian mixture background model algorithm. The method can solve the problem of the algorithm which is susceptible to the influence of light based on the Gaussian mixture background model.

105.2 Gaussian Mixture Background Model

Gaussian Mixture background model was first proposed in the literature [6] by Stauffer. The basic idea of Gaussian mixture background model is as follows: Establish K Gaussian models for each pixel. The number of K is generally 3–5. The larger the K value, the stronger the ability to deal with fluctuations. The speed is also slower accordingly. In these K Gaussian models, parts of them represent background and the other parts represent foreground. These five Gaussian models can be expressed by the following formulae (105.1):

$$f(X_t = x) = \sum_{i=1}^{K} \omega_{i,t} \eta\left(x, \mu_{i,t}, \sum_{i,t}\right) \tag{105.1}$$

In which $\eta\left(x, \mu_{i,t}, \sum_{i,t}\right)$ is the probability density of the i Gaussian distribution in time t. $\mu_{i,t}$ is mean value. $\sum_{i,t}$ is covariance matrix. $\omega_{i,t}$ is weight of the i Gaussian model in time t, and $\sum_{i=1}^{K} \omega_{i,t} = 1$. $\eta\left(x, \mu_{i,t}, \sum_{i,t}\right)$ is defined as follows:

$$\eta\left(x, \mu_{i,t}, \sum_{i,t}\right) = \frac{1}{(2\pi)^{n/2}\left|\sum_{i,t}\right|^{1/2}} e^{-\frac{1}{2}(x_t - \mu_{i,t})^T \sum_{i,t}^{-1} (x_t - \mu_{i,t})} \quad \mathrm{i} = 1, 2 \ldots \mathrm{k} \tag{105.2}$$

Using the Gaussian model to process grayscale images is easer than other images because n is 1. When processing color images with Gaussian model, in order to reduce computation, we can assume the color of each pixel in each frame R, G, B, are independent of each other, and have the same covariance, the covariance matrix is:

$$\sum_{i,t} = \begin{pmatrix} \sigma_r^2 & 0 & 0 \\ 0 & \sigma_g^2 & 0 \\ 0 & 0 & \sigma_b^2 \end{pmatrix}. \tag{105.3}$$

105.2.1 Initialization

In the model initialization process, we can calculate the mean μ_0 and variance σ_0^2 of each pixel of the image of a period of time in the video sequence.

105.2.2 Background Update

For each image, if the image meets the formula (105.1), then it matches with the Gaussian model.

$$\left|f_t(x,y) - \mu_{i,t-1}\right| \leq D_1 \sigma_{i,t-1}. \tag{105.4}$$

In which $\mu_{i,t-1}$ is the mean of Gaussian model of NO. i at time $t-1$, D_1 is the user-defined parameters, $\sigma_{i,t-1}$ is the standard deviation of Gaussian model of NO. i at time $t-1$.

There will be two cases when background updates.

Assume that the point match with No. i Gaussian model, and then update the weight, mean, and variance of this Gaussian model.

Assuming that the point does not match any Gaussian model, the update steps are as follows:

Establish a new Gaussian distribution which mean is $f_t(x,y)$, and then take a larger variance σ_0^2 and smaller weights ω to this distribution.

Remove one which weight value is minimum from K Gaussian distribution, and replace with the new Gaussian distribution

Update the weight of other Gaussian distribution using formulae (105.5)

$$\omega_{i,t} = (1-\alpha)\omega_{i,t-1}. \tag{105.5}$$

105.2.3 Background Distribution Judgment

Sort these K Gaussian distributions by $\omega_{i,t}/\sigma_{i,t}$ from largest to smallest. Select the sequence in the first M Gaussian distribution as background pixel model.

$$M = \arg_M \min\left\{\sum_{i=1}^{K} \omega_{i,t} > T\right\} \tag{105.6}$$

In which T is threshold. M means that the first M Gaussian distributions in all distributions after sorting are the best described of background pixel.

105.3 Gaussian Mixture Background Model Improved Algorithm

The main disadvantage of the Gaussian mixture background model is that it cannot handle the light mutation. This paper presents an improved algorithm for Gaussian mixture background model to solve the problem. The algorithm is divided into two parts: light judgment, and background update.

105.3.1 Light Judgment

Usually light change is divided into two categories: slow change and sudden change. Gaussian mixture background model is able to detect foreground in the slow changes. But it cannot detect foreground in the sudden change. Because the gray values are very different between two frames, and a lot of background area is detected as the foreground. This requires light judgment. It includes two aspects:

1) Whether there is a sudden light change
2) The scene is brighter or darker.

105.3.2 Sudden Light Change Determine

It has two cases using Gaussian background model to detect foreground in sudden light change. One is that the number of foreground is very large. The other is the area of the foreground is very large, usually the foreground area and the image area are almost as large as. Because of these characteristics, this paper uses judging the number and area of the foreground of to determine the sudden light change. Suppose that F is the foreground of a binary image extracted from the Gaussian background model, W is the width of the image, H the height of the image, S is the area of the foreground, N is the number of the foreground of a binary image. If S and N satisfy formulas (105.7) or formulae (105.8), then there is a sudden light change.

$$S > T_1(W \times H) \tag{105.7}$$

$$N > T_2 \tag{105.8}$$

In which T_1 and T_2 are user-defined threshold. S can be obtained by following formula (105.9):

$$S = \sum_{i=0}^{W-1} \sum_{j=0}^{H-1} F(i,j)/255 \tag{105.9}$$

In which H, W are the image width and height. N can be obtained by calculating the number of connected regions in the image and the specific approach can use image growth method. Selecting a white pixel in the image and the growth region of the white pixels is a foreground. If F does not satisfy the formulas (105.7) and (105.8), then there is not a sudden light change. If F satisfies (105.7) or (105.8), indicating that there is a sudden light change and need to judge the way of sudden light change.

105.3.3 Judge the Way of Sudden Light Change

Judging the way of sudden light change is a very important step of the algorithm, and it laid the foundation for the next background update. When the image is bright, the corresponding point in the image gray value is correspondingly larger. When the image is darkened, the image corresponds to the gray value is correspondingly smaller. Suppose $f_t(x,y)$ is the image of the current frame when the light change, then

$$\text{avg}_1 = \frac{\sum_{i=0}^{W-1} \sum_{j=0}^{H-1} f_t(x,y)}{W \times H} \tag{105.10}$$

$$\text{avg}_2 = \frac{\sum_{i=0}^{W-1} \sum_{j=0}^{H-1} f_{t-1}(x,y)}{W \times H} \tag{105.11}$$

In which $f_{t-1}(x,y)$ is the last frame image. avg_1 and avg_2 are the average gray value of the current frame and last frame. H and W are the height and width of the image. If avg_1 and avg_2 satisfy the formula (105.10) and (105.11), then light brighten, otherwise light dims.

$$\text{avg}_1 > \text{avg}_2 \tag{105.12}$$

In the actual calculation process, the summation of image pixel gray value is large, so algorithm uses the method of gray value normalization. The formula (105.10) and (105.11) can be replaced by formula (105.13) and (105.14).

$$\text{avg}_1 = \frac{\sum_{i=0}^{W-1} \sum_{j=0}^{H-1} f_t(x,y)/255}{W \times H} \tag{105.13}$$

$$\mathrm{avg}_2 = \frac{\sum_{i=0}^{W-1}\sum_{j=0}^{H-1} f_{t-1}(x,y)/255}{W \times H} \tag{105.14}$$

105.3.4 Light Update

When there is a sudden light change, the original background is useless. In this case, the traditional Gaussian model need a period of time to study, then it can calculate the background of current scene, but at this time a lot of frames of data have been lost. So the background which is calculated by the original Gaussian background model needs to be updated immediately to meet the scene after sudden light change.

Suppose B is the background that is calculated by Gaussian model and B' is the Background obtained by this method. If the scene is from dark to light, then:

$$B' = \mathrm{Min}(B + |\mathrm{avg}_1 - \mathrm{avg}_2|, 255) \tag{105.15}$$

Otherwise:

$$B' = \mathrm{Max}(B - |\mathrm{avg}_1 - \mathrm{avg}_2|, 0)\cdot \tag{105.16}$$

The background B' calculated by the formula (105.15) or (105.16) is able to make appropriate adjustments quickly based on the background lighten or darken. Then using the background subtraction that B' with the current image difference to get current foreground.

105.4 Experimental Results and Analysis

In order to confirm the validity of the algorithm, this paper tested the algorithm shown in Fig. 105.1.

In which Fig. 105.1a is the 368 frame to 371 frame in a video sequence. Figure 105.1b is the background obtained by using traditional Gaussian mixture background model. Figure 105.1c is the foreground obtained by using traditional Gaussian mixture background model. Figure 105.1d is the background obtained by using the method in this paper, Fig. 105.1e is the foreground obtained by using the method in this paper.

From the test results it can be seen that when using the traditional Gaussian mixture background model, there is a sudden light change in the 369 frame to 370 frame, because the background image did not change timely, it is still the background of the lighter moments of the environment, and the background of current frame already dark, there is a large foreground area in the foreground image of the 370 frame to 371 frame.

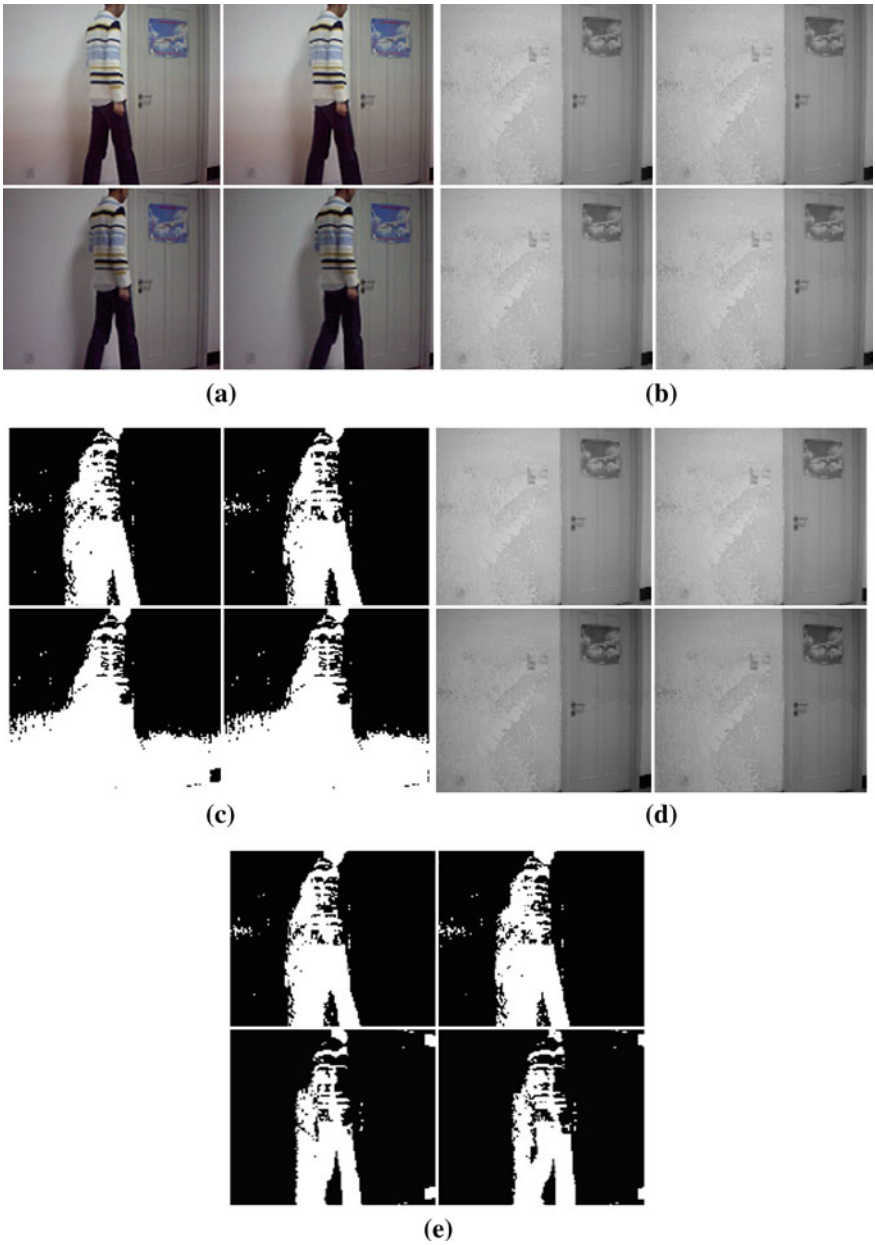

Fig. 105.1 Test effect drawing after improvement

Using this method, the background model detected that there is a sudden light change in the 369 frame to 370 frames, and knew that light turn bright to dark, so the background timely changed. So the foreground obtained by using background

subtraction has also been good results. From 370 frame to 371 frame, we can see that the legs of the person or even the whole body had already been extracted from the background.

105.5 Summary

In this paper, Gaussian mixture background model algorithm has been improved by adding light judgment and background update. The experimental results show that the improved model can well eliminate the sudden light change in the foreground target detection and the update of improved model can reflect the current scene timely.

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Chapter 106
Particle Filter-Based Target Tracking in Gaussian and Non-Gaussian Environments

Tanglin Xie, YiKang Yang and Xue Li

Abstract Particle filter is a new filtering method based on Bayesian estimation and Monte Carlo method and effectively copes with complicated nonlinear and/or non-Gaussian problem. The basic idea of particle filter and the specific algorithm description of particle filter are presented. The particle filter is introduced to radar tracking based on the gaussian noise and glint noise statistical models. The Monte Carlo simulation results show that the particle filter have almost the same tracking accuracy in gaussian and glint environments. With the glint effect increasing, the particle filter has also the good accuracy.

Keywords Traget tracking · Particle filter (PF) · Gaussian noise · Glint noise

106.1 Introduction

The radar target tracking model is nonlinear under the Cartesian coordinate system. The filtering algorithms of nonlinear problems are EKF and UKF [1], but these algorithms require the observation and process noise for independent or related to the white Gaussian noise. Practical situation is due to the scattering

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properties of the target. Radar observation noise is not the gaussian white noise but glint noise of long tail, so the above algorithms in practical applications are flawed. In recent years, with the development of computing power and statistical theory, the particle filter algorithm has been a rapid development, the particle filter algorithm has shown strong vitality in dealing with nonlinear and non-Gaussian problems, and this paper introduces the basic idea and algorithm steps. On the basis of the statistical model of glint noise of radar measurements, we use the particle algorithm under the conditions of glint noise to study simulation of radar target tracking.

106.2 Particle Filter Algorithm

The nature of the PF algorithm is the integration into a summation of the limited sample points, that is, the state probability distribution is the approximate representation by the following empirical probability distribution:

$$\hat{p}(x_{0:k}|z_{1:k}) = \frac{1}{N}\sum_{i=1}^{N}\delta_{x_{0:k}^{i}}(\mathrm{d}x_{0:k}) \tag{106.1}$$

While, $p(x_k|z_{1:k})$ shows the probability density of x at the observation sequence of z. Generally, it is hard to get samples from $p(x_k|z_{1:k})$. An effective solution is the introduction of an easy sample of known probability density function $q(x_{0:k}|z_{1:k})$. Where, the choice is a very critical issue, and selecting one of the principles is the importance of the weight of minimum variance. We extract weighted particles of N from the $q(x_{0:k}|z_{1:k})$. When receiving new observational data, we update the weight of each particle in real time. As time increases, the distribution of importance weights become more and more inclined, and there may be a lack of particle phenomenon. In order to avoid particle scarce, Gorden, who proposes resampling method, and its main idea is to remove the weights of small particles, and copy the right value of particles. Finally, the probability density function of updating can be expressed as

$$p(x_k|z_{1:k}) \approx \sum_{i=1}^{N} w_k^i \delta(x_k - x_k^i) \tag{106.2}$$

The specific steps of the PF algorithm are as follows:

106.2.1 Initialization k = 0

Sample $x_0^i \leftrightarrow p(x_0)$, according to the distribution of sampling $p(x_0)$, we can get $x_0^i, i = 1, 2, \cdots, N$.

106.2.2 The Calculation of the Importance Weights

Set $k := k + 1$, and sample $x_k^i \leftrightarrow q(x_k|x_{0:k-1}^i, z_{0:k}), i = 1, 2, \cdots, N$. Calculate the importance weights

$$w_k^i = w_{k-1}^i \frac{p(z_k|x_k^i)p(x_k^i|x_{k-1}^i)}{q(x_k^i|x_{0:k-1}^i, z_{0:k})}, i = 1, 2, \cdots, N \tag{106.3}$$

Normalize the importance weights $\tilde{w}_k^i = w_k^i / \sum_{j=1}^{N} w_k^j$.

106.2.3 Resampling

According to the importance weight $\tilde{w}_k^i$ from the collection of the $(x_k^i; i = 1, 2, \ldots, N)$, resample and get the collection of N particles. Re-distribute the particle weights $w_k^i = \tilde{w}_k^i = 1/N$.

106.2.4 Output

State estimation: $\hat{x}_k = \sum_{i=1}^{N} w_k^i \tilde{x}_k^i$.

Estimate of variance: $p_k = \sum_{i=1}^{N} w_k^i (\tilde{x}_k^i - \hat{x}_k)(\tilde{x}_k^i - \hat{x}_k)^T$, then return the step (106.2).

106.3 The Target Tracking of Radar

106.3.1 The Description of the Problem

Consider the general radar target tracking problem. Suppose the objective makes the uniform linear motion. The position of radar is (x_0, y_0).

The equation of state [2] is:

$$X(k) = FX(k-1) + \Gamma w(k-1) \tag{106.4}$$

Where, F is the state-transition matrix. Γ is the process noise drive array. $w(k-1)$ is the process noise. $X(k) = [x(k), \dot{x}(k), y(k), \dot{y}(k)]^T$ is the target state vector.

The observation equations of radar is

$$Z(k) = h(X(k)) + v(k) \tag{106.5}$$

Where,

$$h(X(k)) = \begin{bmatrix} \sqrt{(x(k) - x_0)^2 + (y(k) - y_0)^2} \\ \arctan\left(\frac{y(k)-y_0}{x(k)-x_0}\right) \end{bmatrix} \tag{106.6}$$

$v(k)$ is the observation noise. Ideally the observation noise is zero mean Gaussian white noise, while the actual situation is glint noise.

106.3.2 Gaussian Noise and Glint Noise

The main difference of them is that the tail of gaussian noise is longer, glint noise distribution, and Gaussian distribution in the central region is similar to the Gaussian shape. The glint noise makes "QQ-plot" analysis in literature [3] of record, and the radar glint noise can be decomposed into Gaussian noise and the noise of the " thick tail " characteristics. Commonly used in the "thick tail" distribution is the Laplace distribution, t distribution, uniform distribution, the big variance of the Gaussian distribution. Glint noise probability density function can be expressed as

$$p(w) = (1 - \varepsilon)p_G(w) + \varepsilon p_t(w) \tag{106.7}$$

where, $p_G(w)$ is gaussian density function; $p_t(w)$ is the "thick tail" function; $\varepsilon \in [0, 1]$ indicates the strength of the glint effect.

106.4 Tracking Algorithm

For the above two measurement noise circumstances, we use the PF algorithm to track the target. The simulation focuses on the glint noise of the target tracking. For the glint noise, we use gaussian noise of different variances to set models, and glint noise probability density function can be expressed [4] as

$$p(w) = (1 - \varepsilon)N(w; \mu_1, p_1) + \varepsilon\, N(w; \mu_2, p_2) \tag{106.8}$$

$N(w; \mu_t, p_t)$ shows the Gaussian distribution at the probability density w, and the mean value is μ_t, the variance is p_t. A second-order distance of the glint noise is

$$\mu = E(w) = (1 - \varepsilon)\mu_1 + \varepsilon\mu_2 \tag{106.9}$$

$$P = E((w-\mu)(w-\mu)^T) = (1-\varepsilon)p_1 + \varepsilon p_2 + \tilde{P} \tag{106.10}$$

where, $P = (1-\varepsilon)\mu_1\mu_1^T + \varepsilon\mu_2\mu_2^T - \mu\mu^T$.

106.5 The Analysis of Simulation Results

Assuming that the target makes uniform motion in two dimensions, the initial position is (50, 50) km and the initial rate is (0.3, −0.1) km/s. The radar lies in the origin of the coordinate, and the number of particles is N = 300, and sampling period is 1 s. We sampled 100 times. For two observation noises, using the PF algorithm makes 100 times Monte Carlo simulation respectively, and get the mean square error of the location and speed.

106.5.1 Gaussian Noise

The observed standard deviation of Radar is 50 m. Observation standard deviation of azimuth is 1°, Fig. 106.1 shows the real target motion trajectory and estimated trajectory of the PF algorithm.

106.5.2 Glint Noise

The case of glint noise, observation standard deviation of thermal noise is 50 m, the observation standard deviation of azimuth is 1°. Observation standard deviation of glint noise is 50 m; the standard deviation of azimuth is 5°. Figures 106.2 and 106.3 show the case of different intensity of flashing utility using the PF

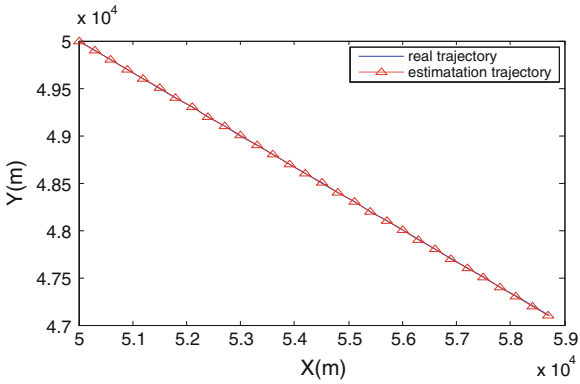

Fig. 106.1 Particle filter to the target tracking of Gaussian noise condition

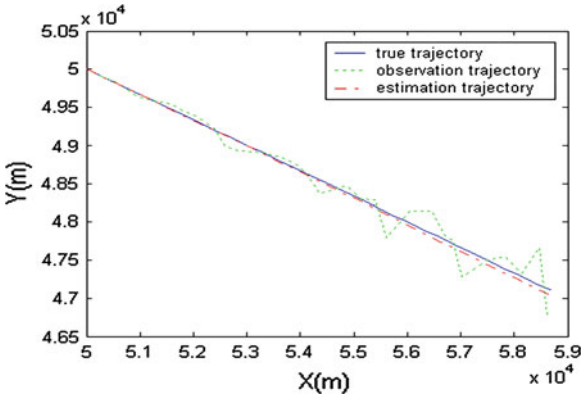

Fig. 106.2 The PF algorithm to the target tracking of $\varepsilon = 0.1$

algorithm shows the true trajectory of the target movement, the observed trajectory, and estimated trajectory.

106.6 Summary

From the simulation results we can draw that both in the case of Gaussian noise and glint noise, the PF algorithm can make very good tracking of the target. From Figs. 106.2 and 106.3, we can conclude that the glint effect enhances, the error of PF algorithm slightly increases, but the performance remains basically unchanged. When the glint effect enhances, it will inevitably leads to larger measurement errors. Therefore, the tracking performance of the PF algorithm to change almost, but due to the flicker effect only takes up a small part. The change is not very obvious. Therefore, the PF algorithm can deal with non-Gaussian problems, and has superior performance.

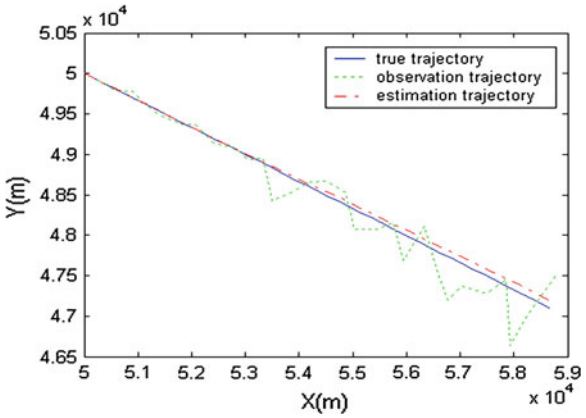

Fig. 106.3 The PF algorithm to the target tracking of $\varepsilon = 0.2$

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Chapter 107
A Delay-Constrained Multicast Routing Algorithm Based on the Ant Colony Algorithm

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Abstract With the rapid popularization of Internet and the rapid development of some high-bandwidth applications, there have been many new communication services, such as video on demand, e-mail blasts, online games, distance learning, video conference, and so on. Such applications consume amounts of network resources significantly, and have a higher quality of service requirements by multiple users. Multicast is an effective way to reduce network bandwidth consumption and increase data transmission efficiency of communication in which such applications has been widely used. The problems of QoS multicast routing which research how to better realize the multicast function to meet the demand of service quality become a research hotspot. This paper researches and analyzes algorithm based on ant colony algorithm and delay-constrained multicast routing.

Keywords Multicast · Communication · Applications · Delay-constrained

107.1 The Mathematical Description for the Problem of a Delay-Constrained Multicast

Let $G = (V, E)$ express the network which V is the nodes set, E is the link set between the nodes set, and $s \in V$ is the multicast source node, $M \subseteq \{V - \{s\}\}$ the node set for the multicast source. Is R_+ the real numbers set? Is R^+ the non-negative real numbers set? For any link $e \in E$, there are two positive real numbers weighted value delay(e) and cos $t(e)$ corresponding to the link, they respectively

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express the link delay and costs. For any two nodes (a, b) in V $P(a, b)$ express the path between two nodes (a, b), the delay function and cost function of the path $P(a, b)$ are calculated as follows:

$$\text{delay}(a, b) = \sum_{e \in P(a,b)} \text{delay}(e) \tag{107.1}$$

$$\cos t(a, b) = \sum_{e \in P(a,b)} \cos t(e) \tag{107.2}$$

In *QoS* transmission of multimedia real-time services, multicast routing based on delay-constrained optimization problem can be described as: Given the network delay, find all multicast tree $T = (V_T, E_T)$, $T \subseteq G$ that from the source node s to destination node, $P_T(s, t)$ express the routing path of multicast tree T that the source node s to the multicast tree destination node t, multicast tree T satisfying the following conditions:

$$\text{Max}(\text{delay}(P_T(s, t))) \leq \text{delay} \tag{107.3}$$

$$\cos t(T) = \min\left(\sum_{e \in E_T} \cos t(e)\right) \tag{107.4}$$

In Eq. 107.3, the delay is the upper limit which is allowed for real-time business, therefore, delay constrained multicast routing problem is to satisfy the delay constraint real conditions, looking for multicast tree that the cost is the minimum form a source node to multiple destination node.

107.2 LDT Algorithm

LDT algorithm (Least-Delay Tree) is the minimum delay tree algorithm which is proposed by salama. The algorithm uses Dijkstra algorithm to calculate the shortest path from source to each destination node, the shortest delay path, and then merge the same link to obtain the delay constraint multicast tree. As LD algorithms use Dijkstra shortest path algorithm, so the time complexity is $O\left(|V|^2\right)$. Multicast tree obtained by this algorithm costs more, because it considered the delay end to end, without considering the cost sedge. LD algorithm is suitable for demanding real-time business, because the multicast tree obtained by the algorithms, from the source node to destination node is the shortest delay. Obtained multicast tree by this algorithm, called the minimum delay tree LDT. In many multicast routing algorithm, it is often first to use the minimum delay tree to determine whether there is solvable.

As such heuristic algorithm is not efficient, high time complexity is not suitable for modernization large-scale network. In recent years, some scholars introduce artificial intelligence methods to optimize spanning tree, and now the study of artificial intelligence methods are genetic algorithm, neural network, Ant colony algorithm, immune algorithm, immune clonal selection algorithm, for example, Ravikumar proposed a routing algorithm based on genetic algorithms, which is minimum cost for the delay constrained multicast routing problem. Sun Lijuan proposed a method using ant colony algorithm (GAACS) to solve the QoSmulticast routing problem, which is combined genetic algorithm and ant colony, but the convergence rate is not satisfactory [1]. The global search capability of the artificial immune algorithm is better than genetic algorithm, that the points in the function optimization problem has been well reflected, Liu Fang proposed a Routing algorithm based on cloning strategy [2], which is aimed to multicast routing with delay constraint problem. When the intelligent algorithm continues to mature, intelligent algorithms have a very broad prospects in the future QoS multicast routing. In this paper, ant colony algorithm for multicast routing algorithm described in detail, and using MATLAB software to program for simulation experiment.

107.3 Introductions for Ant Colony Algorithms

107.3.1 The Basic Principle of Ant Colony Algorithm

Ant colony algorithm (ACA) is the people study group behavior in the ant colony, and first proposed by the Italian scholar Dorigo, it is the simulation algorithm of a population-based evolutionary [3]. The algorithm solves some practical problems by simulating the process of ants searching for food. Ant could find the shortest path from the nest to food source without any indication, and can change with the environment, and then search for new paths, new choices. Ant finding the shortest path from the nest to the food source is through a positive feedback mechanism to implement, a single ant walking along the road left some volatile secretions called pheromones, these substances can be sensed by the later the same Ant colony, and as a signal to effect those who walk the path, embodied in the post to the ants choose the path with these substances is more likely than choose the path without these substances, and then to the pheromone left by the original pheromone will be strengthened, and so the cycle continues. In this way, the path through the more ants, ants in the post-selection to more likely be selected, because the residual pheromone is the larger reason. Because in a certain period of time, the shorter path is visited by the more ants, so the accumulation of the pheromone is more, the next time selected by other ants, the greater the likelihood that this process will continue until all the ants select the shortest path to go so far [4].

107.3.2 Delay Constrained Multicast Routing Algorithm Based on the Ant Colony Algorithm

Delay constrained multicast routing problem in essence, when the constraints are met, the search for the minimum cost multicast tree from the source to multiple destination. There are many scholars who study the problem of delay constrained multicast routing, and proposed a number of algorithms. This paper describes the ant colony algorithm based on delay constrained multicast routing algorithm (ACA).

107.3.3 Fitness Function

Fitness function is the basic for searching road of ant colony algorithm, which is the probability that ants choose the jth path in a alternative path set Ω_i.

$$f(P_i) = \frac{\text{phe}_{P_j(s,D_i)}}{\sum\limits_{P_j \in \Omega_i} \text{phe}_{P_j(s,D_i)}} \tag{107.5}$$

And $\text{phe}_{P_j(s,D_i)}$ is the discharge intensity of the path $P_{j(s,D_i)}$ indicating that a greater discharge intensity of the path is the greater probability of being selected [5].

107.3.4 Adjusting of Ant Colony Algorithm

When ant colony searches road, they adjust the path information according to the following rules:

Adjusting the pheromone on routes in which the ant pass, a is a constant parameter, l is the cost of the path, $\text{phe}_{P_j(s,D_i)}$ is the discharge intensity from the source s to the destination node D_i on the path adjusted

$$\text{phe}_{P_j(s,D_i)} = \text{phe}_{P_j(s,D_i)} + \frac{a}{l} \tag{107.6}$$

Information of the formula to adjust is not fixed, but according to the cost of selected path to adjust, it not only increase the information adaptive adjusts, but also the convergence speeds [5].

When all ants finish one path, adjust the volatile secretions of all paths, ρ is the volatility, and Δ is the initial information strength on each path.

$$\begin{cases} \text{phe}_{P_j(s,D_i)} = (1-\rho)\text{phe}_{P_j(s,D_i)} & \text{phe}_{P_j(s,D_i)} > 0.5\Delta \\ \text{phe}_{P_j(s,D_i)} = 0 & \text{otherwise} \end{cases} \tag{107.7}$$

When ants found the entire destination nodes to form a multicast tree, and then adjust information as following equations, that is,

$$\mathrm{phe}_{P_j(s,D_i)} = \mathrm{phe}_{P_j(s,D_i)} + \frac{B}{\cos t(T)} \tag{107.8}$$

Among of them, B is constant parameters, $\cos t(T))$ is the cost of the multicast tree, and $\mathrm{phe}_{P_{j(s,D_i)}}$ is selected path [5].

107.3.5 Algorithm Description

The algorithm steps are as follows:

Step 1: generates alternative path set: Using depth-first algorithm derived effective path from the source node s to each destination node $D_i(i = 1, 2 \cdots, m)$ which met the delay constraint, and construct the alternate paths set Ω_i.

Step 2: initializes the information intensity Δ of the entire path for a, B, ρ, M and alternative set Ω_i.

Step 3: sent M ants from the source point, according to formula (107.5), calculate the fitness of each path on path set Ω_i, then the ants choose a path according to roulette wheel rule, and use the formula (107.6) to adjust the discharge strength.

Step 4: When the ants have completed a path selection, according to formula (107.7) to adjust discharge volatile.

Step 5: Repeat Step 3 and Step 4, until all the ants find the path to the destination node, each ant's path to be found compose a multicast tree. Calculate the cost of the multicast tree (the cost of the same link only once), to determine whether most of the ants converge to the same multicast tree, if it is the multicast tree is the optimal path, exit the program: otherwise with the minimum cost multicast tree instead of the maximum cost multicast tree, turn the Step 6 implementation.

Step 6: ants return to the original way, according to the formula (107.8), adjust the discharge intensity on return path and then turn Step 3 implementation.

107.3.6 Simulation Results and Algorithm Analysis

Use Matlab software to applied Delay constrained multicast routing algorithm program based on ant colony algorithm proposed in this paper, in order to facilitate comparison, the choice of network topology model is the same with Ref. [6], as shown in Fig. 107.1. The source node of topology is 1, the destination node is

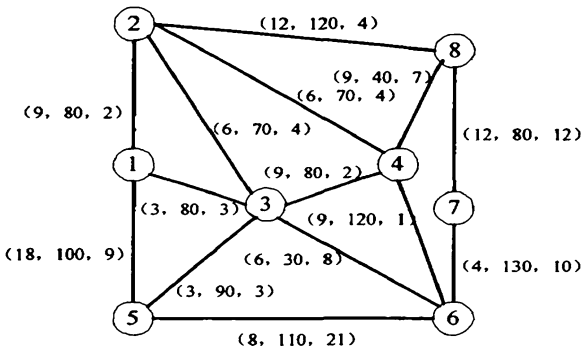

Fig. 107.1 8-node network topology

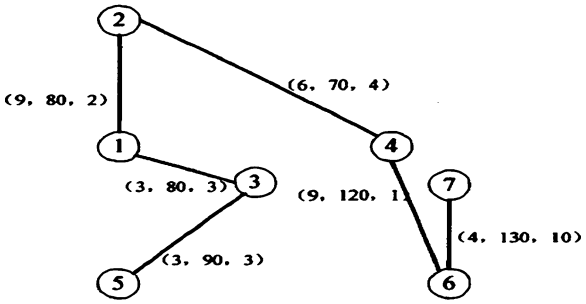

Fig. 107.2 The optimal multicast tree for the algorithm

2,4,5,7. The values on each edge respectively delay, bandwidth, cost in figure were all expressed by (D_{ij}, B_{ij}, C_{ij}), its value is randomly given.

In the simulation, when the minimum bandwidth constraint is $B = 70$, delay $D < 46$, in accordance with the basic process of ant colony algorithm, first the bandwidth requirements of the system, delete the link 3–6, 4–8 to simplify the network, increase speed, according to the process of algorithm, using mat lab to write the delay constrained multicast routing algorithm program based on ant colony algorithm, run to solve the optimal multicast tree shown in Fig. 107.2.

For the problem of Network topology multicast routing in Fig. 107.1, the result of multicast routing algorithm based on delay constrained genetic algorithm is shown in Fig. 107.3, and using the ACA algorithm for this multicast tree, get the results as shown in Fig. 107.4. Graph shows the simulation results, ACA algorithm makes the multicast routing algorithm converge to the optimal in the computer network when the ninth generation, compared to multicast routing based on genetic algorithms graph algorithms, ACA algorithm convergence and stability are greatly improved, but when the network size is relatively large, large number of nodes, due to the presence of information evaporation coefficient ρ, so that those who have never been on a search for the solution to the amount of information will be reduced close to 0, reducing the global search ability, but ρ is too large, the amount of information increases, the possibility exists that solution is searched before it will be choose again, it will also affect the global search capability.

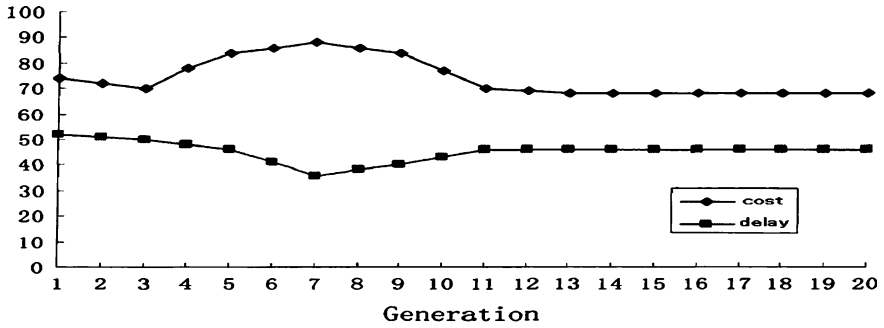

Fig. 107.3 Delay and cost curve changes with the algebraic of the optimal multicast tree based on genetic algorithm

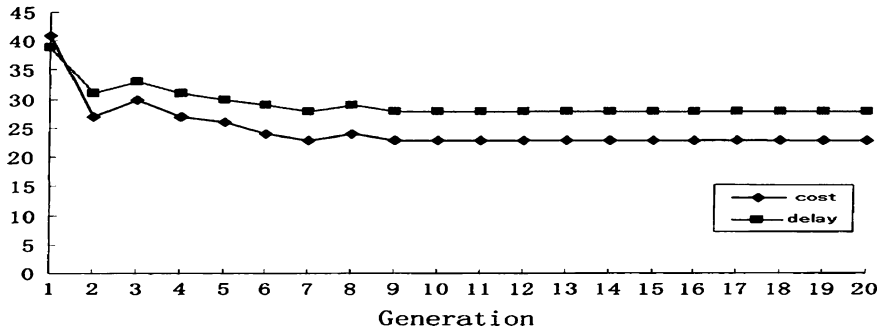

Fig. 107.4 Delay and cost curve changes with the algebraic of the optimal multicast tree based on ant colony algorithm

Although it can improve the global search capability by reducing ρ, but the convergence rate will decrease. The more the number of ants, the global search ability is stronger, but the number of ants increases, the convergence will slow down. And under the same number of ants, the problem size increases and the global search ability reduces. The biggest flaw of ant algorithm is easy to fall into local optimal solution and convergence speed slowly [5]. Therefore, delay constrained multicast routing algorithm has its own unique advantages based on ant colony algorithm, but also has its own disadvantages.

107.4 Conclusions

Ant colony algorithm is a novel simulated evolutionary algorithm for solving complex combinatorial optimization problems where it provide a new way of thinking. Ant colony algorithm is by selecting the strategy, local search,

information adjusted to solve the optimization problem. Local information to adjust can expand the search space, so it is conducive to find the global optimum. The adjustment of the global information can speed up the convergence. Ant colony algorithm is paid more mention in combinatorial optimization, and achieves good results in many practical applications. Taking into account of the larger time complexity of ant colony algorithm operations, the calculation takes a long time, now there are many scholars studied to develop some new algorithms to improve the ACA algorithm.

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Chapter 108
An Improved Discrete Particle Swarm Optimization Algorithm

QingFeng Liu

Abstract Evolutionary algorithms solve complex identification problems because they do not take into account any constraint on the cost function and more flexibility is offered when the model structure is chosen and the cost function is minimized. Step input-based identification has been developed, which could be used to determine the transient behavior of a system rapidly. In this paper, a new discrete particle swarm optimization (DPSO) algorithm is presented and the performance of this algorithm for solving identification problems is compared with the GA. The obtained results demonstrate that the proposed DPSO algorithm performs rather well in terms of speed (FNGC) and reaching to the minimum cost.

Keywords Genetic algorithm · Particle swarm optimization algorithm · DPSO

108.1 Introduction

One of the first steps in many technological areas consists of building a mathematical model. For instance, in process control, modeling crucially influences on quality control. So building a linear or nonlinear model is common and often difficult problem [1]. Since most processes possess dead time, the problem of constructing control algorithm that are capable of handling dead time is a key issue in process control. Powerful dead-time compensation methods are available in the literature for processes. These methods have been motivated by the pioneer work of Smith, who developed the well-known Smith predictor. There have been many

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modifications and extensions of the original form of the Smith predictor [2]. In a good model case, the merits of the Smith predictor include the ability of improving the performance and of disregarding the dead time caused by the characteristics of a closed-loop system. But, to apply the Smith predictor effectively, the model must be matched with a real system. If the model is mismatched with the system, the Smith predictor will be difficult to apply in the real world. Thus, system identification is very important in time-delay systems [3]. System identification consists of two tasks [4]. The first task is structural identification of the equations and the second one is an estimation of the model's parameters. In control engineering, system identification is used to find a model of the plant to control.

108.2 Previous Works

Several typical identification methods based on step tests are used in industry. Most of them result in first-order plus dead-time models such as

$$Y(s) = \frac{K}{Ts+1} e^{-Ls} U(s) \tag{108.1}$$

which describes a linear monotonic process quite well in most chemical processes and HVAC processes and is often sufficient for PID controller tuning, However, for plants such as mechanical systems whose behavior is very different from first-order plus dead-time processes, "(108.1)" is not adequate and these identification methods should not be used. Instead, these plants should be modeled as second-order plus dead-time processes. The input parameters for the identification of the second-order plus dead-time system consist of four parameters as seen in (108.2). Four input parameters as seen in (108.3) are represented as down-to-four-points of real-number.

$$Y(s) = \frac{K}{T_1 s^2 + T_2 s + 1} e^{-Ls} U(s) \tag{108.2}$$

$$S_i = \{K_i, T_{1i}, T_{2i}, L_i\} \tag{108.3}$$

108.3 Genetic Algorithm

The genetic algorithm (GA) acts on the "survival-of-the-fittest" Darwinian–Wallace principle that emulates natural selection and genetics. A GA searches the solution space in parallel, evaluating a population of potential solutions. It is particularly effective in approaching the global optimum in a noisy, poorly understood, and/or non-differentiable search space. In order to apply GAs in systems identification, each individual in the population must represent a model of

the plant and the objective becomes a quality measure of the model by evaluating its capacity of predicting the evolution of the measured outputs. The measured output predictions, inherent to each individual i is compared with the measurements made on the real plant. The obtained error is a function of the individual's quality. As less is this error, as more performing the individual is. There are many ways in which the GAs can be used to solve system identification tasks. The main tendencies are described in [5].

108.3.1 Chromosome Representation

Encoding of the chromosomes for the GA model is an essential factor in the success of a GA as it will affect not only the efficiency and performance of the GA, but also the speed and quality of the final result. Therefore to have a good quality feasible estimation, a lot of effort must be spent in selecting the most suitable chromosome representation estimated system that should contain all the information about the solution. It represents, in this case, a feasible estimation with good quality. For system described by (108.1), a chromosome consists of three or four genes depending of proposed system. These genes are process gain, time constant(s), and dead times, respectively.

108.3.2 Genetic Operators

The genetic operator for the GA tool is defined in following sections:

Selection. Among the N_{pop} chromosomes in a generation, only the top N_{Keep} with the lowest cost will survive to the next generation and $N_{\text{pop}} - N_{\text{Keep}}$ offspring will be born to replace the discarded chromosomes. We use natural selection for selecting N_{Keep} chromosomes and keep 50 % ($X_{\text{rate}} = 0.5$) in the natural selection process. In this paper for selecting each parent, Tournament selection is used.

Crossover. Two types of crossover are applied here as follows:

(1) Uniform crossover (UX)
(2) Modified uniform crossover (MUX)

Generally for the binary encoding scheme, it has been shown that the uniform crossover is more effective for many problems especially for numerical optimization problems. For improving UX operator performance, the bits in parent 1 are compared with the corresponding bits in parent 2.

Mutation. Mutation has traditionally been regarded as a secondary operator for GAs. For numerical optimization, real number encoding coupled with adequate mutation operators can perform at least as well as binary encoding. On the other hand, mutation is the second way in which GA explores a cost surface.

108.4 Discrete Particle Swarm Optimization Algorithm

As mentioned above, discrete particle swarm optimization (DPSO) is derived from bird flocking or fish schooling simulation. When solving function optimization problems, the solution of the problems corresponds to the position of the bird, which is called as "particle". Each particle has its own space position and flying velocity to move in the search space. Every particle memorizes and tracks the current best particle, then flies to the better position according to its own best experience and its neighbor's best experience.

Suppose that the search space is D-dimensional and a particle swarm consists of M particles, then, the i^{th} particle of the swarm can be represented by a D-dimensional vector, $X_i = (x_{i1}, x_{i2}, \ldots, x_{id})$, $i = 1, 2, \ldots, M$. The number of bits for each variable should be set. The velocity of this particle can be represented by another D-dimensional vector, $v_i = (v_{i1}, v_{i2}, \ldots, v_{id})$, $i = 1, 2, \ldots, M$ which means the probability of the position will take the value with 1. The best previously visited position of the i^{th} particle is noted as its individual best position $p_i = (p_{i1}, p_{i2}, \ldots, p_{id})$. The position of the best individual of the whole swarm is noted as the global best position p_g. Then the velocity of particle and its new position will be updated according to the following two equations:

$$v_{id}^{n+1} = \xi \cdot (\omega v_{id}^{n} + c_1 \cdot r_1 \cdot (p_{id}^{n} - x_{id}^{n}) + c_2 \cdot r_2 \cdot (p_{gd}^{n} - x_{id}^{n})) \tag{108.4}$$

$$fr_{id}^{n+1} \leq S(v_{id}^{n+1}) \quad x_{id}^{n+1} = 1 \tag{108.5}$$

$$\begin{gathered} \text{else} \qquad\qquad x_{id}^{n+1} = 0 \\ S(v_{id}^{n+1}) = 1/1 + \exp(-v_{id}^{n+1}) \end{gathered} \tag{108.6}$$

where D $iD - 1, 2, \ldots, D$ $i = 1, 2, \ldots, M$, ξ is a constriction factor, which is used to limit the maximum velocity and it is usually set to 0.5; c_1 and $c_2$are two positive constants called acceleration coefficients ($c_1 = c_2 = 2$); r_1 1 r and r_2 are two random numbers uniformly distributed between 0 and 1, and ω is called inertia weight. In this paper it is calculated from "(108.7)":

$$\omega = 0.7 + (\text{rand}()/2)(1 - \exp(-\text{iter})) \tag{108.7}$$

108.5 The Cost Function

The cost function for a problem would then be as below:

$$\varepsilon = \frac{1}{n+1} \sum_{k=m}^{m+n} [v(kT_s) - \hat{y}(kT_s)]^2 \tag{108.8}$$

where $v(kT_s)$ is the actual system output under a step change, and $\hat{y}(kT_s)$is the response of the estimated system under the same step change. T_s is the sample time and n is the number of sampling data.

108.6 Simulation Results

The identification parameters of the first- and second-order plus dead-time system are shown in "(108.1)" and "(108.2)", respectively. To analyze identification characteristic of step response with noise, two systems are proposed. These systems are multi lag system $1/(s+1)^8$ and non minimum phase system $(1-s)/(s+1)^5$ Step responses of these systems with noise are shown in Figs. 108.1 and 108.2 respectively.

Number of iteration equal to 100 is considered. Selecting a bit several times and mutation occurring on the best solution are avoided. And for these algorithms the number of bits for any variable is eight. Mutation rate in all iterations is fixed number. The parameters and cost value for different mutation rate for DPSO and GA are shown in Tables 108.1, 108.2, 108.3, and 108.4. The performances of the different algorithms were compared using two criteria: (1) the obtained cost; (2) the first number of generation for convergence of parameters (FNGC). In all experiments, the algorithm was stopped when one of the following two criteria was satisfied: (1) the cost function reached target value of 0.001 (i.e., reaching within an acceptable distance from the known optimum value), or (2) the iterations reached to maximum iterations.

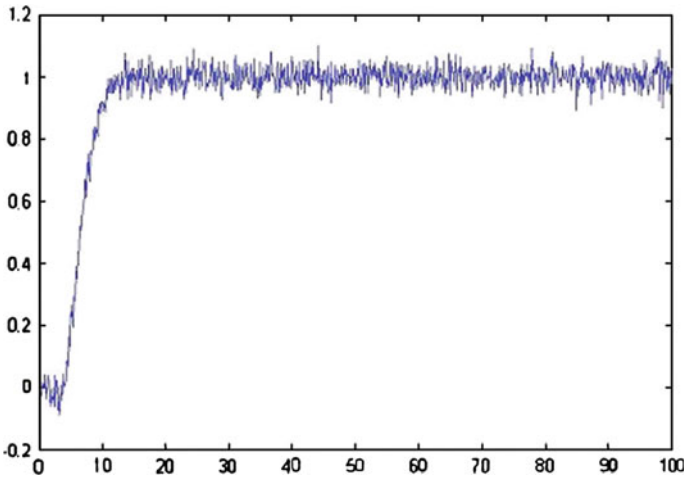

Fig. 108.1 Step response of multi lags system with noise

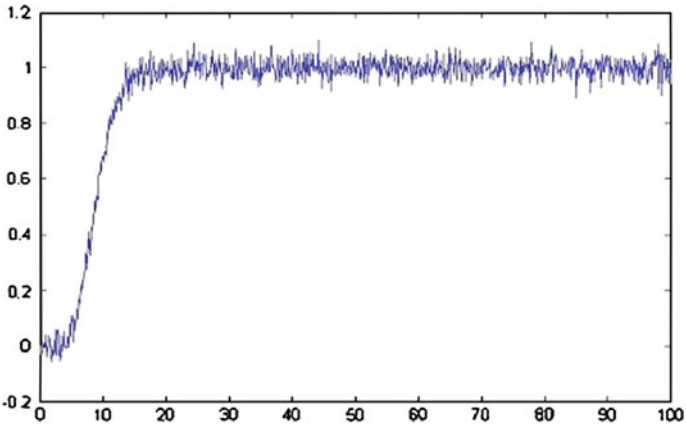

Fig. 108.2 Step response of non minimum phase system with noise

Table 108.1 The identified parameters for multi lag system with first-order plus dead-time system

	Mutation rate	Identified parameters			Cost ($\times 10^{-4}$)	FNGC
		K	T	L		
DPSO	0.02	1.0053	3.5054	4.7843	9.3976	13
	0.06	0.9999	3.4153	4.796	9.1543	15
	0.1	1.0043	3.1262	5.2781	9.8344	20
	0.12	1.0031	3.6565	4.9146	9.5981	21
	0.14	0.9993	3.299	4.861	8.9989	38
	0.18	0.9966	2.9083	5.4063	8.966	25
GA	0.02	1.0105	5.006	3.8803	15.644	100
	0.06	0.99991	3.577	4.8803	9.7758	27
	0.1	1.0072	3.5124	4.9379	9.9052	29
	0.12	1.0105	3.5798	4.8478	9.9026	25
	0.14	1.0073	2.9112	5.3057	9.8595	58
	0.18	0.99905	3.0728	5.0101	9.8538	62

108.7 Analysis of Results and Discussions

The obtained results demonstrate that our proposed DPSO algorithm have better performance in terms of speed and cost.

Table 108.1 illustrates the identified parameters for multi lag system with first-order plus dead-time system. The proposed DPSO algorithm approximately has better performance in finding optimal solutions. And in DPSO algorithm the speed of convergence is higher than GA. By increasing the mutation rate of both of the algorithms, better solution can be found but the number of generations for reaching

Table 108.2 The identified parameters for non minimum phase system with first-order plus dead-time system

	Mutation rate	Identified parameters			Cost ($\times 10^{-4}$)	FNGC
		K	T	L		
DPSO	0.02	1.0002	2.6915	3.6254	8.6966	24
	0.06	0.9961	2.8777	3.2172	9.533	12
	0.1	0.9963	2.5738	3.8141	9.1834	26
	0.12	1.0018	2.4272	3.7735	9.0126	14
	0.14	1.0102	2.7446	3.5704	8.6708	18
	0.18	1.003	2.9328	3.1109	9.2795	29
GA	0.02	1.0025	2.3933	3.9341	9.921	57
	0.06	1.0102	2.2691	3.8874	9.4734	20
	0.1	1.0078	2.9129	3.5583	9.1915	34
	0.12	1.0003	2.4699	3.496	9.5741	37
	0.14	0.996	2.1819	3.8043	9.4882	49
	0.18	0.9936	2.3856	3.8287	9.8938	32

Table 108.3 The identified parameters for multi lag system with second-order plus dead-time system

	Mutation rate	Identified parameters				Cost ($\times 10^{-4}$)	FNGC
		K	T_1	T_2	L		
DPSO	0.02	0.998	8.952	5.023	3.084	7.917	14
	0.06	0.993	7.918	4.503	3.554	7.668	13
	0.1	0.999	7.033	4.6668	3.455	7.278	24
	0.12	0.997	5.832	4.506	3.573	8.245	16
	0.14	1.008	5.357	4.53	3.768	8.488	16
	0.18	0.996	7.751	4.702	3.197	8.068	10
GA	0.02	1.005	8.053	5.045	3.048	9.225	18
	0.06	0.999	3.649	4.126	3.995	9.841	37
	0.1	0.999	5.763	4.428	3.758	9.335	22
	0.12	1.007	4.757	4.619	3.905	9.383	22
	0.14	0.994	3.251	3.656	4.521	9.72	48
	0.18	1.011	1.224	3.539	4.886	9.582	54

the target value increases. Table 108.2 illustrates the identified parameters for non minimum phase system with first-order plus dead-time system. Both of the algorithms approximately have the same performance but the speed of convergence in DPSO is better than GA. Tables 108.3 and 108.4 illustrate the identified parameters for multi lag system and non phase system with second-order plus dead-time system, respectively. These tables show that the proposed DPSO algorithm has got better performance in terms of cost and FNGC. But in Table 108.3 by increasing the mutation rate the costs of solutions increase.

Table 108.4 The identified parameters for minimum phase system with second-order plus dead-time system

	Mutation rate	Identified parameters				Cost ($\times 10^{-4}$)	FNGC
		K	T_1	T_2	L		
DPSO	0.02	1	4.37	3.449	2.51	8.12	22
	0.06	1	4.08	3.326	2.44	6.95	22
	0.1	1	2.94	3.122	2.66	7.35	33
	0.12	1	0.55	2.495	3.43	8.54	40
	0.14	9970	1.92	3.053	3.05	7.58	44
	0.18	1	2.76	3.24	2.83	7.84	40
GA	0.02	0.99	6.89	4.011	1.97	9.84	40
	0.06	1.01	3.43	3.543	2.63	9.14	30
	0.1	1	3.58	3.243	2.25	9.53	32
	0.12	1	0.84	3.219	2.87	9.47	36
	0.14	1	4.68	3.392	2.09	8.3	45
	0.18	0.99	4.8	3.178	2.73	9.59	70

108.8 Conclusion

In this study, we developed a genetic optimizer tool for constructing first- and second-order systems for non minimum phase and multi lag systems. To improve the quality of the estimated system, two mutation rates are used. The uniform crossover in different mutation rates is compared. The comparison between fix and variable mutation rate is considered for propose systems.

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Erratum to: An Enhanced BitTorrent Protocol Supporting Multiple Network Accesses

Xue Yifei

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The paper entitled "An Enhanced BitTorrent Protocol Supporting Multiple Network Accesses" by Xue Yifei, starting on page 169 of this volume, has been retracted due to a serious case of plagiarism.

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Author Index

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