

Zhicai Zhong
Editor

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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 over complex. The complexity is getting more critical along with the growing applications. To cope with the growing focus on intelligent, self manageable, scalable information systems, applications are being created to the maximum extent possible without human intervention or guidance.

Information engineering and applications are 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 the 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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Part I
Business Intelligence and Applications

Chapter 1

Breeding Base System Based on GIS

Xiaoguang Li, Fenghua Wu, Jian Wang and Guie Tian

Abstract Based on the comparison with all kinds of GIS development modes, this paper has built the breeding base information system using the visualization development language of C# and the module of Arc Engine 9.3. This system has accomplished the basic management of the breeding base, such as the map basic operation, inquiry, special subject pursue functions, printing output, space analysis, and so on. Using different interpolation methods, using the technology of variable rate fertilization and the method of nutrient balances, based on the data of spatial distribution maps of soil nutrition, taking the breeding of corn as example, it can ensure the quantity demanded according to the method of Target Production and calculate the vector prescription figure and grid prescription figure of urea, phosphoric acid, DAP, potassium chloride according to the fertilizer requirement.

Keywords Precision agriculture · Geographic information system (GIS) · Arc engine · C#

1.1 Introduction

Precision agriculture is mainly based on “3S” space technology and artificial intelligence techniques of modern farmland precision farming technology systems. Based on the growth of crops and the space differences in soil fertility, it adjusts the investment in crops and then makes a real-time quantitative diagnosis of arable land and crops [1] using the best investment ratio to reduce input and improve production. In addition, it can reduce the environment pollution due to pesticides

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and chemical fertilizers. The most important element of precision agriculture is the benefit and not the high yield. It is the result of informational technology development and the direction of modern agriculture in the twenty-first century. GIS has been applied widely with its powerful spatial data management and processing capabilities and showed broad application prospects [2]. As the core technique in precision agriculture, GIS shows broad application prospects in the area of agricultural application. With the continually increasing application in agriculture, GIS is becoming more and more vital [3]. As a part of precision agriculture, breeding base information system is the element task of precision agriculture. Managing the breeding base with the method of precision agriculture, combining the agriculture geography informational system and precision, redeveloping with Arc Engine objects in the C#.net environment, this system is used to study the management of breeding base, analyze-estimate, and make suitable variable decisions [4].

1.2 Components GIS

The components software technique has become one of the trends in modern times (GIS software is not an exception). The development of the GIS software has experienced the process of function module, bag-type software, core-type software, components GIS, and Web GIS [5]. The traditional GIS software has been relatively mature in its functions, but most of these systems are independent. At the same time, the GIS has become so enormous that it is beyond the grasp of users, and is very expensive, limiting its popularization and application. The components GIS provides a new method of solution to the problems facing the traditional GIS.

A Component GIS is the product of GIS technology and level of technology; the major technology is basement-component object model (COM) and ActiveX widget [6]. COM is the acronym of Component Object Model and the common basis of Object Linking and Embedding (OLE) and ActiveX. ActiveX widget is a kind of programmable and reusable object based on COM. The advantage of ActiveX is it interacts with applications with attributes, event, and method without the consideration of the computer language of the original components [7]. With the method of modularization, the components GIS can be divided into different components according to their functions. Every GIS component and Com GIS component is gathered together with the visual development tools according to the standard.

Arc GIS Engine is also called AE. It is a kind of new generation component accompanying the launch of Arc GIS9 (ESRI America). AE is a simple Arc Object encoding environment dependent on ending of application. Its SDK provides a set of Embedded Arc GIS modules, and these modules can be used out of the Arc GIS Desktop framework [8]. Examples are the individual objects in the database as a portion of the AE management, rather than in Arc Map.

1.3 System Design

According to the different aims of systems, this system is divided into four function modules:

1.3.1 GIS Basic Function Module

This module contains the most basic functions of the GIS desk software, such as layer management, basic controlling function of maps, and Hawkeye. Information query is regarding the query between images and attribute data Print function is the ability to output the various data.

1.3.2 Data Management Module

The management of spatial data is mainly in regard to the management of the spatial and attributes data of Geo database and shape forms. We can manage the attribute data in all kinds of forms and it has the function of importing the attribute data into spatial data.

1.3.3 Spatial Interpolation Module

The spatial interpolation module comprises Kerrey interpolation, Splice function interpolation, inverse distance weighted interpolation. The main function of spatial interpolation is to produce maps according to the sampling point. For example, it can produce the N , P , K distribution map according to the soil fertility; it can produce the water content distribution map according to the soil water content; and the yield predicted distribution map according to sampling point production [9]. These maps are all raster data.

1.3.4 Decision Support Modules

The breeding base management system provides the decision support to precision agriculture. The decision of precision agriculture considers before-planting decisions, fertilization decision, Irrigation decision, and so on, where the fertilization decision is the core component. The main processes of fertilization decision include: GPS measurement of soil sampling data is used as the primitive data; the

spatial Interpolation soil fertility is used as the basic data; calculation of the fertilizer requirement of each raster cell separately according to the soil fertility and the fertilizer requirement from Experts' fertilization library. And then convert the raster data prescription map into vector data prescription map, which is used as the basis of scientific fertilization.

1.4 System Implementation

1.4.1 Import GPS Observation Data

This function is about converting .txt data to ship data to have the relevant data of GPS sampling points imported into this system to make various calculations. While importing, the data form must be in the system metadata format of the system or the system cannot read it. According to the field of database design, the files in .txt form are: dot mark, coordinate Y , coordinate X , organic matter, Total N , Alkali solution nitrogen, rapid available phosphorus, available potassium, PH field, and so on. Every field is separated by a comma in the English state. If there are more measurement attributes, the data editing function is available.

The GPS sampling point data format is shown in Fig. 1.1

1.4.2 The Generation of Land Fertility Distribution

Land fertility is the foundation of precision fertilization. The data of soil fertility is the land fertility distribution produced by spatial interpolation function, according to the soil content measured by GPS. The system is based on the actual measured GPS sampling data of some breeding base to spatial interpolation [10]. The distribution range of spatial interpolation is the range of the breeding base, which has been designed by the system. For the interpolation of different areas, we should choose different ranges. The size of the raster produced by interpolation can be set in the Interpolation dialog box, according to the actual situation. Here, we set it as 2×2 m. To make the distribution of soil fertility clearer, the produced raster maps are reclassified. The units of N , P , and K are the grams of each kilogram of soil. Take K to be an example:

Potassium content distribution analysis (Figs. 1.2, 1.3 and 1.4).

```
0,597552.3423,4390689.691,18.58,0.37,106.48,29.29,99.80,7.0
1,597761.6574,4390687.735,28.41,1.16,112.30,37.21,110.06,6.
2,597998.3594,4390689.691,24.73,0.27,122.02,29.58,95.80,6.7
3,598211.5869,4390693.603,14.15,0.29,102.11,62.85,94.57,6.8
4,597552.3423,4390480.376,15.58,0.91,90.07,45.93,97.17,7.05
```

Fig. 1.1 Txt data format

Fig. 1.2 The reclassification of potassium content by kiting interpolation method

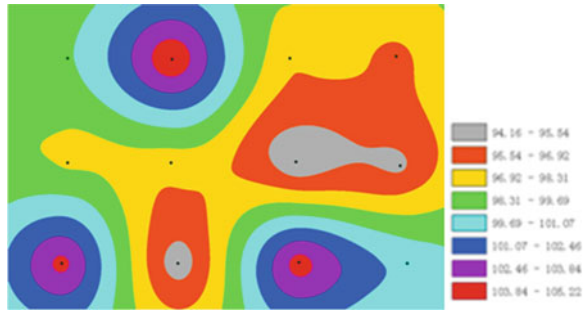


Fig. 1.3 The reclassification of potassium content by Splice interpolation method

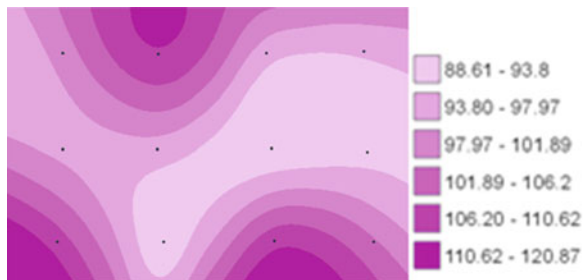
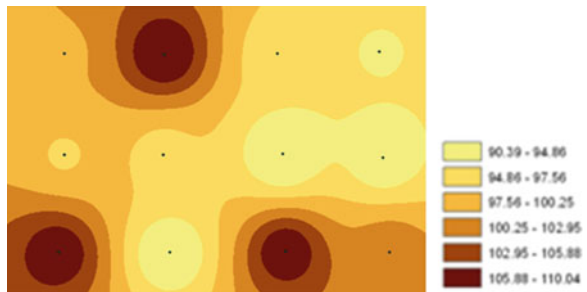


Fig. 1.4 The reclassification of potassium content by IDW interpolation method



According to the sampling points, analyze the distribution of K with the three kinds of spatial interpolations. In combination with other information (soil structure, classification, and gradation information) and the data detecting point, comprehensive analysis, splice function interpolation results are more consistent with the actual situation. So regard the K raster generated by splice function as the foundation of the calculation of the content of K .

1.4.3 Generation of Fertility Requirement Prescription

Precision fertilization requires the accurate fertilizing amount of each cell. Only in this way can we combine the fertilizing amount with the soil nutrient content by a mathematic model. This system builds the mathematic model with a simpler nutrient balance method. Nutrient balance method is a method to calculate the fertilizing amount according to the structure of the crop, considering only soil and fertility [11]. According to corn fertility requirement, plan production, soil fertilizer ability, the seasonal fertilizer utilization ratio, and so on, the nutrient balance method mainly calls for the following formula:

$$W_{in} = (W_{out} - 0.15 \times K_{soil} \times T_n) / K_{ker} \quad (1.1)$$

W_{in} is Fertilizer use(kg/mu); W_{out} is a component of the crop requirements (kg/mu), K_{soil} is soil nutrient utilization rate (%), 0.15 is the scale factor, calculation in 20 cm plough layer in this system.

The calculation of the quantity of fertilizer is based on a certain target. There are two methods to ensure the production of target: first, the amount of corn is decided by the soil fertility. Second, improvement by 10–5 % the target production based on the average corn production in the past 3 years. It has been analyzed that for corn to produce 100 kg of grain requires an amount of N 2–4 kg, P 0.7–1.5 kg, K 1.5–4.0 kg.

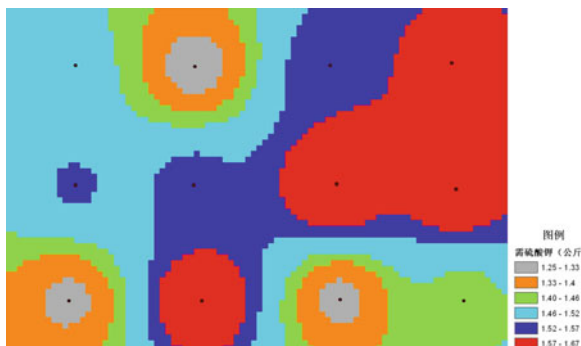
Utilization of fertilizer nutrient value is as follows: utilization of seasonal nitrogen fertilizer of about 40–50 %, seasonal phosphate utilization of about 30–35 %, and seasonal potash utilization of about 40–50 %.

In reality, the grid is divided widely by the intelligent fertilization machine. To make it clear, we use a 10 × 10 m grid and corn breeding machine fertilization to calculate the fertilizer requirement of each cell. The set of soil available nutrient utilization generated by the regional statistical functions that required fertilizer prescription is shown in the figure vector grid data for the current grid net of fertilizer needed; the raster picture shows the spacing reclassified fertilizer prescription needed for potassium, in Fig. 1.5.

Fig. 1.5 The grid prescription figure of demand for nitrogen



Fig. 1.6 The grid prescription figure of applying potassium sulfate



1.4.4 Fertilization Decision

Corn fertilization is based on the Corn Laws requiring fertilizers for the function of N , P , K in different processes of corn. This should be grasped flexibly. The types of modern chemical fertilizers are various, so to decide the fertilization plan, we must decide which kind of fertilizer to use first. We take potassium sulfate, phosphate ammonia, urea fertilizer to be examples. Phosphate ammonia is a common K fertilizer. In general the content of K is over 50%. According to potash fertilizer characteristics, the earlier the better; we can decline the K fertilizer early in time because K fertilizer is single. Based on the seasonal utilization of potash, the nutrient requirement of the grid ($10\text{ m} \times 10\text{ m}$ Mix-network) to calculate the amount of potassium sulfate fertilizer, the fertilization prescription map after raster reclassified, As Shown in Fig. 1.6.

The relevant input data can produce the raster prescription map of phosphor dies erase ammonia, urea. Because of the word limit, we do not describe it in detail.

1.5 Conclusion

To introduce GIS's function of spatial data collection, processing, analysis, and expression into the system of agricultural production will make agriculture get out of the traditional process, and get onto the information management route. It is significantly meaningful to perfect the precision agriculture technology system based on this platform.

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Chapter 2

Research on Social and Environmental Factors Impact on College Students' Interview Impression Management Behavior

Cheng-hu Zhang, Ying Yue and Dong-mei Li

Abstract This paper, combined with previous research findings and target depth interview results, uses SPSS statistic software to undertake exploratory factor analysis, and construct five structure dimensions of the college interview impression management. The use of multiple regression analysis further explores the impact mechanism of the social and environmental factors on interview impression management behaviors in college students. Finally, it puts forward rational suggestions with the actual situation.

Keywords Interview impression management • Social and environmental factors • Gender differences • Exploratory factor analysis • Multiple regressions

2.1 Connotation and Dimensionality of Interview Impression Management

In previous studies, the concept “candidates impression management” is widely mentioned, which refers to the impression management in the interactive processing of interview, including interview interaction situation and also other

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interaction situations (Fletcher 1992; Erving 1959; Wang 2006). Compared to the “interview impression management”, the contextual extension of the former is wider (Feng 2011). Combined with the object of this paper—college students, I will define the interview impression management behavior as follows: in the job interview, it is a behavior, in order to leave a positive impression but not a negative one on the recruiters, done by college students through controlling the information the recruiters acquired to affect their views, the nature of it is an interpersonal influence strategy.

It has nounified understanding about the structural dimensions division of interview impression management behavior (Roth 1986; Snyder 1974). In the existing researches both at home and abroad, different scholars from different angles led to different dimensions and measurement tools, the methods of dividing dimensions from the same perspective are also different (Kumar 1991; Kacmar 1992; Wayne 1995). This study, starting from the existing literature, has done deep exchanges in 13 different identities carefully selected the interview subjects. Twenty-seven -indexes (achievements show, personal stories and statement fitness and expertize show, etc.) of the interview impression management have designed by secondary extraction of interviews. With the application of LiKert 5-Scale to carry on the questionnaire design, respondents chose the used degree of the behavior strategy according to the actual situation in the interview (1–5 said no, less frequently used, in general, more frequently used, often used). To obtain the structure dimensions of the interview impression management behavior, this study dose an analysis of the exploratory factors with the statistical software SPSS 16.0. (A total of 400 copies of questionnaire, reclaim 380, of which 356 valid questionnaires).

After preliminary analyzed, three items (Question 4: The performance of individual skills and expertize. Question 12: Words and deeds show that their own values are consistent with corporate culture and style. Question 15: Overcome your nervousness, calm) have high load or little common in multiple factors. To further improve the scale, they should be removed. By comparison, these questions were deleted in entirely, the statistical indexes are more desirable. Shown in Table 2.1, KMO = 0.907, approximate Chi-squared value is 3.49 1E3, freedom is 276, the significance probability is 0.000, which can be carried out in factor analysis.

In this paper, it extracted common factors by principal component analysis and it carried on factor rotation through variance maximum method. As shown in Table 2.2, the number of factors whose eigenvalue is greater than 1 is 5, namely we can extract five common factors (principal components), which can be accumulated to explain the original 60.23 % variables (variables explained more than 60 %, that is good) through exploratory factor analysis.

Table 2.1 Interview impression management behavior scale KMO and Bartlett’s test

Kaiser-Meyer-Olkin sampling appropriately measured values	0.907
Bartlett’s spherical test	Approximate Chi-squared value
	Freedom
	Sig.
	3.491E3
	276
	0.000

Table 2.2 Total variance of interview impression management behavior scale

Principal components	Initial eigenvalues			Square and load after the shaft		
	Total	Variation	Accumulative total	Total	Variation	Accumulative total
1	7.901	32.922	32.922	3.838	15.994	15.994
2	2.207	9.194	42.117	3.390	14.123	30.117
3	1.581	6.588	48.705	2.694	11.226	41.343
4	1.451	6.045	54.750	2.395	9.981	51.324
5	1.315	5.480	60.230	2.138	8.907	60.230

In Table 2.3, Index 12–17 (Positive outlook, Calm, Eye contact, Neat appearance, Posture, and Facial expression) can be expressed by factor 1. Index 18–24 (Face-saving pretext, Borrow excuses, Deliberately avoid, Rational reason, Table determination, Conceal ambition, and Conceal weaknesses) can be expressed by factor 2. Index 4–7 (Attitudinal commitment, High motivation, Special requirements commitment) can be expressed by factor 3. Index 8–11 (Improving similarity, Meet the needs, Meet the esteem needs, and Culture meet) can be expressed by factor 4. Index 1–3 (Achievement show, Personal story, Declared fit) can be expressed by factor 5. These above five factors are named as following: Nonverbal behavior, Protection and defense, Motivation commitment, Cozy, and Self-promotion.

The research on college students’ job interview impression management behaviors was generically described and analyzed using the results of exploratory factor analysis, drawing mainly the following five aspects of interview impression management behaviors in college students: (1) Self-promotion class. That is according to job requirements on their own experience, achievements, skills and expertise, qualities, character, and other positive description of the self-promotional, display, and raise, (2) Motivation commitment class. The candidates have a good impression to the employer by expressing a strong interest and enthusiasm and sending a high degree of professionalism and loyalty to the organization and the post, (3) Cozy class. The candidates boost their interpersonal attraction by catering to the culture of the appointment unit, praising the appointment unit, and cozying recruiters, (4) Nonlanguage class. The candidates acquire more positive evaluation by smiling, leaning forward, natural facial expression, and other non-verbal behavior of self-display, and (5) Protect and defensive class. The defensive measures have been taken to weaken their own inadequacies or avoiding negative look from recruiters as much as possible in candidates.

2.2 Effects of Interview Impression Management Behavior in the Social and Environment Factors

Studies have suggested the concept “gender role approval”. Gender role refers to the normative expectations of sexual division of labor in specific social and cultural context and rules related to gender identity in social interaction. The gender role

Table 2.3 Rotated component matrix of interview impression management behavior scale

Observed variable	Factor structure				
	Factor 1 (A12–17)	Factor 2 (A18–24)	Factor 3 (A4–7)	Factor 4 (A8–11)	Factor 5 (A1–3)
A1	0.141	0.126	−0.006	0.121	0.831
A2	0.110	0.164	0.072	0.115	0.832
A3	0.236	0.076	0.300	0.139	0.631
A4	0.328	0.093	0.742	0.010	0.113
A5	0.265	0.070	0.732	0.142	0.072
A6	0.014	0.249	0.708	0.162	0.009
A7	0.242	0.071	0.703	0.122	0.123
A8	0.072	0.157	0.021	0.766	0.040
A9	0.210	0.237	0.157	0.685	0.163
A10	0.253	0.204	0.103	0.735	0.071
A11	0.096	0.187	0.287	0.548	0.288
A12	0.617	0.210	0.294	0.048	0.201
A13	0.594	0.223	0.131	0.235	0.102
A14	0.730	0.119	0.239	0.010	0.153
A15	0.741	0.090	0.085	0.197	0.076
A16	0.815	0.115	0.138	0.142	0.050
A17	0.767	0.169	0.196	0.113	0.115
A18	0.280	0.558	0.151	0.070	0.218
A19	0.293	0.634	0.050	0.212	0.064
A20	0.253	0.759	0.055	0.009	−0.027
A21	−0.037	0.713	0.101	0.240	0.051
A22	0.294	0.576	0.340	−0.034	0.108
A23	0.088	0.605	0.142	0.323	0.073

approval of college students refers to their attitudes to the traditional gender role, which reflects the osmosis and internalization of social traditional gender culture in male and female college students. The higher the degree of gender roles recognized, the attitudes of gender role are more traditional. Based on the detail of the recognized gender roles, this study will be divided into two dimensions: work—family gender role approval and ability trait gender role approval (Wang 2009).

This study will not only recognize the effect of the interview impression management behavior from social and environmental factors, but also analyzes the differences of effects on different gender students through the four dimensions: employment situation awareness (ESA). Perceived unfairness of gender differences in employment (PUGDE) (The awareness of the different treatment and unfair opportunities caused by gender has no capacity in the employment of male and female employment), Work-family gender role approval (WGRA), and Ability trait gender role approval (ATGRA).

Table 2.4 Regression analysis of social environment factor to self-promotion

	R ²	Adjusted R ²	△R ²	Change	Variable	Beta	T	Sig
Male	0.136	0.120	0.037	8.892	PUGDE	0.195	2.982**	0.003

** P < 0.01

Table 2.5 Regression analysis of social environment factor to motivation and commitment

	R ²	Adjusted R ²	△R ²	Change	Variable	Beta	T	Sig
Male	0.133	0.116	0.088	21.129	ESA	0.259	3.800**	0.000
	0.154	0.133	0.021	5.047	PUGDE	0.152	2.247*	0.026

* P < 0.05

** P < 0.01

Table 2.6 Regression analysis of social environment factor to ingratiation

	R ²	Adjusted R ²	△R ²	Change	Variable	Beta	T	Sig
Male	0.246	0.232	0.094	25.945	ESA	0.279	4.579**	0.000
	0.283	0.266	0.037	10.577	WGRA	0.202	3.252**	0.001

** P < 0.01

2.3 The Influence of Social Environment Factors on Interview Impression Management Behavior

As a result, professional category and practice experience in this study will affect the interview impression management behavior, so set as control variable. Therefore, using hierarchical multiple regression analysis, it explores the effects of each variable in social environment on various interview impression management behavior. The dependent variable is various interview impression management behaviors, and the independent variable is the influencing factor. As shown in Tables 2.4, 2.5, and 2.6.

Therefore, the following relationship was partially confirmed, respectively: (1) The ESA had significant influence on interview impression management behavior of male and female college students; (2) PUGDE greatly affected interview impression management behavior of male and female college students; (3) WGRA had an obvious impact on interview impression management behavior of male and female college students; (4) ATGRA dramatically affected interview impression management behavior of male and female college students. As shown in Tables 2.7 and 2.8.

Table 2.7 Regression analysis of social environment factor to nonverbal behavior

	R ²	Adjusted R ²	ΔR^2	Change	Variable	Beta	T	Sig
Male	0.179	0.163	0.086	21.775	PUGDE	0.202	2.920**	0.004
	0.205	0.186	0.026	6.808	ESA	0.143	2.133*	0.034
	0.220	0.197	0.015	3.937	ATGRA	0.138	1.984*	0.049
Female	0.079	0.059	0.042	6.266	PUGDE	0.241	2.994**	0.003
	0.129	0.104	0.050	7.952	ATGRA	-0.228	-2.820**	0.006

* P < 0.05

** P < 0.01

Table 2.8 Regression analysis of social environment factor to defensive behavior

	R ²	Adjusted R ²	ΔR^2	Change	Variable	Beta	T	Sig
Male	0.304	0.291	0.140	41.854	PUGDE	0.254	4.098**	0.000
	0.350	0.334	0.046	14.668	ATGRA	0.201	3.211**	0.002
	0.372	0.354	0.022	7.167	ESA	0.161	2.677**	0.008
Female	0.121	0.102	0.084	13.339	PUGDE	0.291	3.652**	0.000

** P < 0.01

2.4 Strategies and Suggestions

Correctly understand and attach great importance to the interview impression management behavior. Appropriate impression management behavior could help candidates to better show themselves and make the interpersonal relationship in the interview harmonious. Simultaneously, it reflects a person's cultivation and could contribute to the good impression of candidates.

Female college students should strengthen the subject consciousness, and deal with the employment gender injustice by individualized strategies. First, in order to increase the employment opportunities, determine the reasonable expectation of employment. Second, adjust impression management motivation to avoid the problems caused by high motivation such as, unnatural nonverbal behavior, excessive use of protection, and defensive behaviors. Third, provide the individual information of female role bias.

Protect employment rights and interests of the female college students with legal system, and strengthen the supervision by law-enforcement. Male and female college students perceive that the level of the employment gender inequality is too high, which reflects the discrimination phenomenon for gender differences in employment market is still serious. Female college students are inferior in the employment competition, and their difficulty in employment is still very prominent.

Strengthen the social adaptation, and build a fair and equal gender culture from the source, which is very important for correcting gender discrimination and promoting female college students' employment and development. Nothing but fair and equal gender concept in social environment can promote the change of the gender role attitude of individual consciousness.

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Chapter 3

Analysis of Arrears Problem for Independent College Students

Guangbiao Sun, Jun Zheng, Luyang Gao and Hui Wang

Abstract The arrears phenomenon of Independent College Students is very common, which has a serious impact on the normal operation of independent college funds and the healthy development of the institute under the new mechanism. Relative to the public colleges and universities, the tuition is the survival lifeline of Independent College. This article makes a brief analysis of the characteristics and reasons for college students' arrears, and proposes some methods to solve the arrears problem.

Keywords Independent college · Arrears · New mechanism

3.1 Introduction

The Independent College established, with the approval of the Ministry of Education, jointly held the full-time undergraduate college by the state-run college and social forces according to the new mechanisms and modalities in the new era [1]. Brought into the national enrollment plan, according to the Ministry of Education "the colleges and universities that have the enrollment eligibility of regular higher academic education in 2011 List" show that in 2011, there were 311 Independent Colleges with the enrollment eligibility of regular higher academic education [2, 3]. Thus, the Independent College is an important component of

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private higher education, and it has made a positive contribution to promote the popularization of higher education [4]. The tuition fee income, the main source of funding in an Independent College, is the financial security of survival, development, and growth. For the serious facts of independent college students' arrears in recent years, we analyzed and summed up the reasons: blind enrollment for poor students is relatively increased; tuition fees increase very fast relatively to expand the number of poor students; loopholes in the school management. The advantage of the loophole to "false poor students" is attributed to the moral qualities of the students themselves. The malicious arrears are moving the tuition to other uses; national student loans which are not smooth, and others, the specific analyses of which are given below.

3.1.1 High Tuition

In their fourth year in the Independent College, students often have to pay one or more times higher tuition than other college students. Many people think that independent school students have excellent domestic economic conditions, high level of consumption, and therefore should have no payment difficulties, but in fact many parents are influenced by the current concepts of education and employment situation. When the marks are not enough for students to get into a university in the college entrance examination they are dissatisfied with their children not attending specialist courses and then they exhaust their resources to send their children to Independent College in order to obtain an undergraduate diploma and a bachelor's degree. Therefore, more students are from remote mountainous areas or from economically disadvantaged families in Independent College. After enrollment, these students cannot afford the high tuition fees, and repeatedly default.

3.1.2 The Deficiencies in Fee Collection Management in Independent College

Independent Colleges, in order to strengthen the management of student fees, generally formulate the management system from a register for freshmen enrollment to graduation fee management aspects. However, various factors exist that make these management systems weak and useless. They are: schools within departments generally lack experience, have incomplete systems, inadequate measures, lack of unity and understanding, lack of coordination between various departments, few coercive measures, and deliberate arrears in payment of tuition due to poor management and imperfect charging system. Charge is a system task needed the relevant departments to work together, closely and Interlocking. Therefore, if the various departments do not have clear responsibilities, reminders

for the charge work cannot be reached. At present, in arrears reminder of Independent Colleges, the relevant functional departments lack communication. Collection of tuition fees, student management, enrollment, graduation, and the distribution of reward and credit are disjointed; there are obvious loopholes in management. Some departments one-sidedly think that the collection of tuition fees is the affair of a certain department; they are not enthusiastic, unable to understand the students' pay and arrears situation, cannot form an effective binding of delinquent students, contribute to the fluke mind of some students, and even form a vicious circle. The following are examples of the Tuition Collection Quality of management (TCQI) score.

The results show that the average score of college students' TCQI is 4.62 ± 3.03 , with tuition collection quality factor scoring 1.49 ± 0.64 , admission time 0.86 ± 0.80 , and functional departments understand the time 0.67 ± 0.73 , tuition reminders efficiency 0.80 ± 0.71 , sleep disorders 0.85 ± 0.74 , tuition collection department coordination 0.85 ± 0.74 , and tuition collection experience 0.87 ± 0.74 , respectively. The results show tuition collection of poor quality, mainly tuition collection department coordination, understanding of functional departments the time, the tuition collection quality, and admission time of four dimensions.

Normal college students normal payment of college students' quality (TCQI < 7, the normal group) 1,116, Nonpayment of tuition group 209. Comparison results of the two sets of the TCQI dimension scores of the normal group and unnormal group show that the each dimensional and total score difference of the two sets were statistically significant ($p < 0.05$). (See Table 3.1).

3.1.3 Poor Students Cannot Afford to Pay Tuition Fees

The Independent College is the main front of China's implementation of the popularization education; students are mostly from rural areas. For economically disadvantaged students, paying their tuition fees is a heavy burden. "Can't let a poor students drop out of school because of financial difficulties" the green channel policy allows the delay payment of the poor students in colleges and universities, part or all of the fee remission. Virtually, it increases the number of arrears students in schools. Such as an Independent college in Hebei, students are mostly from rural households or urban residents in low income families, some parents are partly or seriously ill without the ability to work, in some cities, both parents are laid off, and some are limited income families with many children. Although the nation implements "award, help, reduction, exemption, subsidy, slowing, loan" to help poor students, but what is assigned to the individual is only a drop in the bucket. From Table 3.1 in the data view, arrears students are mostly from Hebei Province, the proportion to 48 %, the remaining 52 % of the arrears students are from the foreign province. In foreign arrears students, 66 students are from the economically developed eastern region, accounting for 66 % of the

Table 3.2 The statistical tables of the economic geographical characteristics of the arrears students' families in a Hebei Independent College

Area	Province	Numbers	Percentage (%)
East	Hebei	48	48.0
	Liaoning	9	9.0
	Shandong	4	4.0
	Jiangsu	1	1.0
	Tianjin	2	2.0
	Fujian	1	1.0
	Guangdong	1	1.0
	Subtotal	66	66.0
Middle	Heilongjiang	6	6.0
	Henan	1	1.0
	Anhui	5	5.0
	Hubei	2	2.0
	Hunan	3	3.0
	Jiangxi	3	3.0
	Subtotal	20	20.0
West	Sinkiang	1	1.0
	Gansu	2	2.0
	Sichuan	8	8.0
	Chongqing	1	1.0
	Guizhou	1	1.0
	Yunnan	1	1.0
	Subtotal	14	14.0
	Total	100	100.0

overall sample; 20 students are from the middle, accounting for 20 %; and 14 students from the west, account for 14 % of the overall sample. Visible, since the reform and opening up, even though the income levels of residents in China have improved significantly, however, due to regional economic development imbalance between the urban and rural, people's living standards are still significant gaps. Currently, charge of higher education for students from low income families is indeed a heavy burden. See Table 3.2.

3.1.4 Weak Sense of Some Students and Their Parents to Pay Tuition Fees

“Higher Education Act” Chapter VI Article 54 provides that: “University students should pay tuition in accordance with state regulations.” “University Charging Measures” Article 3 provides that: “higher education belongs to the non-compulsory education; school should charge tuition fees of students according to the relevant regulations of the State.” Small group of students are malicious arrears, they have money but to non-payment or late phenomenon, and tuition fees to be paid and not be

paid to school without much impact. Some use the tuition fees to purchase computers, mobile phones, designer clothes; some store in the bank to earn interest; some use it for investment, stocks, and business and so on. There are some students who do not pay tuition fees but are still in class, examinations, and also appraised and assessed first, resulting in subjective low enthusiasm of payment and having the psychology to escape by luck.

3.1.5 Graduates Rise Result the Increase of Job Stress

In recent years, the scale of Independent Colleges admissions continues to expand, while the employment rate of students is not very high. Many students were unable to find their counterparts in professional work; diploma do not have access right now. Now after the diplomas are networked, some students lose their certificate or fraud to regain the diploma by querying through the network. Diploma gradually loses its practical significance.

3.2 The Hazards of the Independent College Arrears

Independent Colleges use the social forces to promote the new school system of higher education development, relying on students' payment to maintain the operation. Malicious arrears will result in the school's inadequate investment in teaching. It affects the school's normal teaching order, the further development and construction, and ultimately is not conducive to the cultivation of talents.

Some opportunistic students pretend poverty. This behavior of occupied grants and scholarships seriously damaged the rights of other students, resulting in genuine difficulties of students who cannot get a timely and effective help. The policies of grants and scholarships cannot be maximized, not conducive to the construction of the normal school environment.

Malicious arrears are breach of contract. Students owe tuition, are not just the issue of integrity, but also to legal obligations. Students in the moment get a college acceptance letter, in fact, have formed with the school de facto contractual relationship. University is not compulsory education according to the relevant provisions of the "Contract Law", as long as the school fees in advance to inform and in accordance with the standards of the price department, college students in the school get education services, while due to the obligations of payment. If there is no special reason of malicious arrears, it is breach of contract; the school has the right to be demanded through legal channels. Deliberate refusal to pay tuition, which show that students lack awareness of honesty, in the long run, is bound to form bad habits not in favor of the individual's sound character formation, and ultimately harm their own interests. It even lowers the level of Independent college education. The whole social atmosphere will also be adversely affected.

3.3 Countermeasures of Independent College Arrears

At present, more and more serious arrears phenomenon has become the bottleneck constraints of the Independent Colleges' future healthy development. Therefore, how to take effective measures to resolve the arrears problem of independent college students is particularly important. Corresponding countermeasures are proposed: the National Student loans are the main channel to solve the poor students, we should establish and maintain the security system of the main channel; make "award, loan, exemption, and subsidy, work-study", caring contributions to a multipronged. We should make a wide range of financial assistance become more perfect; firm school management, curb malicious arrears; strengthen the integrity of education, do legal education without delay, pay attention to "spirit helping the poor"; and value to improve the ability of the poor students.

3.3.1 Schools Should Implement the Measures to Help Study

"Higher Education Act" provides that, students of families with financial difficulties may apply for grants or tuition waiver. Independent Colleges respond to students with financial difficulties, especially poor students through a variety of ways to give economic assistance. The state has increased investment in education efforts, in 2009, Hebei Province annual payment is 1.291 billion for national scholarships; college set up a dedicated Education Fund; contributions of students, teachers, and social; sponsorship of corporate and so on. Students are required to obtain this through study, work, or other forms of compensation, such as our college has a college scholarship, benefit up to 28 %. On the one hand to encourage students to study hard and try to get scholarships to complete their studies, on the other hand actively provide students with work-study positions for students to work while studying, exercise the social practical abilities of students, and cultivate a sense of spirit, while addressing the students' part of the cost of living.

3.3.2 Local Implement Student' Local Grants Loan

Students with financial difficulties may get a secured Student Loan from the local bank. Taking Hebei Province as an example, in 2009, 18.23 million Yuan were issued to National Student Loan, benefiting 3,550 students; issuing students local credit loans exceeded 100 million Yuan the first time, up to 100.32 million Yuan, benefiting 18,400 students. Loans of schools from the province's 68 public universities expanded to over 2,000 colleges and universities across the country, students local credit loans up to a maximum of 6,000 Yuan per person per year, the

Financial repay the full amount of discount of students' loan interest during school; after graduating, interest is paid by their own. Local loan application procedure is simple, convenient, and the funds are credited into account in a timely manner; by comprehensive promotion of students loans, the problems faced by the existing loan system can be solved, and reduce the students arrears pressure bear by the school.

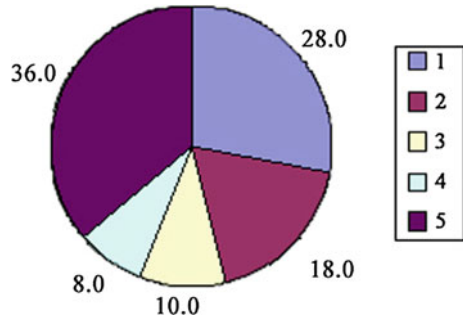
3.3.3 Strengthen the Integrity of Education and the Ideological and Political Education of Students

Taking the integrity of education into the ideological and political education and enrollment and graduation of education, we should actively guide students to “take pride in being honest and trustworthy”, stressing that integrity is the basic moral quality of life in the country which every college student should have. Educating through class meeting, blackboard, campus radio, colleges, sports activities, and other channels, we should make students know that it is the obligation of college students to payment timely, and also an honest performance.

3.3.4 Set up Punishment Mechanism Against Malicious Arrears Students

Independent Colleges should work out relevant charging policy, research, and develop solutions, after Institutionalized, in the form of school documents issued to various departments and included in the student handbook. Forming a series calls system of tuition fees, such as: In order to urge the students to pay on time and deal with the arrears situation have rules, an independent College in Hebei from the fall of 2008, the students were implemented “School year Electronic Registration” Status Management System, the system specifically provides that: “all kinds of students who not fully paid the tuition or training fees before registration”, “not to handle registration procedures, their courses temporarily not be recognized accomplishments”; “not to participate in a variety of awards”; “their scholarships, grants and work-study funds should priority pay for repayment of tuition fees, accommodation”; “not yet paid in full before graduation tuition fees, accommodation during the school, cannot be a thesis defense, withheld to confirm the thesis results”, etc. In case of the malicious arrears of students, we can withhold the diploma graduates and file, do not recommend to the employing unit and to the personal contact work units, does not introduce the overall performance of the student to the employer, and do not sign views of college in the employment agreement.

Fig. 3.1 Statistics of reminders tuition constraint measures



The survey results show that in the terms of the constraints set by the “End payment and registration” system, that not allow to the respondent and withholding of the diploma have the best force of constraint, in the sample, 36 % of students believe that they are pressure on them; second, not to give a registered student status, students select the items accounted for 28.0 % of the sample; others, the total proportion is not more than 40 % such as “do not confirm the results (18.0 %), not allowed to participate in the awards (10.0 %), scholarships deductible debt (8.0 %)”. Visible, except from not allowed replying and the withholding of the diploma, the other terms of the constraint are limited. See Fig. 3.1.

3.3.5 Do a Good Job in Enrollment and Employment

Higher education directly to the face of the social market economy, one of the most distinctive features of the market economy is full of intense tension, and even brutal competition. College need to actively promote the cooperation with enterprises, use scientific and technological achievements in schools to serve the community, and provide students with real teaching, learning environment, and practical place. Whether students are employed or not, employment is good or not are directly related to payment problems; only students finding a job, finding a good job, have the ability to repay the arrears and the National Student Loan.

3.4 Conclusions

The arrears of the Independent College are a social problem. For the Independent Institute, it is related to the future survival and teaching level of development. We should ensure that tuition fees in full and on time is paid, at the same time, also ensure not to allow a student discontinue their studies due to financial difficulties. In short, to solve the arrears problem of Independent Colleges, students also need

to actively explore in the future run a school, continue to find new problems, and ensure the healthy development of the Independent College Education under the new mechanism.

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Chapter 4

Real Estate Industry Situation Analysis Model

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Abstract In this paper, using the multiple linear regression method we built the cobweb and gray models to forecast a model based on the national real estate data. Reasonable assumptions were built of our country using real estate industry trend analysis and sustainable development model; the model is calculated and analyzed, and the results with the T inspection and F inspection test validated for rationality. Then the reasonable explanations and suggestions are given.

Keywords Real estate · Gray prediction model · Cobweb model

4.1 Introduction

In recent years, the rapid development of the real estate industry has not only contributed to the national economy, but also played an important role in improving China's housing conditions for the common people. However, the real estate industry is also faced with more serious problems and challenges, and the disputes caused accordingly. All parties insist on their own ideas, and merely base their ideas according to the levels of policy, psychology, fund, etc., and thus their qualitative analysis outweighs the quantitative analysis. Hence, in order to find out effective measures to solve the problems, we need to clarify the current situations in real estate from the systematic perspective, to grasp the quantitative relation

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between each index from the quantitative angle, to conduct efficient regulation and control on real estate based on accurate prediction, and to obtain a profound knowledge of the Laws of Economics to realize the sustainable development [1, 2]. Thus, a research on mathematical modeling is a worthwhile direction for the real estate industry in China [3].

4.2 Situation Analysis Using Gray Prediction Model on China's Real Estate Industry

4.2.1 Model Analysis

As regards prediction analysis of the real estate industry, there are many aspects to predicting the related factors in real estate. Here, we only consider the trends of selling in real estate. The usual methods of predicting the problems are: the congruence model of dynamic data fitting [4], multiple regression (step-by-step) model and time series model [5, 6], and fuzzy combination model [7]. Professor Deng Julong of Huazhong University of Science and Technology put forward and developed the gray system theory in 1982. It drew the attention of a number of domestic and foreign scholars [8, 9], and made rapid progress over the past 10 years because of its less needed raw data [10], convenience of collection, simple methods, and high accuracy [11, 12]. Gray prediction is a kind of method of prediction for systems with uncertain factors. Although the phenomenon showed in the process is random and desultory, it is the orderly, bounded gray prediction that identifies the difference degree in the development trend of factors in the system. The so-called correlation analysis finds the regular pattern of system change for the original data, produces data sequence of strong regularity, and then establishes the corresponding differential equation model, thus predicting the future development trend and using the reflection predicted by virtue of equal intervals to predict the series features of its object.

4.2.2 Establishment of Model of China's Housing Supply

Within this model, the model to be used is GM (1, 1) of Gray prediction model. First, showing the establishment process of GM (1, 1) model, we just need to give a set of measurement data sequence $x^{(0)}(i)$.

Suppose, the given model set of data sequence is: $x^{(0)}(i) = \{x^{(0)}(1), x^{(0)}(2), \dots, x^{(0)}(n)\}$.

Once accumulation is made, the sequence is set to: $x^{(1)}(i) = \sum_{j=1}^i x^{(0)}(j) (i = 1, 2, \dots, n)$.

Now, series $x^{(1)}(i)$ weakens the influence of bad data on raw data, which just fits the following first-order single variable linear differential equation:

$$\frac{dx^{(1)}}{dt} + ax^{(1)} = u \quad (4.1)$$

Therein, a is a constant coefficient, called development gray number, and u is coordination coefficient, called endogenous control gray number. As regards the change relation of response data, order

$$Y = \left(x^{(0)}(2), x^{(0)}(3), \dots, x^{(0)}(n) \right)^T \quad (4.2)$$

$$B = \begin{pmatrix} -\frac{1}{2} [x^{(1)}(2) + x^{(1)}(1)] & 1 \\ -\frac{1}{2} [x^{(1)}(3) + x^{(1)}(2)] & 1 \\ \dots & \dots \\ -\frac{1}{2} [x^{(1)}(n) + x^{(1)}(n-1)] & 1 \end{pmatrix}, \quad U = \begin{pmatrix} a \\ u \end{pmatrix} \quad (4.3)$$

Then use the least square method based on U to get:

$$\hat{U} = \begin{pmatrix} \hat{a} \\ \hat{u} \end{pmatrix} = (B^T B)^{-1} B^T Y \quad (4.4)$$

Now substitute \hat{a} and \hat{u} into the function (4.3) and get:

$$\hat{x}^{(1)}(k+1) = \left(x^{(0)}(1) - \frac{\hat{u}}{\hat{a}} \right) e^{-ak} + \frac{\hat{u}}{\hat{a}}, \quad k = (0, 1, 2, \dots, n-1) \quad (4.5)$$

Make the subtraction reduction for function (4.5), and get the gray prediction model of raw series: $\hat{x}^{(0)}(i) = \hat{x}^{(1)}(i) - \hat{x}^{(1)}(i-1)$, $(i = 2, 3, \dots, n)$.

Thereby we get the set of function $\hat{x}^{(0)}(i)$, and suppose it is an estimate for the sale price of real estate. By the calculation of $\hat{x}^{(0)}(i)$, we can get the annual sale price of real estate.

After the modeling, we conduct a survey for the model and take advantage of raw data $\hat{x}^{(0)}(i)$ and its gray prediction model to produce the residual error: $E(k) = x^{(0)}(k) - \hat{x}^{(0)}(k)$, $(k = 1, 2, \dots, n)$. The residual error mean is:

$$\bar{E} = \frac{1}{n-1} \sum_{k=2}^n E(k), \quad (k = 1, 2, \dots, n) \quad (4.6)$$

The relative residual error is: $e(k) = \frac{x^{(0)}(k) - \hat{x}^{(0)}(k)}{x^{(0)}(k)}$.

The variance of raw data is: $S_1 = \sqrt{\frac{1}{n} \sum_{i=1}^n (x^{(0)}(i) - \bar{X})^2}$.

Therein, $\bar{X} = \frac{1}{n} \sum_{i=1}^n (x^{(0)}(i))$ $(i = 1, 2, \dots, n)$.

Table 4.1 Grade comparison table

Grade	P	C
Excellent	> 0.95	< 0.35
Good	> 0.80	< 0.45
Middle	> 0.70	< 0.50
Bad	≤ 0.70	≥ 0.65

The variance of the residual error is: $S_2 = \sqrt{\frac{1}{n-1} \sum_{k=2}^n (E(k) - \bar{E}(k))^2}$.

The posteriori error ratio is: $C = \frac{S_2}{S_1}$.

The error probability is: $P = P\{|E(k) - \bar{E}(k)| < 0.6745S_1\}$.

According to the comparison of P and C , the prediction accuracy can be divided into four grades, each grade is shown in Table 4.1.

We can make the rectification of the residual error when encountering a big error and insufficient accuracy.

Regarding the residual sequence $\varepsilon^{(1)}(k) = x^{(1)}(k) - \hat{x}^{(1)}(k)$ ($k = 1, 2, \dots, n$) as the new data sequence, making accumulation once for the positive and negative numbers in the data to neutralize them; this leads to the negation of gradually increasing sequence, so we need to make all data of positive value. The method is to seek the minimum negative value $\varepsilon^{(1)}\min$ in the residual error sequence, the value of the residual sequence adds equally $|\varepsilon^{(1)}\min + 1|$, so $\varepsilon^{(1)'}(k) = |\varepsilon^{(1)}(k) - \varepsilon^{(1)}\min + 1|$ ($k = 1, 2, \dots, n$), then establish $\varepsilon^{(1)'}$ based on GM(1.1) model and add all formats of these residual error models $\varepsilon^{(1)'}$ to the fitted value $\hat{x}^{(1)}$ of raw model to increase its accuracy.

Using RMS (root mean square): $e_s = \sqrt{\frac{1}{n-1} \sum_{i=2}^n (x^{(0)}(i) - \hat{x}^{(0)}(i))^2}$, or average relative error: $e_a = \sqrt{\frac{1}{n-1} \sum_{i=2}^n \frac{|x^{(0)}(i) - \hat{x}^{(0)}(i)|}{|x^{(0)}(i)|}}$ to calculate its accuracy.

4.2.3 Solution and Results Analysis of Situation Model of Real Estate Industry

4.2.3.1 Using the Gray GM(1.1) Model to Deal with the Statistical Data

According to the data provided to make a prediction on the 2010 sale price of commodity house (Table 4.2).

Making accumulation sequence once for the raw data, results in $x^{(1)}$ shown in Tables 4.3 and 4.4.

Establishing the matrix B , vector Y , by calculation to get:

$$\hat{U} = \begin{bmatrix} \hat{a} \\ \hat{u} \end{bmatrix} = [B^T B]^{-1} B^T Y = \begin{bmatrix} -0.076119 \\ 1307.7 \end{bmatrix} \quad (4.7)$$

Table 4.2 Sale price of commodity house

Years	Sequence number	Sale price
1994	1	1,409
1995	2	1,591
1996	3	1,806
1997	4	1,997
1998	5	2,063
1999	6	2,053
2000	7	2,112
2001	8	2,170
2002	9	2,250
2003	10	2,359
2004	11	2,778
2005	12	3,168
2006	13	3,367
2007	14	3,864
2008	15	3,800
2009	16	4,681

Table 4.3 Once accumulation data

Years	Sequence number	$x^{(0)}$	$x^{(1)}$
1994	1	1,409	1,409
1995	2	1,591	3,000
1996	3	1,806	4,806
1997	4	1,997	6,803
1998	5	2,063	8,866
1999	6	2,053	10,919
2000	7	2,112	13,031
2001	8	2,170	15,201
2002	9	2,250	17,451
2003	10	2,359	19,810
2004	11	2,778	22,588
2005	12	3,168	25,756
2006	13	3,367	29,123
2007	14	3,864	32,987
2008	15	3,800	36,787
2009	16	4,681	41,468

Substitute vector \hat{a} and vector \hat{u} into the time response equation, due to $x^{(0)}(1) = 1,409$, so it is set to: $x^{(1)}(k + 1) = 18,588.68e^{0.076119} - 17,179.68$.

Calculating the fitted value $\hat{x}^{(1)}(i)$, then by the calculation of subtraction reduction to get the calculated value $\hat{x}^{(0)}(k)$ of the model, as the first column of Table 4.4.

Table 4.4 Table for model calculation value and actual value

Model calculated value $\hat{x}^{(0)}(k)$	Actual value $x^{(0)}(k)$	Residual error $E(k)$	Relative residual error $e(k)$ (%)
$\hat{x}^{(0)}(2) = 1470.2$	$x^{(0)}(2) = 1,591$	120.8	7.5927
$\hat{x}^{(0)}(3) = 1586.5$	$x^{(0)}(3) = 1,806$	219.5	12.1540
$\hat{x}^{(0)}(4) = 1,712$	$x^{(0)}(4) = 1,997$	285	14.2710
$\hat{x}^{(0)}(5) = 1847.4$	$x^{(0)}(5) = 2,063$	215.6	10.4510
$\hat{x}^{(0)}(6) = 1993.5$	$x^{(0)}(6) = 2,053$	59.5	2.8982
$\hat{x}^{(0)}(7) = 2151.2$	$x^{(0)}(7) = 2,112$	-39.2	-1.8561
$\hat{x}^{(0)}(8) = 2321.3$	$x^{(0)}(8) = 2,170$	-151.3	-6.9724
$\hat{x}^{(0)}(9) = 2504.9$	$x^{(0)}(9) = 2,250$	-254.9	-254.9
$\hat{x}^{(0)}(10) = 2,703$	$x^{(0)}(10) = 2,359$	-344	-14.5820
$\hat{x}^{(0)}(11) = 2916.8$	$x^{(0)}(11) = 2,778$	-138.8	-4.9964
$\hat{x}^{(0)}(12) = 3147.5$	$x^{(0)}(12) = 3,168$	20.5	0.6471
$\hat{x}^{(0)}(13) = 3396.4$	$x^{(0)}(13) = 3,367$	-29.4	-0.8732
$\hat{x}^{(0)}(14) = 3665.1$	$x^{(0)}(14) = 3,864$	198.9	-5.1475
$\hat{x}^{(0)}(15) = 3954.9$	$x^{(0)}(15) = 3,800$	-154.9	-4.0763
$\hat{x}^{(0)}(16) = 4267.7$	$x^{(0)}(16) = 4,681$	413.3	8.8293

4.2.3.2 Accuracy Test and Prediction

Calculation residual error $E(k) = x^{(0)}(k) - \hat{x}^{(0)}(k)$ and relative residual error $e(k) = \frac{x^{(0)}(k) - \hat{x}^{(0)}(k)}{x^{(0)}(k)}$ are shown in the last two columns of Table 4.4.

Mean of $x^{(0)}$ is: $\bar{X} = \frac{1}{16} \sum_{k=1}^{16} x^{(0)}(k) = 2,591.75$.

Variance of $x^{(0)}$ is: $S_1 = \sqrt{\frac{1}{n} \sum_{i=1}^n [x^{(0)}(i) - \bar{X}]^2} = 899.01$.

Mean of residual error is: $\bar{E} = \frac{1}{n-1} \sum_{k=2}^n E(k) = 28.03$.

Variance of residual error is: $S_2 = \sqrt{\frac{1}{n-1} \sum_{k=2}^n [E(k) - \bar{E}]^2} = 207.35$.

Posteriori error ratio is: $C = \frac{S_2}{S_1} = \frac{207.35}{899.01} = 0.2306$.

Now, $0.6745S_1 = 0.6745 \times 899.01 = 606.38$, however, all $|E(k) - \bar{E}|$ are less than 606.38, so the small error probability is: $P = P\{|E(k) - \bar{E}| < 0.6745S_1\} = 1$.

On the basis of $P \geq 0.95$, $C = 0.2306 < 0.35$ which indicates an excellent prediction grade, we can get the available prediction equation as follows:

$$\hat{x}^{(1)}(k+1) = \left(x^{(0)}(1) - \frac{\hat{u}}{\hat{a}}\right)e^{-ak} + \frac{\hat{u}}{\hat{a}} = 18588.68e^{0.076119k} - 17179.68 \quad (4.8)$$

As the prediction grade is excellent, we can take this model to predict the sale price of real estate in the future years; here, we make a prediction on the 2010 sale price of real estate.

Making the extrapolation prediction: successively order $k = 16, 17$, and substituting them into time response Eq. (4.8), we get:

$$\hat{x}^{(16)} = 45651.84, \quad \hat{x}^{(17)} = 50621.24 \quad (4.9)$$

Thereby, based on the prediction model, the due sale price of real estate in 2010 is: $\hat{x}^{(17)} = 50621.24 - 45651.84 = 4969.4$ (RMB Yuan).

4.2.4 The Differential Equation Form of Cobweb Model for the Sustainable Development of Real Estate Industry

Model Analysis We assume that each factor in questions one and two does not influence each other, in order to realize the sustainable development of the real estate industry; in view of the conclusions drawn in questions one and two, the housing price, Engel coefficient, and population have a major influence on housing demand and supply. We should keep these variables in a specific range without much fluctuation. Next, we use the differential equation form of cobweb model to discuss the stability relation between demand and supply, and thus get the range. Therefore we suppose:

Time refers to continuous variable, price, commodity quantity vary as time goes;

The final real estate quantity in the market is simultaneously determined by supply quantity and resettlement quantity;

The housing price is simultaneously determined by housing price, Engel coefficient, and population. The more the resettlement quantity, the more the housing purchasing quantity, and the price increases accordingly.

For establishment of model of sustainable development for the real estate industry, assume the housing quantity of time is $x(t)$, housing price $y(t)$, supply quantity of unit time $g(y(t))$, quantity demanded $f(x(t))$, resettlement rate of housing and μ , increase rate of housing price as a result of resettlement is β . On the basis of questions one and two, we note that there exists a linear relation among housing price, Engel coefficient, and housing demand, as well as between population and housing supply. So based on the above supposition, we can know x, y

and fit the differential equation set:
$$\begin{cases} \frac{dx}{dt} = g(y) - \mu x \\ \frac{dy}{dt} = f(x) + \beta y \end{cases}$$

System (1.24) is a first-order differential equation set. Suppose the influencing factors of supply quantity influence supply quantity by virtue of influencing price. In general, a cheap commodity price, a less supply quantity; a high commodity price, a more supply quantity. Seeing from the supply curve, the supply function is generally viewed as the monotone increasing function. Thus, we can suppose supply function is just the linear function of price:

$$g(y) = g_0 + ay(t), \quad g_0 > 0, a > 0 \quad (4.10)$$

Demand refers to the commodity or service that consumers are willing to and able to purchase. Similarly, the quantity demanded is also influenced by several factors. Here, we also suppose these factors influence demand by virtue of influencing the price of commodity. As for normal goods, we can know from the demand curve of commodity that the cheaper the commodity price, the more quantity demanded, and vice versa. Thus, we can suppose demand function is just the linear decreasing function: $f(x) = f_0 - bx(t)$, $f_0 > 0$, $b > 0$.

$$\text{We can get: } \begin{cases} \frac{dx}{dt} = g_0 + ay - \mu x \\ \frac{dy}{dt} = f_0 - bx + \beta y \end{cases}.$$

Therefore the system is translated into first-order linear differential equation set; we can use the plane power system method to research it and for this reason we order:

$A = \begin{pmatrix} -\mu & a \\ -b & \beta \end{pmatrix}$. When $|A| = ab - \mu\beta \neq 0$, system (1.27) has unique equilibrium point $p_0 \left(\frac{af_0 - \beta g_0}{ab - \mu\beta}, \frac{\mu f_0 - bg_0}{ab - \mu\beta} \right)$. The characteristic equation of A is $\lambda^2 + (\mu - \beta)\lambda + ab - \mu\beta = 0$, its characteristic value is $\frac{(T \pm \sqrt{\Delta})}{2}$, therein, $T = \beta - \mu$, $\Delta = T^2 - 4D$, $D = ab - \mu\beta$. According to the stability theory of equilibrium point, we can get: only when $D = ab - \mu\beta > 0$, $T = \beta - \mu < 0$, $\frac{\mu\beta}{ab} < 1$, $\beta < \mu$, the equilibrium point would be stable, and the cobweb model corresponds to stability. But when $\frac{\mu\beta}{ab} < 1$ and $\beta \geq \mu$, or $\frac{\mu\beta}{ab} > 1$, the cobweb model will correspond to diverging.

According to the meanings of a , b , μ and β and the above theoretical analysis, we can make an explanation for the markets of real estate about its stability. When supply function g is fixed, that is the time a is fixed, the lesser b is the gentler the demand curve will be, which also indicates that consumers' demand to housing is more sensitive and less. If μ is rather small, then β will be far smaller than b ; if μ increases slightly, β will still keep very small, all of these are beneficial to the stability and sustainable development of real estate market. When demand function f is fixed, that is the time b is fixed, the smaller a is, the more steep the supply curve is, which means producers' sensitive degree will be less, μ will be smaller simultaneously. Housing is not only consumers' rigid demand, but also a necessity. Thus, the increased price is greater than the resettlement rate, consequently, for the benefit of the stability and sustainable development of the real estate market. The data provided in the accessory is shown in Table 4.5, which is also the table giving the house price and housing area since 2001–2010.

Using least square method to make sure the demand functions on the eight sets of data provided, including (15,541.872, 2,369), (10,920.321, 2,778),..., (57,305.196, 4,278), in which we can get $f_0 = 1,928.2265$, $b = 5.443 \times 10^{-2}$, and the demand function: $f(x) = 1928.2265 + 5.4443 \times 10^{-2}x$.

Table 4.5 2001–2010 house price and housing area

Years	House price	House quantity	Cost price
2003	2,359	15541.872	378.4
2004	2,778	10920.321	697.4
2005	3,168	22587.302	421.2
2006	3,367	26103.131	446.5
2007	3,864	31550.648	488.6
2008	3,800	38107.682	520.7
2009	4,681	45909.678	516.7
2010	4,912	57305.196	559.6

Similarly, based on the data (15541.872, 378.4), (10920.321, 679.4)... (57305.196, 559.6), we can get the supply function: $g(y) = 489.0529 + 4.7023 \times 10^{-4}x$.

We can get:
$$\begin{cases} \frac{dx}{dt} = 489.0529 + 4.7023 \times 10^{-4}y - \mu x \\ \frac{dy}{dt} = 1928.2265 - 5.4443 \times 10^{-2}x + \beta y \end{cases}$$

For the consideration of the stability of equilibrium point of system (1.30), this needs its parameters to fit the conditions; $\frac{\mu\beta}{4.7023 \times 10^{-4} \times 5.4443 \times 10^{-2}} < 1$ and $\beta < \mu$, that is $\mu\beta < 2.56 \times 10^{-5}$, and $\beta < \mu$.

Next, we attempt to calculate and get the resettlement rate and increase rate of price by means of information access or indirect method, and to draw up the figure of the system and thus to get more intuitive results. Thanks to the lack of relevant data and in order to verify its stability trend, we can suppose $\mu = 1.71 \times 10^{-2}$, $\beta = 1.5 \times 10^{-3}$, and then use Matlab software to draw up the figure of differential equation of system (1.30) as below.

Within Fig. 4.1, abscissa stands for t, initial year is 2003. We can see in Fig. 4.1 that as time goes by, the two curves gradually get closer to each other. The relation

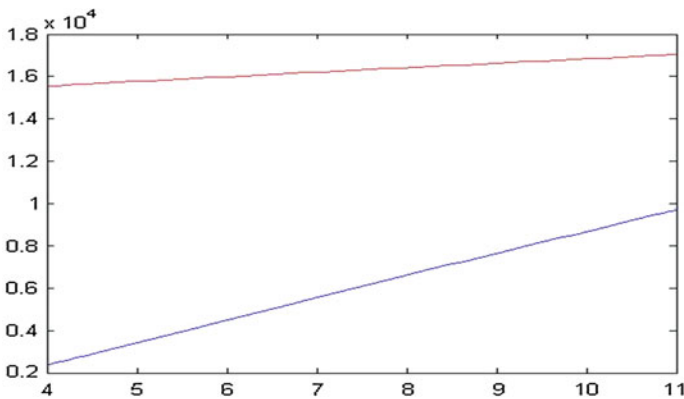


Fig. 4.1 Removal rate and price rising rate diagram

of the two is not reflected accurately enough because of their big differences in data, but after observation, we note that this system tends to be stable, which also means that our theoretical derivation and analysis on stability are reasonable and meaningful. Thus, $\mu\beta < 2.56 \times 10^{-5}$ and $\beta < \mu$, model of sustainable development is asymptotic and stable.

4.3 Suggestions for Model Improvement

We may try to establish a dynamic continuous differential equation for the supply and demand model, and to discuss its conditions fitting its stability, and thus to make a prediction and put forward relevant suggestions.

As regards the MLR model of relation of the real estate industry and other industries concerning national economy, dealing with the problems of how to quantify the relation of each industry will make their results more general.

As regards the model of sustainable development of the real estate industry, we need to deal with problems such as how to calculate resettlement rate and price increase rate caused by resettlement rate, how to use multiple fitting to get more accurate results, and how to use the model to make predictions for the stability of the real estate industry of the future.

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Chapter 5

Study on Consumer Satisfaction in Agricultural Products Supermarkets and Fairs

Lifang Zhang and Zhichao Liu

Abstract This paper gives a comparative study between consumer satisfaction in agricultural products supermarkets and in fairs using cluster analysis and gray correlation analysis methods. In order to evaluate consumer satisfaction, the first step was to select the correlative indexes and then to conduct a survey on consumer satisfaction in those two kinds of markets. The second step was to analyze the data using cluster analysis method and to sort all agricultural products supermarkets and fairs by applying gray correlation analysis method to evaluate their state of business. The results show that consumers are more satisfied with agricultural products supermarkets, and generally the state of business of agricultural products supermarkets is better than that of fairs. It is a trend in the future that fairs will change into agricultural products supermarkets.

Keywords Agricultural products supermarkets · Fairs · Cluster analysis method · Gray correlation analysis method · Consumer satisfaction

5.1 Introduction

Agricultural products supermarkets, or fresh food supermarkets, or agricultural products self-service stores are comprehensive retail stores in which agricultural products are packed according to their quality and quantities and put on the shelves with price labeled. Consumers may choose based on their needs [1, 2]. Agricultural

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products supermarkets introduce the operation principle of supermarket in their business operations [3–5]. Aiming to satisfy the one-stop shopping needs of the consumers, agricultural products supermarkets have integrated into citizens' daily life as a newly emerging business retail organization. Fairs are temporary or regular places in which agricultural products can be sold and bought freely [6]. The trade between the sellers and the consumers is its purpose and its main form is retailing. The development of fairs plays a very important role in promoting the circulation of products, increasing the income of the service group, and enriching citizens' "vegetable baskets." However, there are a lot of problems such as shopping environment, hygienic condition, and the business managements. With the improvement in people's living conditions and the civilization level of our society, fairs will transform into agricultural products supermarkets step-by-step through active promotion by the government [7–10]. Because consumers' attitudes are very important to whether this transformation will realize or not, it is necessary to make a survey on consumers' satisfaction in agricultural products supermarkets and in fairs in order to analyze the feasibility of the transformation [11].

5.2 Selection of Evaluating Indexes and Data Surveys of Agricultural Products Supermarkets and Fairs

5.2.1 Selection of Evaluating Indexes

In order to define the evaluating indexes of agricultural products supermarkets and fairs, this paper applies the assignment method to evaluate the importance degree of the produce operational indexes to the consumers. We divide this degree into five levels and assign it with 1, 2, 3, 4, and 5 points from low level to high level. Then we calculate the average degree. By reordering the degree, it shows that consumers pay more attention to price, quality, category, location, shopping environments, service, display, operating area, and packing. Therefore, this paper selects the above items as the evaluating indexes. Table 5.1 shows the data of the survey.

Conducting a weighted mean of the data in Table 5.1, the rank order of the indexes is obtained, which is presented in Table 5.2. From Table 5.2, a descending order of the nine indexes is price, quality, category, location, ambience, service, display of products, operating area, and packing.

5.2.2 Data Surveys of the Consumers' Satisfaction Level of Agricultural Products Supermarkets and Fairs

This paper selects seven samples including five agricultural products supermarkets and two fairs, labeled respectively as A, B, C, D, E, F, and G. Furthermore, we set

Table 5.1 Survey of consumers putting value on different indexes

Indexes	Strongly not value	Not value	Moderate value	More value	Strongly value	Total
Price	3	9	39	482	91	624
Category of produce	0	93	347	103	81	624
Packing	77	155	302	61	29	624
Quality	0	12	53	507	52	624
Display	86	199	202	80	57	624
Ambience	95	137	246	88	58	624
Operating area	76	248	147	95	58	624
Service	81	145	273	86	39	624
Location	45	87	314	127	51	624

Table 5.2 Ranking table of per capita consumers' attention degree

Indexes	Strongly not value	Not value	Moderate value	More value	Strongly value	Total
Price	0.48	1.44	6.25	77.24	14.58	4.0397
Category of produce	0	1.92	8.49	81.25	8.33	3.9596
Packing	0	14.9	55.61	16.51	12.98	3.2757
Quality	7.21	13.94	50.32	20.35	8.17	3.0830
Display	15.22	21.96	39.42	14.1	9.29	2.8025
Ambience	12.98	23.24	43.75	13.78	6.25	2.7708
Operating area	13.78	31.89	32.37	12.82	9.13	2.7160
Service	12.18	39.74	23.56	15.22	9.29	2.6967
Location	12.33	24.84	48.40	9.78	4.65	2.6958

X₁, X₂, X₃, X₄, X₅, X₆, X₇, X₈, and X₉ to describe, respectively, the price, quality, category, location, ambience, service, display of products, operating area, and packing.

In this paper, consumers' satisfaction with each index is divided into three scales of satisfied, moderately satisfied, and extremely satisfied. Table 5.3 outlines the survey data of the nine indexes.

5.3 Cluster Analysis of Consumers' Satisfaction in Agricultural Products Supermarkets and Fairs

Analyzing the converted data with the hierarchical function of software SPSS, the following conclusions are drawn.

During the process of hierarchical cluster, we suppose that all the seven samples belong to one category at first. And then we calculate the similarity measure

among the seven samples and combine two most similar ones. Thus, now the number of categories reduces to six. The same process is repeated again and again until all the samples come into a single category.

As indicated in Table 5.1, when all the samples fall into two parts, five agricultural products supermarkets constitute one category while the two fairs constitute another one; when the samples fall into three parts, the first category consists of supermarkets A, B, and C, the second category consists of supermarkets D and E, and the third consists of fairs F and G.

The results of the cluster show that consumers are generally more satisfied with agricultural products supermarkets than fairs, which means that the former operate better than the latter.

5.4 Gray Correlation Analysis of the Operation Status of Agricultural Products Supermarkets and Fairs

In order to analyze the advantages and disadvantages of the two kinds of markets in detail, it is necessary to sort the operation status of these supermarkets and fairs with gray correlation analysis.

5.4.1 Setting the Reference Array and the Comparing Array

First of all, in order to estimate the operation status of these supermarkets and fairs, the reference array should be constructed. It should be built on the principle of relative optimization, which means that it is made up of the optimal values of each index in each comparative sequence. Particularly, in this paper, the maximum value is also the optimal value. The reference array here should be $x_0 = [59.43, 70.67, 61.94, 86.37, 74.33, 89.25, 79.37, 64.28, 77.59]$ according to the collected data in Table 5.3. Thus, the comparing array is the matrix D:

Table 5.3 Consumers' satisfaction with fairs and supermarkets (%)

Markets	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9
A	33.72	45.68	39.55	65.62	49.25	47.83	37.69	45.91	61.47
B	55.86	42.19	39.57	50.76	43.67	40.34	32.58	48.88	39.75
C	32.81	42.88	42.94	45.37	45.97	32.69	59.88	37.68	57.85
D	35.89	70.67	57.95	70.34	74.33	81.37	75.46	58.16	62.50
E	39.15	67.33	61.94	86.37	67.59	89.25	79.37	64.28	77.59
F	53.87	29.31	21.37	23.84	17.86	17.65	19.67	16.79	39.67
G	59.43	37.81	26.37	23.90	18.92	21.81	25.13	17.13	35.37

$$D = \begin{bmatrix} 59.43 & 70.67 & 61.94 & 86.37 & 74.33 & 89.25 & 79.37 & 64.28 & 77.59 \\ 33.72 & 45.68 & 39.55 & 65.62 & 49.25 & 47.83 & 37.69 & 45.91 & 61.47 \\ 55.86 & 42.19 & 39.57 & 50.76 & 43.67 & 40.34 & 32.58 & 48.88 & 39.75 \\ 32.81 & 42.88 & 42.94 & 45.37 & 45.97 & 32.69 & 59.88 & 37.68 & 57.85 \\ 35.89 & 70.67 & 57.95 & 70.34 & 74.33 & 81.37 & 75.46 & 58.16 & 62.50 \\ 39.15 & 67.33 & 61.94 & 86.37 & 67.59 & 89.25 & 79.37 & 64.28 & 77.59 \\ 53.87 & 29.31 & 21.37 & 23.84 & 17.86 & 17.65 & 19.67 & 16.79 & 39.67 \\ 59.43 & 37.81 & 26.37 & 23.90 & 18.92 & 21.81 & 25.13 & 17.13 & 35.37 \end{bmatrix}$$

5.4.2 Initialization Transformation

Due to the dimension and order of magnitude among indexes in the original series, it is impossible to make a direct comparison. Thus, it is necessary to make a scale processing of the original series and unify the polarity of the maximum index Eq. (5.1).

$$x_i(k) = \frac{x_i(k)}{\max x_i(k)}. \tag{5.1}$$

As shown in Table 5.4, a new gray relation space is reached after the dimensionless processing of all the indexes by Eq. (5.1) and matrix D.

5.4.3 To Solve the Date Column of Differences

Table 5.5 is made according to Eq. (5.2).

$$\Delta_i(k) = |x'_0(k) - x'_i(k)|, \quad i = 1, 2, 3, \dots, 7. \tag{5.2}$$

Table 5.4 Statistics of the gray relation space

X_i	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9
A	0.5674	0.6464	0.6385	0.7598	0.6626	0.5359	0.4749	0.7142	0.7922
B	0.9399	0.5970	0.6388	0.5877	0.5875	0.4520	0.4105	0.7604	0.5123
C	0.5521	0.6068	0.6933	0.5253	0.6185	0.3663	0.7544	0.5862	0.7456
D	0.6039	1	0.9356	0.8144	1	0.9117	0.9507	0.9048	0.8055
E	0.6588	0.9527	1	1	0.9093	1	1	1	1
F	0.9064	0.4147	0.3450	0.2760	0.2403	0.1978	0.2478	0.2612	0.5113
G	1	0.5350	0.4257	0.2767	0.2545	0.2444	0.3166	0.2665	0.4559

Table 5.5 Differences data

X_i	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9
A	0.4326	0.3536	0.3615	0.2402	0.3374	0.4641	0.5251	0.2858	0.2078
B	0.0601	0.4030	0.3612	0.4123	0.4125	0.5480	0.5895	0.2396	0.4877
C	0.4479	0.3932	0.3067	0.4747	0.3815	0.6337	0.2456	0.4138	0.2544
D	0.3961	0	0.0644	0.1856	0	0.0883	0.0493	0.0952	0.1945
E	0.3412	0.0473	0	0	0.0907	0	0	0	0
F	0.0936	0.5853	0.6550	0.7240	0.7597	0.8022	0.7522	0.7388	0.4887
G	0	0.4650	0.5743	0.7233	0.7455	0.7556	0.6834	0.7335	0.5441

5.4.4 To Solve the Correlation Coefficients

Table 5.6 is made by substituting the variables of Table 5.6 into Eq. (5.3). $\xi = 0.5$

$$r_{0i} = \frac{m + \xi M}{\Delta_i(k) + \xi M}. \tag{5.3}$$

5.4.5 To Solve the Correlation Degrees

The state of business in agricultural products supermarkets and fairs is listed in Table 5.7, which is made by summing the variables of Table 5.6 using Eq. (5.4).

$$r_{0i} = \frac{m + \xi M}{\Delta_i(k) + \xi M}. \tag{5.4}$$

From the results of the gray correlation analysis, supermarket E has the best state of business with the index value of 0.9167; supermarket D ranks second with the index of 0.8045; supermarkets A, B, C follow with 0.5385, 0.5318, 0.5141; fairs G and F rank the last two with 0.4528 and 0.4204.

To sum up, in the selected samples, supermarket E ranked top in both consumer satisfaction and state of business. For price, supermarket E ranked third with

Table 5.6 Correlation coefficients

r	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9
A	0.4811	0.5315	0.5260	0.6254	0.5431	0.4636	0.4331	0.5840	0.6588
B	0.8697	0.4988	0.5262	0.4931	0.4930	0.4226	0.4049	0.6261	0.4513
C	0.4724	0.5050	0.5667	0.4580	0.5125	0.3876	0.6203	0.4922	0.6119
D	0.5032	1	0.8616	0.6837	1.0000	0.8196	0.8906	0.8082	0.6735
E	0.5403	0.8946	1	1	0.8156	1	1	1	1
F	0.8109	0.4067	0.3798	0.3565	0.3455	0.3333	0.3478	0.3519	0.4508
G	1	0.4631	0.4112	0.3567	0.3498	0.3468	0.3699	0.3535	0.4243

Table 5.7 Correlation degrees

r	rE	rD	rA	rB	rC	rG	rF
Value	0.9167	0.8045	0.5385	0.5318	0.5141	0.4528	0.4204

supermarkets G and F ahead; for variety, supermarket E ranked second, a little inferior to supermarket D; for packing, supermarket E ranked top; for quality, which consumers put much value on, supermarket E won 86.37 % degree of satisfaction, which means the majority of the consumers are satisfied with its quality. In products display, supermarket E ranked second with 67.59 % degree of satisfaction; in other aspects which present the infrastructure of agricultural products supermarkets such as ambience, service, business operation, and location, supermarket E is far ahead of the other agricultural trade places.

5.5 Conclusions

With the rapid development of our national economy, traditional fairs have become more and more unfit for the daily needs of the consumers and have affected the planning and harmonious development of the city. Against this background, the transformation from fairs to agricultural products supermarkets is the irresistible general trend. In terms of consumer satisfaction, a scientific and systematic analysis on the business operation state of both fairs and agricultural products supermarkets has been done by applying agglomerative and gray relative analysis methods. The conclusions show that consumers are more satisfied with the business operation state of agricultural products supermarkets and they welcome the transformation from fairs to supermarkets; generally, the business operation state of agricultural products supermarkets are better than that of fairs. Supermarket E has the best business operation state and it can be taken as a sample that regulates the agricultural trade markets during the transformation from fairs to agricultural products supermarkets.

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Chapter 6

Study on Corporate Governance Based on Acquirer's Long-Term Performance Analysis

Zhang Jia and Han Liyan

Abstract This paper is the first attempt to investigate into the relationship between the overall governance level and firm performance. Using 114 M&As occurred during 2006–2007, this paper investigates the relationship between the corporate governance of listing firms in China and the performance after M&As. The result shows that board size, CEO salary, and the share percentage held by the blockholder have significant impacts on firm performance after M&As. Whether firms are state owned, the counterbalance among shareholders can impact firm performance after M&As together with share percentage held by the blockholder. By constructing an index which can reflect the comprehensive corporate governance, this paper also concludes that the general corporate governance has positive impact on firm performance.

Keywords Corporate governance · M&As · Blockholder · Firm performance

6.1 Introduction

One of the most significant factors driving firm performance over recent years is without any doubt the blossoming of mergers and acquisitions (M&As). M&As are also one of the most fundamental forms of firm control market and have great influence on firm performance. The most substantial objective that one firm acquires from another is to gain synergy effect. However, a great many academic researches,

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using worldwide data of countries including China find that most M&As cannot enhance firm value as expected in terms of increasing stock price [1, 2]. Besides the research on the short-term stock price effect that M&As bring to the acquirer, there are also a great many papers probing into the long-term operating performance impact caused by M&As [3]; however, the results are mixed without any uniform conclusion that can be widely accepted. Some of them find that better corporate governance can improve the acquirer's performance while others argue that there is no significant relationship between the two variables.

The unique characteristics of the concentrated ownership pattern add to new perspectives of the research on the relationship between corporate governance and firm performance change following M&As. In countries where ownerships are more concentrated with the protection of shareholders' benefit weak, controlling shareholders can expropriate the benefit of minority shareholders by "tunneling". M&As are mentioned as one of the most important tunneling and this may do harm to a firm's long-term value. Ownership pattern in China can also be labeled as "concentrated" and tunneling through M&As is also a very common phenomenon. The overall conclusion can be generalized that some governance mechanisms are crucial to the acquirer's performance while others do not play any significant role in the post-M&A performance. They cannot come to a uniform conclusion due to the different empirical methods that they adopt.

6.2 Relevant Theories and Hypotheses

Corporate governance is a set of rules which aims at mitigating agency costs. Based on the two types of agency problems, corporate governance can also be categorized into manager governance mode and blockholder governance mode. In a literature review by Becht et al. (2003), five basic corporate governance mechanisms are identified: (1) takeovers; (2) blockholders; (3) boards; (4) executive compensation; and (5) minority shareholder action. These different mechanisms play different roles in each governance mode. In manager governance mode, the constraint imposed on managerial decisions by the firm board is very crucial, while controlling shareholders as well as other blockholders plays a substantial role in blockholder governance mode. Listed firms in China have highly concentrated ownership structures due to their unique and historical institutional reasons and the governance mode is obviously dependent on the role of blockholders, especially the controlling shareholders. Thus, this paper investigates three types of governance mechanisms including the board, executive compensation, and blockholders.

According to the basic theories on corporate governance, several hypotheses are proposed as follows. H1: the acquirer's performance change following M&As is negatively related to the size of the board. H2: the acquirer's performance change following M&As is positively related to the executive compensation. H3: the acquirer's performance change following M&As is positively related to the ownership

of controlling shareholders. H4: the acquirer's performance change following M&As is positively related to the shareholder counterbalance. H5: the acquirer's performance change following M&As of state-owned firms is worse than their non-state-owned counterparts.

Despite the three main governance mechanisms, including five variables, discussed above, Berry et al. (2006) argue that different governance mechanisms are substitutable to some extent. The effect of single governance factors cannot replace the comprehensive impact of the overall level of corporate governance. It is not precise to draw conclusions on the impact of overall level of governance, based on only one or several aspects of governance mechanisms. With the purpose of tackling this problem, an index containing comprehensive governance information is constructed to capture the overall level of corporate governance with principle component method, following Nogata et al. [4]. Using the sample data, the principle can be written as:

$$\text{Index} = -0.115\overline{\text{Boardsize}} + 0.125\overline{\text{Executive}} + 0.624\overline{\text{Block}} - 0.614\overline{\text{Counterbalance}} + 0.444\overline{\text{Stateown}} \quad (6.1)$$

Variables that appear in the formula above are all standardized. With the increase of this index, the overall level of corporate governance is getting better. Consequently, hypothesis 6 is naturally proposed as follows.

H6: the acquirer's performance change following M&As is positively related to corporate governance index.

6.3 Empirical Research

We construct a sample of 114 M&As happened during 2006–2007 that can be obtained for further analysis.

In our regression models, COPCFR is used as the dependent variable. Core corporate governance variables, together with some other control variables, are chosen as independent variables (Tables 6.1, 6.2).

Using the five core corporate governance mechanisms as the main explanatory variables, Models (1)–(5) probe the relationship of single governance factor and the acquirers' performance change following M&As. Generally speaking, those coarse conclusions in Sect. 6.3 are further approved by our single governance factor regression models, despite the fact that subtle difference still exists.

The coefficient of variable Boardsize is -0.538 and significant at 10 % level, affirming H1 that there exists a negative relationship between the size of firm board and performance change. The possible explanation for this seemingly "abnormal" negative correlativity compared with Western countries' reversed U-shape relationship is that the board size is so big that the incremental effect of board size is just the decrease of management efficiency. It can be safely concluded that executive compensation also has a significant influence on the performance

Table 6.1 Regression model (1)

	(1)	(2)	(3)	(4)	(5)
Constant	-13.508 (-1.642)	-11.022 (-1.455)	-10.296 (-1.396)	-9.235 (-1.121)	-10.559 (-1.390)
Board size	-0.538* (-1.767)				
Stateown		3.071 (1.335)			
Counterbalance			-12.229 (-1.353)		
CEO holding				0.226* (1.662)	
Block					0.167** (2.233)
Blocksquare					
Block × Stateown					
Block × Counterbalance					
Index					
BM	12.016** (2.160)	10.663* (1.882)	11.803* (2.096)	11.906** (2.102)	11.758* (2.084)
Growth	0.003 (1.509)	0.003 (1.351)	0.002 (1.223)	0.002 (1.263)	0.003 (1.278)
Leverage	-4.408 (-0.758)	-4.573 (-0.781)	-4.798 (-0.804)	-4.125 (-0.700)	-5.181 (-0.863)
ROA	22.040 (0.851)	19.286 (0.734)	18.908 (0.692)	23.988 (0.912)	20.725 (0.752)
Focus	-0.627 (-0.264)	-0.576 (-0.241)	-0.816 (-0.338)	-0.676 (-0.280)	-0.770 (-0.318)
Liquidity	5.510* (1.747)	5.212 (1.637)	6.033* (1.890)	5.167 (1.614)	5.459* (1.708)
Payment	-0.389 (-0.089)	-1.183 (-0.269)	-0.445 (-0.101)	-0.707 (-0.159)	-0.333 (-0.075)
R ² Adjusted	0.198	0.127	0.142	0.205	0.169
F	1.514*	1.222	1.330	1.565*	1.683*

T-values are shown in parentheses. *, **, and *** indicate statistical significance at 10, 5, and 1 %, respectively. We do not report the coefficients of year and industry dummies.

change, given the fact that the coefficient of variable Executive is 0.226 and significant at 10 % level. H2 is approved again by our regression model. With regard to the blockholder mechanisms, empirical results from our single factor regression models are still ambiguous. On one hand, the variable Block has a positive coefficient 0.167, significant at 5 % level. This makes it clear that the ownership of controlling shareholders has a positive impact on the performance

Table 6.2 Regression model (2)

	(6)	(7)	(8)	(9)	(10)
Constant	-10.574 (-1.430)	-8.294 (-1.060)	-11.254 (-1.309)	-13.358 (-1.085)	-9.557 (-1.298)
Board size				-0.743** (-2.043)	
Stateown				3.669 (1.449)	
Counterbalance				-12.256 (-1.246)	
CEO holding				0.279* (1.719)	
Block	0.153* (1.768)	0.163** (2.178)	0.393** (2.002)	0.508* (1.708)	
Blocksquare	0.006 (1.417)				
Block × Stateown		0.110* (1.698)			
Block × Counterbalance			-0.572* (-1.832)		
Index					2.702** (1.989)
BM	12.065** (2.147)	11.032* (1.947)	12.401** (2.207)	10.324* (1.813)	11.697** (2.069)
Growth	0.003 (1.321)	0.003 (1.324)	0.003 (1.285)	0.003 (1.430)	0.003 (1.295)
Leverage	-4.193 (-0.701)	-4.793 (-0.800)	-4.142 (-0.694)	-5.191 (-0.872)	-4.354 (-0.734)
ROA	20.993 (0.766)	21.317 (0.775)	22.580 (0.824)	16.040 (0.586)	21.867 (0.809)
Focus	-0.151 (-0.062)	-0.395 (-0.162)	-0.178 (-0.073)	-0.553 (-0.229)	-0.777 (-0.320)
Liquidity	5.439* (1.700)	5.247 (1.642)	5.587* (1.759)	5.775* (1.815)	6.067* (1.890)
Payment	-1.446 (-0.327)	-1.338 (-0.301)	-1.667 (-0.376)	-1.946 (-0.433)	-0.769 (-0.174)
R ² Adjusted	0.261	0.284	0.304	0.273	0.259
F	1.679*	1.819**	1.523*	1.693*	1.758**

T-values are shown in parentheses. *, **, and *** indicate statistical significance at 10, 5, and 1 %, respectively. We do not report the coefficients of year and industry dummies.

change, namely the alignment effect of H3 is supported. But still, we cannot draw any inference on the entrenchment effect based on our single governance factor regression models. On the other hand, although the signs of Counterbalance and Stateown are approvals of H4 and H5, we cannot make any safe conclusions because of the insignificance of the two variables.

We design models (6)–(8) to embrace the entrenchment effect into our regression models. With the purpose of including the entrenchment effect into our new designed models, we introduce the square item of variable Block, namely Blocksquare, to capture the entrenchment effect. In model (6), Block is still statistically significant while Blocksquare is not. The result means that the entrenchment effect does not hold in our model, contrary to Ben-Amar and André [5] and Zhu and Chen [6]. That is to say, even after taking entrenchment effect into our consideration, H3 still holds due to the fact that the coefficient of Blocksquare is not significant, revealing that only alignment effect works in our sample.

To inspect the potential cross-effect of Counterbalance and Stateown, now we introduce cross-items formed by Block times Counterbalance and Stateown, respectively, namely Block \times Counterbalance and Block \times Stateown. In models (7) and (8), Block is even more significant with the significance level increasing to 5 %. What is more, the cross-items, Block \times Counterbalance and Block \times Stateown, are all significant at 10 % level and the signs conform to our expectations. Thus, we can safely conclude that Counterbalance and Stateown also play an important role. Counterbalance and Stateown are somewhat special owing to the fact that these two blockholder mechanisms cannot work individually. Only combined with Block can they work on the performance change following M&As.

We introduce another two models to achieve this goal. In model (9), we use all the five governance mechanisms together as the main explanatory variables. The empirical results illustrate that all the signs of main explanatory variables are consistent with our expectations. Boardsize, Executive, and Block are still significant in model (9) while Stateown and Counterbalance are no longer statistically significant. But it is still very difficult for us to make any comment on the issue “how the overall governance level affects the acquirer’s performance change following M&As”. In terms of Boardsize, Executive, and Block, we can conclude that corporate governance does affect the performance change. While with regard to Stateown and Counterbalance, it seems that there is no obvious relationship between corporate governance and firm performance. Due to the fact that it cannot come to a uniform conclusion on the important issue, model (9) is not an ideal model for us to investigate into the relationship of the overall governance level and performance change.

The corporate governance index we constructed in the previous section is a comprehensive scale of the overall corporate governance level, containing all key information that the five main governance variables have. Using Index as the main explanatory variables, the embarrassment we encounter in model (9) can be effectively avoided and this is what we do in model (10). The coefficient of index is 2.702 and significant at 5 % level, which shows that a better overall corporate governance level leads to a better performance change.

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Chapter 7

Research on Chinese Marxism Social Development Theory Based on Analytic Hierarchy Process

Qiulan Chen

Abstract Chinese Marxism is the Marxism developed according to the product of China's specific national conditions and practical basis of Marxism; it is a continuation of the progress and vitality of the era of Marxist thought and development. In this paper, using the mathematical models based on modeling studies, the structural analysis of Marxism in China is studied for a complete grasp of the overall meaning of Marxism., as a better guide to China's socialist modernization, and to solve different periods of the line, principles, and other important decision-making problems to provide a solid theoretical basis.

Keywords Marxism · Hierarchy · Mathematical model · Analytic hierarchy process

7.1 Introduction

The term Marxism in China, a combination of Marxism with China's national conditions, was determined by China's Chairman Mao Zedong. He put forward in simple terms, what is Marxism in China, the basic principles of Marxism, and the Chinese revolution and construction, combining all to arrive at a suitable route for China's socialist revolution and construction [1, 2].

The theory of social development of Marxism in China is a continuous process of exploration of efforts to achieve the close integration of Marxism with China's national conditions [3]. This entire process, includes Chairman Mao Zedong's,

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thoughts and Deng Xiaoping, (Deng Xiaoping Theory) who explored Marxism in China and, of course, Mr. Chen Duxiu, the founder and leader of the Communist Party of China, an important leader for the party's Marxist exploration dedicated his life to establish a Marxist regime [4]. The next step was the sublimation of the theory of Marxism in China by the three representatives before President Jiang Zemin. President Hu Jintao put forward the scientific concept of development, which more fully reflects the combination of Marxism with China's specific national conditions and for which unremitting efforts should be made to further promote the process of Marxism in China. Because of the theoretical achievements of Marxism in China, which guided the great cause of the Party, the people continue to win. This provides us a powerful spiritual pillar for the cohesion of the whole Party and all Chinese nationals. The most important thing in Marxism in China is the distinctive theoretical expression of the scientific attitude and the fine style of work. We treat Marxism as the successor of the twenty-first century and we need to constantly open up a new realm of Marxism in China.

7.2 The Establishment of the Level of the Marxism Social System

In the world today, there are two systems: the private ownership system and the public ownership system [5]. The capitalist and feudal systems belong to the private ownership system and the socialist system belongs to the public ownership system. The classical Marxist literature defines that the socialist system has three basic elements: public ownership; planned economy; and democracy. The socialist system is the basic system of the People's Republic of China.

Stage 1 was the first meeting of the First National People's Congress held on September 15, 1954 in Beijing. On behalf of 1,210 members the tasks of this meeting were: the constitution, the development of several important laws; the consideration of the government work report; to elect new national leaders, meeting the provisions of the agency model as shown in Fig. 7.1.

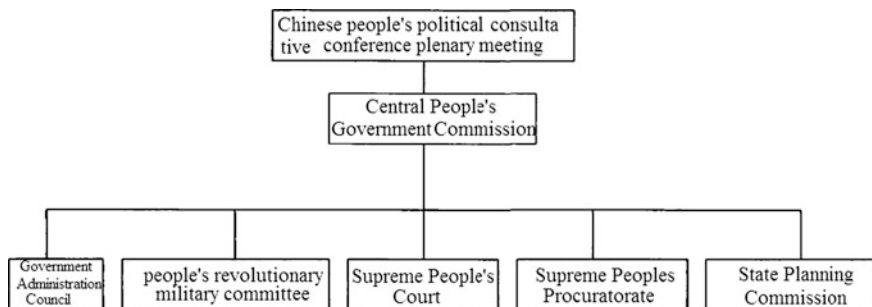


Fig. 7.1 Central state institutions mode

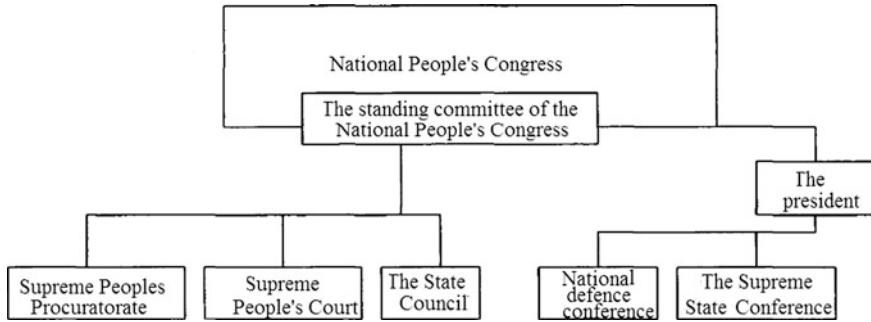


Fig. 7.2 China’s national institutions mode

Stage 2 was promulgation of the Constitution of the People’s Republic of China. It is the fundamental law of the People’s Republic of China, whose provisions have the highest legal effect. The People’s Republic of China developed a total of four Constitutions, existing Part IV of the Constitution in 1982, which was adopted by the Fifth National People’s Congress. And after 1988, 1993, 1999, and 2004, four amendments constituted the organization to discuss the national affairs. The specific model is shown in Fig. 7.2.

Stage 3 was the constitutional reform. It cancelled the presidential organizational system and the Prime Minister Di Mingquan, because at that time the Cultural Revolution was strongly colored, hence a serious shortcoming and the error of the constitution. The graphics do not display this.

Stage 4 in 1978 was the revision of the constitution. On March 5, 1978, the fifth session of the National People’s Congress held the first meeting with Chapter 4 of Article 60, which is known as the Seven–eight Constitution. The constitution again, within the specified China national agency model, corrected the mistake of the constitution of the seventh regulation, as shown in Fig. 7.3.

Constitutional research has been established for 20 years. In these 20 years the constitution after four changes has led to the development of the future 20 years. The development of the constitution accompanied with constitutional jurisprudence obtained the development, especially the development of Marxism [6]. This is along the correct road of constitutional jurisprudence on the results. Lenin said: “the way of the theory of Marxist along the forward, we will increasingly close objectivity (but never end it); and any other along the road ahead, in addition to chaos and falsehood and outside, we get nothing.” In order to make constitutional jurisprudence on the way to science to move on Marxism, continue to adhere to the basic principle of law. Marxism is known as the truth of the world system.

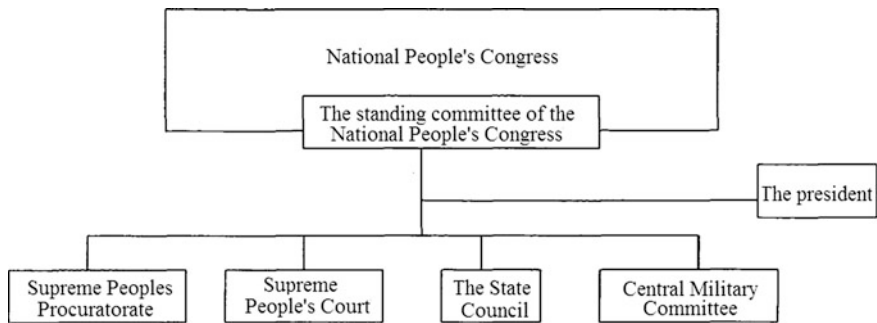


Fig. 7.3 New national institution mode

7.3 Marxism Social Development Based on the AHP Method

Analytic Hierarchy Process (AHP) is about the decision decomposed into target, criterion elements, such as scheme level, based on the qualitative and quantitative analysis for the decision-making method [7, 8]. In the United States house of operations research, a professor at the University of Pittsburgh in the 1970s, in his research for the department of defense stated, “according to various industrial department of national welfare contributions and electric power distribution” topics, the application of the network system theory and multiobjective synthesis evaluation method puts forward a kind of level of weight decision analysis method.

7.3.1 The Three Steps of AHP Method

The three steps of the AHP method are shown in Table 7.1.

Table 7.1 The steps of AHP method

Step 1	Analysis of all factors in the system, the relation between the same level of each element on a level of the importance of a standards comparison between two, two comparison of the two tectonic judgment matrix
Step 2	Judgment through matrix calculation is to compare elements for the relative weight of this code, and the consistency of the judgment matrix inspection
Step 3	Calculation of all levels for the system total sort the weight and sorting
Step 4	Total order of the goals of all the schemes

Table 7.2 Index definition

Scale	Definition
1	In contrast, they have the same importance
3	In contrast, one factor is slightly important than the other
5	In contrast, one factor is obviously important than the other
7	In contrast, one factor is strongly important than the other
9	In contrast, one factor is extremely important than the other
2,4,6,8	Between the two scales The ratio of the importance of u_i and u_j is n

7.3.2 The Establishment of the Weight of Index System of Each Layer in Chinese Marxism

In order to extract useful information for the regularity of things from the judgment matrix, and provide a scientific basis for decision-making, they need to calculate the judgment matrix of the weight of the vector. We define judgment matrix, such as, if established, said the meet consistency, called the consistency matrix.

Chinese Marxism level analysis chooses methods on a scale of one–nine, the influence of the development of Marxism to the relative importance of evaluation; the meaning of the index is shown in Table 7.2.

7.3.3 Establishment of the Mathematics Model

First make sure A is judgment matrix.

Then the judgment matrix R's all the product of each element r_{ij} [9]:

$$R = \begin{bmatrix} r_{11} & r_{12} & r_{13} & r_{14} & r_{15} \\ r_{21} & r_{22} & r_{23} & r_{24} & r_{25} \\ r_{31} & r_{32} & r_{33} & r_{34} & r_{35} \end{bmatrix} \tag{7.1}$$

Establish weighted function: with focus on factors, according to the different degrees of importance, the corresponding weight distribution is given as [10]:

$$A = (a_1, a_2, a_3) \tag{7.2}$$

Tectonic good judgment matrix needs according to the judgment matrix calculation for a rule layer the relative weight of each element, and consistency examination. Although in tectonic judgment matrix when a judge does not require consistency, judging from excessive consistency is not allowed. Therefore, there is a need to make consistency examination on judgment matrix A.

$$B = A^*R = (b_1, b_2, b_3, b_4, b_5) \tag{7.3}$$

Table 7.3 The weight of the Chinese Marxism system

Target layer	R1 = 0.311578	R2 = 0.502145	R3 = 0.135214	R4 = 0.090452	R4 = 0.090452
Index layer	$r_{11} = 0.187541$	$r_{12} = 0.061262$	$r_{13} = 0.216309$	$r_{14} = 0.184756$	$r_{15} = 0.120978$
	$r_{21} = 0.154892$	$r_{22} = 0.223547$	$r_{23} = 0.064254$	$r_{24} = 0.307541$	$r_{25} = 0.449527$
	$r_{31} = 0.3548952$	$r_{32} = 0.302546$	$r_{33} = 0.125475$	$r_{34} = 0.125874$	$r_{35} = 0.156639$

Namely,

$$B = (a_1, a_2, a_3) * \begin{bmatrix} r_{11} & r_{12} & r_{13} & r_{14} & r_{15} \\ r_{21} & r_{22} & r_{23} & r_{24} & r_{25} \\ r_{31} & r_{32} & r_{33} & r_{34} & r_{35} \end{bmatrix} = (b_1, b_2, b_3, b_4, b_5) \quad (7.4)$$

$$B = A * R = (b_1, b_2, b_3, b_4, b_5) \quad (7.5)$$

This means $B = (a_1, a_2, a_3) * \begin{bmatrix} r_{11} & r_{12} & r_{13} & r_{14} & r_{15} \\ r_{21} & r_{22} & r_{23} & r_{24} & r_{25} \\ r_{31} & r_{32} & r_{33} & r_{34} & r_{35} \end{bmatrix} = (b_1, b_2, b_3, b_4, b_5)$

For A judgment matrix, which gives the characteristic value: $\lambda \text{ Max} = 3.95741$, and the feature vector: (0.295587, 0.46871, 0.135102, 0.08246), when $n = 4$, $RI = 0.02458$, $RP = 0.036841 < 0.1$, it has satisfactory consistency.

The results are shown in Table 7.3.

Finally, the statistical classification through the use of software SPSS statistical, concluded that it will be the product of a matrix. The calculation results, for the data 6.98547, indicate that the process of Marxism, is in a good state of development. China is at a higher level in the creation of Chinese Marxism ideological and political development.

7.4 Conclusion

The theory of Marxism, combined with the concrete realities of China’s combination can bring forth a strong vitality and can promote the socialist modernization drive. Marxism is the fundamental guiding principle of our party; the practice has proved that the ideological and theoretical basis of this guidance at any time, under any circumstances cannot be lost and cannot be divorced from China’s specific national conditions, or our cause will be lost, because there is no correct theoretical guidance and ideological for the disoriented soul. As a younger generation of Marxists, who are charged with the important task of building the motherland, we should unswervingly adhere to the ideology of Marxism and integrate it into China to be used by the Chinese people.

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Chapter 8

SWOT Analysis of the Innovative Strategies of Independent Colleges' Development Norms—Taking Zhejiang University of Finance and Economics Dongfang College for Example

Ge Mao and Dongliang Huang

Abstract The No. order 26 issued by the Ministry of Education orders the promulgation of the truly and standardized independent running of schools and colleges, and for improvement of the educational quality. It guides and promotes the healthy development of independent colleges, which is an important measure. Independent colleges have to develop, and they must be according to the norms of the standard set for development, for innovative development, in order to provide standard quality education. In this paper, we use the SWOT analysis method, using the strategic environmental analysis of Zhejiang University of Finance and Economics, Dongfang College, and take the opportunity to make a strategic choice. For the development of the college, strategic target key research brand strategy, market orientation strategy, differentiation strategy, and target cluster strategy, we put forward the strategic implementation and strategic control evaluation mechanism.

Keywords Independent colleges · Standardization construction · Innovative development · SWOT analysis · Innovative strategies of development

8.1 Introduction

By the end of the 1990s, with much vigor and vitality, independent colleges were established. The increased enrollment in the colleges across the country turned out to be a major breakthrough in the innovation mechanism and model reform of higher education in China. The independent institutes took 13 years to take shape,

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and has become an important part of the higher education system [1, 2]. In February 2008, the Ministry of Education issued Order 26 set of Independent Colleges and management approach to clear the legal property of the independent Institutes, management system, setting standards, education and teaching, asset management, and legal system, marking the independent colleges in China to enter the legal system management track, and thus regulating the development of the independent institutes [3].

A good example of an independent institute outside Zhejiang province is the Zhejiang University of Finance and Economics, Dongfang College, which realized a good start, smooth operation, and positive development. The college faculty and staff carry forward the arduous spirit of struggle, keeping pace with the times, with continuous innovation, and actively explore a new mechanism and mode of the independent college rule. For some running experience certain achievements have been made, make the institute the construction and development of further accelerate the pace, running process further standardize, further improve managerial condition, and then realized the scale, structure, quality, and benefit the coordinated development, which shows a good momentum of development.

8.2 Research Methods

8.2.1 Frame Structure

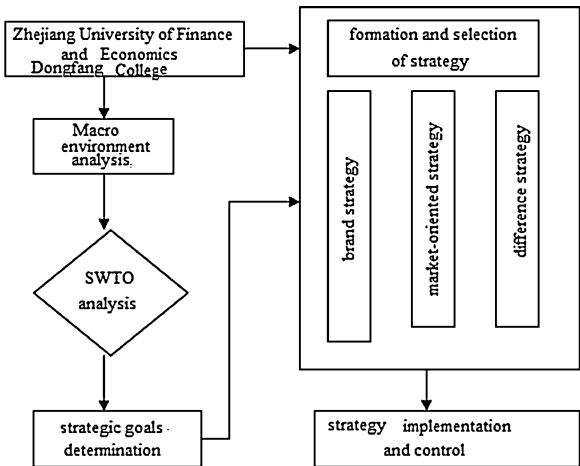
SWOT analysis method (also called TOWS analysis method, and the word matrix) is actually situation analysis; it was put forward in the 1980s by Warily Rick, an American professor of management. SWOT represents [4]: Strength (Strength) and disadvantages (Weakness), Opportunity (Opportunity) and threat (Threats). SWOT analysis, which is one of the most commonly used methods, is often used to make group development strategy and analysis competitor in strategic analyses. This paper first goes through macro environment analysis and then through SWOT analysis; it is concluded with strategic objectives. The framework is shown in Fig. 8.1.

8.2.2 Numerical Calculation and SWOT Strategic Analysis

We adopt the method of mathematical analysis of strategic model.

Single overall t inspection is the test of a sample mean and a general average known if the difference is remarkable. When the general distribution σ is a normal distribution, such as general standard deviation unknown and sample capacity < 30 , then sample mean and overall average deviation statistics is distribution. Test statistics is [5]

Fig. 8.1 Framework



$$t = \frac{\bar{X} - \mu}{\frac{\sigma_X}{\sqrt{n-1}}} \frac{1}{n} \tag{8.1}$$

If the sample belongs to a large sample (n > 30), it can also be written as [6]

$$t = \frac{\bar{X} - \mu}{\frac{\sigma_X}{\sqrt{n}}} \tag{8.2}$$

Here, *t* is the sample average and overall average deviation statistics; *X* is sample average; *μ* is general average; *σ_X* is sample standard deviation; *n* is sample size.

1. SO strategy

The higher education evaluation system of the state regulates that the reform and development of the discipline in college and the major settings are identical with each other;

The country’s concern for university graduates can further strengthen and establish the employment and education system and at the same time, through cooperation with enterprises, invite enterprise professionals to provide employment and entrepreneurship education as a complement to the teachers;

Use the existing course and information management system, adjust the course structure, optimize the course system, deal with the foundational and professional courses, required courses, and the relationship between the elective course;

Build good public basic, professional, and various specialized course platforms and resources which can be shared;

Combine teaching assessment, promote development through evaluation, increase software and hardware, actively use state policies, award bachelor’s degrees, and also award applications for preparation for private colleges and universities.

2. ST strategy

Use the formed orientation characteristics with the combination of industry and enterprise for depth of cooperation, and reinforce the advantage in this area letting oneself be more professional, more standardized, realize the education industry with IT kind of professional templates and standards, the face of the industry from forming characteristic brand;

Higher education faces competition from home and abroad, the use of the advantages of running a flexible mechanism can with the Chinese and foreign-related institutions through joint form such as running multiple development.

3. WO strategy

Use the good condition of opportunity Zhejiang province in 2016 before the university entrance exam candidates, in the stable matriculate, under the premise of practice the internal organs, strengthen their own brand features;

Use the Yangtze River delta industrial for upgrading the opportunity of river development and strengthen the information service, modern service industry, cultural and creative industries, etc., and college offers related discipline and professional;

The higher education strategy makes use of the country's background to strengthen their characteristics and enhance their brand strength.

4. WT strategy

The equity struggle between investors;

The management concept of integration problems between investors and host;

The students' quality needs to be further improved, and the student management idea and services are to be changed.

8.3 Development Specifications and Innovation Strategies of the Independent Colleges

Independent Colleges must adapt to the new situation and need to promote their healthy development, we must further strengthen and standardize management. The specification can improve various rules and regulations, as well as the school system of the Independent Institute, and shorten the gap between the independent colleges and public schools. The organizers of the Zhejiang University of Finance, the investment side is the Zhejiang Jin Haizhou Development Co., Ltd. of Haining is a company with government background, the moment is a more reasonable mode of cooperation. At the same time, the Independent Institute in Zhejiang Province also began the relocation of cooperation with local governments, such as the Zhejiang Institute of Media Campus settled in Tongxiang, Zhejiang Forestry College Institute settled in Zhuji, and Zhejiang University of Technology River College will be located in Shaoxing Bridge [7]. As shown in Fig. 8.2.

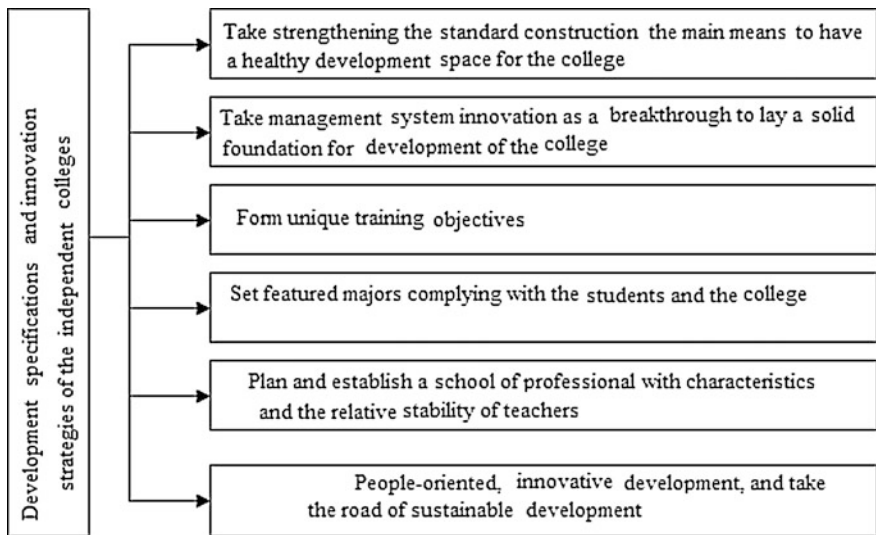


Fig. 8.2 Development specifications and innovation strategies of the independent colleges

1. Take strengthening of the standard construction as the main means to have a healthy development space for the college

Independent colleges must adapt to the new situation need to promote their healthy development, we must further strengthen and standardize management. The specification can improve various rules and regulations, as well as the school system of the Independent Institute, shorten the gap between the independent colleges and public schools.

2. Take management system innovation as a breakthrough to lay a solid foundation for development of the college

Dongfang College, Zhejiang University of Finance followed the guiding ideology of the Ministry of Education for stable, scalable, and innovative management. First, the president responsibility system is under the leadership of the board of directors and the preferential formation of the college management team. The college party committee under the leadership of president responsibility system change for the president responsibility system under the Board of Directors, the President directly to the Board.

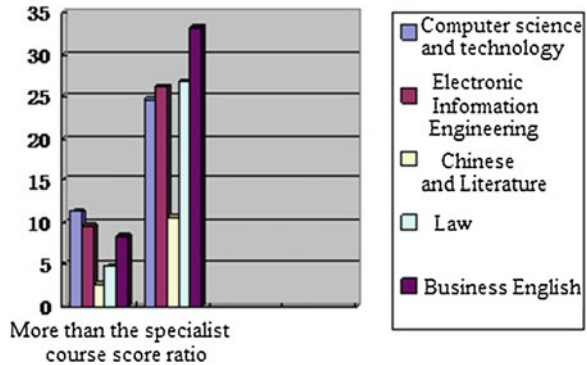
3. Form unique training objectives

Institute in the disciplines construction, according to the purpose of service of the local economy, the founder of the discipline need to adapt to local economic and social development and industrial restructuring, and provide a strong pool of talent and intellectual support for regional economic and social development. Table 8.1 below take Grade 2010s 384 students to do the analysis.

Table 8.1 Zhejiang university of finance and economics Dongfang college 2010 grade students' analysis

Major	More than the specialist course score ratio (%)			Less than the specialized score of 20 points (%)		
Computer science and technology	11.24	10.69	6.8	24.7	25.2	23.7
Electronic and information engineering	9.5			26.2		
The Chinese language and literature	2.63	4.78		10.5	23.1	
Law	4.72			26.8		
Business english	8.3			33.3		

Fig. 8.3 2010 grade students' analysis of Zhejiang University of Finance and Economics, Dongfang College



The bar graph is shown in Fig. 8.3.

4. Set featured majors complying with the students and the college

Training of students for social needs, students' knowledge structure, and practical ability is recognized by society, which is related to the survival of Independent College. How to set up a professional, how to adjust the professional direction to do their own specialty, the Independent College should first solve the problem.

5. Plan and establish a school of professional with characteristics and the relative stability of teachers

After more than 10 years of school, Dongfang College of Zhejiang University of Finance the independent school students on the whole have a relatively high quality and practical ability, but the basis of their cultural gap is an objective reality. Mode Reform of Training Academy as a breakthrough, as the goal of training senior-to-use talent, constantly deepening teaching reform, optimize the training model to improve the teaching conditions, improved teaching management, and personnel training significantly improved the quality.

6. People-oriented, innovative development, and take the road of sustainable development

After nearly 13 years of practice, independent colleges from spontaneous self toward a standardized and orderly start-up development improve the development, from the amount of development toward the improvement of quality. It is an important result of China's higher education reform and innovation, it has become a very important force in the field of higher education, as it made a positive contribution to the development of private higher education to promote the popularization of higher education. But overall, the Independent Institute in the exploratory stage, in various parts of a very inconsistent, pattern diversity, different forms, there are many problems. Traditional public universities, compared to the educational goals, are unknown, unclear positioning, policy deflection system that is not the macro level and micro level there are funds management, asset utilization, the preparation of teachers, enrollment level, etc. Therefore, the independent institutes need in-depth understanding of the scientific content of the scientific concept of development, the spiritual essence, and the fundamental requirement to realize its sustainable development.

For independent colleges take the road of sustainable development, we must persist in overall consideration [8]. We want a comprehensive look at the opportunities and challenges faced by the school, school reform and development to be thinking on the overall situation of building an innovative country and industry, local economic and social development, on the future of higher education reform and development of a new direction, new goals, new to plan the mission [9]. It is aimed at local economic and social development, to seek support at the local service, and to seek development contributions for local initiative for local modernization, and economic and social development services to promote education and technological innovation, economic development, cultural prosperity, and social progress closely.

8.4 Conclusion

This paper takes enterprise development strategies relevant theories and methods, analyzes the strategic environment of Zhejiang University of Finance and Economics, Dongfang College strategic objectives and the implementation of the strategy initiatives, papers qualitative analysis, supplemented by a small amount of quantitative analysis. This uses SWOT analysis to make a comprehensive analysis of the strategic environment of Guangzhou HR College, and to seize opportunities for strategic choice. Focusing on the college's strategic objectives on brand strategy, market-oriented strategy, and differentiation strategy, this paper puts forward the evaluation mechanism of the implementation of the strategy path and development strategic control.

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Chapter 9

Comparative Analysis on Financial Governance of Listed Companies Between China and European Countries

Gang Xu

Abstract Nowadays, more and more enterprises are listed, but at this stage of Listed Companies in the financial control and management still have existed defects. This paper, first, gives a contrasting analysis on the listed companies which have performed better than any other listed companies in China and European countries in financial management; second, gives descriptive statistics of some of the listed Chinese and European countries companies' financial management current situation, mainly proceeding from China's financial governance structure mode, and compared and analyzed with European financial management; finally, the paper utilizes the analytic hierarchy process analysis to analyze the final statistics of financial governance index, the data show that there is a certain gap, low level compared to the present stage of our country's listed companies in the financial control and management with the European countries.

Keywords Listed company · Financial management · China · European countries · Comparative analysis · Analytic hierarchy process (AHP)

9.1 Introduction

Since the 1960s, Internationally, successive financial scandal, financial fraud cases, as well as the financial crises appeared, those are not only the severe problems in financial markets, but more like feedbacks of the serious problems of enterprise's financial control and management [1]. At the present stage in our

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country, many companies listed in order to finance enterprises and carrying out planning, management, and to further enhance the enterprise image, reputation, and brand. Although the listed companies improve the stage and financial management, and more normative and reasonably finical, the company management system, personnel allocation, the effective use of resources' allocation are more perfect, many of the listed companies after the listing will have some problems. Because the listed companies need to carry out financial data, statements, and other information disclosure in the stock market, thus, they will appear on the financial fraud, illegal transactions, information distortion problems, not only for enterprises, but also for the shareholders will bring great loss, while these problems feedback the main problem of the listed company's financial control and management.

Listed companies not only need enterprise to finance, but it is more important to make enterprises much bigger and stronger, in line with international standards. The current European financial markets are open and use market-oriented management mechanism; in such developing and developed financial markets, companies need more standardized and sustainable development to occupy the market, to facilitate international standards [2]. Chinese listed companies need to achieve international standards, it is necessary to analyze international developed country by means of finance, management, and other aspects of the differences, in order to guide China's listed companies to do better. Governance structure of listed companies in China has its special aspect, based on comparative analysis relevant financial data of Central European listed companies, using analytic hierarchy process to get listed companies' financial management level index.

9.2 Comparative Analysis on Listed Companies Between China and European Countries

By the end of 2011, there were 620 listed companies in the high level of the financial management, total equity was 502,136,000,000 yuan, and the total market capitalization was 1,439,275,000,000 yuan [3]. These listed companies after issuing share capital not less than RMB 50 million yuan and individual shareholders who hold the value 1,000 yuan not less than 1,000 people, a person who holds the total par value of the shares not less than RMB 10 million yuan; these listed companies are much stronger and have much more channels to raise company development needed capital (IPO, issuance, allotment of shares, can be convertible bond, and so on); these companies can raise without the return of principal long-term capital; in circulation shareholders and under the supervision of regulatory departments, these companies are able to improve the governance well and expand the company's visibility and influence.

From Fig. 9.1, we can see that in 2006 the financial governance of Chinese listed firms exhibit higher levels more than 300, and in 2007, it is increased by

Fig. 9.1 Chinese listed companies' number statistical chart based on the higher level of financial management

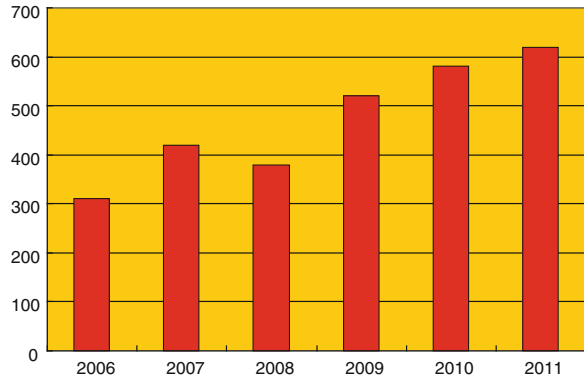
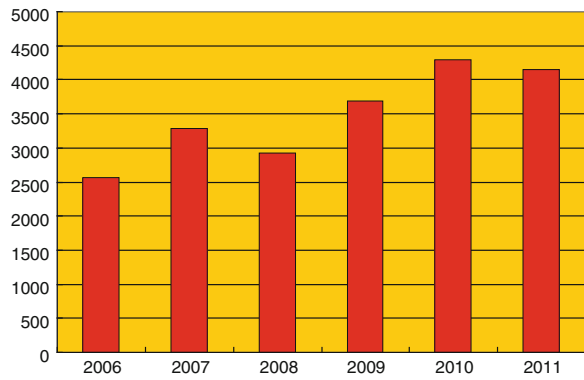


Fig. 9.2 Based on higher financial management level of European listed companies' number statistics chart



more than 100, but by 2008 it falls to 400, while in 2011 it rises to 620. Chinese listed companies which are much better in the financial control and management basically show an upward tendency, in addition to 2008, because of the impact of financial crisis; the listed company's financial situation was affected [4].

In 2008, due to the financial crisis, the financial meltdown, the amount of financing became scarce; therefore, many listed companies became overwhelmed, financial management level was lower. But in 2009, our country government published a series of encouragement policy in order to alleviate many survived listed company economy and also let those companies learn from the lessons of the financial crisis, save a lot experience, improve their listed companies' financial management level.

As for the advanced developed countries in Europe, the European countries' listed companies with a higher level of financial management are too many. From the Fig. 9.2, it can be seen that European listed companies generally have the higher level of financial management, and the numbers of these companies are big. In 2006, the number of European listed companies which have higher levels of financial governance more than 2,500, and in 2007 more than 4,000, but by 2008 it fell to 3000, while in 2011 from 10 years' average number 4,300 to about 4,100.

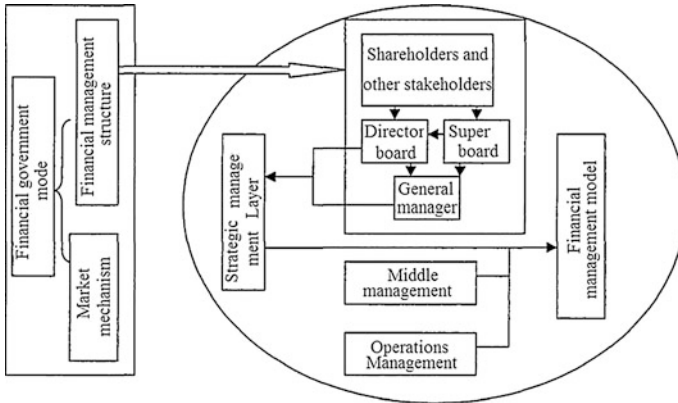


Fig. 9.3 The listed company of our country financial management mode

European listed companies in the financial control and management are more normative, but European developed countries' listed enterprises are easily influenced by some of the events in financial market and the financial crisis, the number of listed companies presented fluctuated in a upward trend; because in dealing with financial problems, many listed companies mainly use the capital plan, continue to issue bonds or capital to realize financing. The whole trend is growing, but amplitude is relatively slow.

In European countries, they mainly use the double-layer board of governance structure to handle these listed companies; the board of supervisors is established by the election of shareholders, while the board of directors established by supervisors. The board of supervisors is located in the core of supervision status in the European countries listed companies' financial governance structure. The bank can be used not only as the lender but also as the shareholders to governance the company; on one hand, the bank can become a member of the board of supervisors to supervise decision making and execution, on the other hand, the bank can participate as a member of the board of directors in management decision making. Employees of the company or company creditor shareholders and banks can become members of the board of supervisors. The board of supervisors' member staff, shareholders, and banks will be involved in major decision-making process to maintain their own maximum interests, so they can be both partners and competitors. And in order to guarantee the independence of board of supervisors, the CEO of the company could not function over them.

There is the difference in governance structure's form and characteristics between Chinese and European listed companies. Chinese listed companies' financial management model is shown in Fig. 9.3, in listed company, the board of directors is for the decision making and guidance center, while the establishment of the supervisory board is made up with employees and shareholders [5]. The enterprises of our country are fusion of these two kinds of system feature, because they established in the background of the enterprise system reform and change, so

in Chinese listed Companies some special aspects existed in the financial control and management. Enterprise system affected by special corporate governance structure will affect the enterprise decision-makers' strategic direction; also can affect the company's strategic performance. Moreover, with the deepening of reform, the structural arrangements of corporate governance changes will also bring new influence on the company strategy.

9.3 Analysis on Financial Government Level of Listed Company Based on AHP

Hierarchical analysis method is one of the commonly used system analysis methods; it uses an analytic hierarchy analysis method in the network system theory. The financial governance structure model as the foundation, which mainly includes the financial power allocation, financial control, financial supervision, and financial incentives as well as several other factors, uses the analytic hierarchy process for the listed company's financial governance index. Indeed, there are four major steps in analytic hierarchy process, look at Table 9.1.

First, to establish selection solution model, this can be seen as Fig. 9.4 [6].

According to these factors, we can construct a matrix [7]:

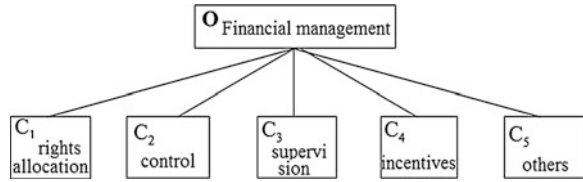
$$R = \begin{bmatrix} r_{11} & r_{12} & r_{13} & r_{14} \\ r_{21} & r_{22} & r_{23} & r_{24} \\ r_{31} & r_{32} & r_{33} & r_{34} \\ r_{41} & r_{42} & r_{43} & r_{44} \end{bmatrix} \tag{9.1}$$

$$R = \begin{bmatrix} \frac{w_1}{w_1} & \frac{w_1}{w_2} & \dots & \frac{w_1}{w_n} \\ \frac{w_2}{w_1} & \frac{w_2}{w_2} & \dots & \frac{w_2}{w_n} \\ \dots & \dots & \dots & \dots \\ \frac{w_n}{w_1} & \frac{w_n}{w_2} & \dots & \frac{w_n}{w_n} \end{bmatrix} \tag{9.2}$$

Table 9.1 Analytical hierarchy process step table

Step	Content
1	Construction of model
2	Establishment of comparison matrix (important)
3	Hierarchical ranking
4	Consistency test

Fig. 9.4 The solution model of the analysis



Next step is the hierarchical ranking [8]:

$$\begin{aligned}
 A_1 &: a_1b_{11} + a_2b_{12} + \dots + a_mb_{1m} \\
 A_2 &: a_1b_{21} + a_2b_{22} + \dots + a_mb_{2m} \\
 &\dots \\
 A_n &: a_1b_{n1} + a_2b_{n2} + \dots + a_mb_{nm}
 \end{aligned}
 \tag{9.3}$$

	A_1, A_2, \dots, A_m a_1, a_2, \dots, a_m	Hierarchical ranking
B_1	$b_{11} \quad b_{12} \quad b_{1m}$	$\sum_{j=1}^m a_j b_{1j} = b_1$
B_2	$b_{21} \quad b_{22} \quad b_{2m}$	
\dots	$\dots \quad \dots \quad \dots$	
B_n	$b_{n1} \quad b_{n2} \quad b_{nm}$	$\sum_{j=1}^m a_j b_{nj} = b_n$

The last is a one-time inspection; the formula is [9]:

$$CR = \frac{a_1CI_1 + a_2CI_2 + \dots + a_mCI_m}{a_1RI_1 + a_2RI_2 + \dots + a_mRI_m}
 \tag{9.4}$$

When CR is less than 0.1, we can say it is conforming to a one-time inspection.

We put each index value into the formula, the final calculated results, we found that China’s listed companies’ financial management main index is between 21 and 83, in average 54.66. The largest index was for Ling Steel Corporation, the index reached at 82.17, while the smallest index was of the ST Jinding Company, index was 21.26. Most of the listed company’s financial control and governance index in mean fluctuate; between 50 and 60 scores are high level index. The Indexes reached even higher than 60 points for only 563 listed companies, the proportion was only 26.89 %, this fully shows that the Chinese listed company’s financial governance is in poor condition. And it is also waiting for further strengthening of the standard management and control. While in European countries, among the listed companies, more than 50 % of the financial governance index reached 70 points, far ahead of Chinese listed company’s financial governance level.

9.4 Conclusion

In the current capital market reform stage, the capital market in our country gradually developed from the government supervision into market supervision; therefore, listed companies need more strict requirements of enterprise standardization, keep on strict management and control. Corporate governance structure mode should be strictly in accordance with the listing requirements; the board of directors, the board of supervisors, and the board of shareholders should carry out their duty; and at the same time the listed companies should standardize enterprise management, formulate a reasonable strategic planning, and when the listed companies handle with financial capital market environment change, at the same time, they should also deal with competition in the market, strengthen the enterprise standard management and operation, and stand firm in the capital market, so that we can continue to do our business strongly and greatly, and keep an invincible position. At the mean time, the listed companies should react actively toward the international market standard requirements to standardize our enterprises' management, in order to realize the Chinese listed companies' connection with international companies. Chinese listed companies in the management process need to fully consider the problems between the general pattern and company specific implementation ways of diversify combination. A pattern which we speak is just the simplification of most corporate governance structure features, in specific ways, it can be diversified. As it is not identical in different sectors of the company, in the ownership structure, in the input of resources structure, and also in each strategic characteristic, therefore, the focus in corporate governance structure is not the same.

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Chapter 10

Separation of Bromine by Liquid Surfactant Membranes

H. Wang, Cang Yan Xiao and Bin Zhao

Abstract The method of separating bromine using emulsion liquid membrane is described. The effects of various experimental parameters, such as the concentration of surfactant and internal phase reagent, the proportion of oil and internal phase reagent, and the proportion of emulsion and water have been studied in detail. With Blue 113-B as surfactant, kerosene as the membrane solvent, Na_2CO_3 as the internal phase reagent, N7301 as carrier, bromine is extracted by emulsion liquid membrane system. The migration mechanism is discussed; the best operating conditions for the separation: the surface-active agent dosage Blue 113-B is 2–3 %, N7301 dosage as carrier is 2 %, the appropriate proportion of emulsion and water is 1:30, the appropriate proportion of oil and internal phase reagent is 5:5. In the best operating conditions, the extraction efficiency could achieve 98 %; after the breaking, bromine recovery can reach 95 %.

Keywords Bromine · Emulsion liquid membrane · Separate

10.1 Introduction

The use of bromine compounds is very broad. The main methods of extracting bromine are air blowing and steam distillation method, but these are energy consuming and costly. They are also subject to be affected by external conditions. Emulsion liquid membrane technology is the concept of Chinese-American Li [1]

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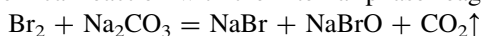
invented in 1968. It was the first emulsion liquid membrane technology. In the past three decades, it has been a very active research topic. The emulsion liquid membrane has great mass transfer area ($106 \text{ m}^2/\text{m}^3$) [2], so the mass transfer rate is higher. Therefore, it is more applicable in large-scale industrial productions. In recent years, the technology has rapidly developed from the preliminary stage of basic research to the first industrial application, and has proved effective.

10.2 Separation Mechanism

Emulsion liquid membrane is also known as liquid surfactant membrane (LSM). The form of liquid droplets in the parcel layer of liquid between the two wrapped phases is called the phase fluid, the Foreign Secretary is in a liquid phase outside the membrane. Internal phase emulsion liquid membrane is dispersed into many microdroplets and suspended in the liquid membrane phase to form an emulsion. Droplet diameter is $1\text{--}100 \mu\text{m}$ and emulsion droplet diameter is $0.2\text{--}2 \text{ mm}$ (Fig. 10.1).

Formation process: first by dispersing the internal phase liquid into the membrane phase, the emulsion is made (methods commonly used for system of emulsion liquid membrane include rapid mixing in the mixer system for emulsion liquid membrane, emulsion liquid membrane with a colloid system, and the ultrasonic emulsification method of manufacturing emulsion liquid membrane), and then distributed to the external aqueous solution. Emulsion breaking step is after the separation of emulsion. The load is released from the liquid phase, the separation of a substance is recovered, and the inclusion of surfactant and carrier liquid membrane phase is recycled for the emulsion.

Bromine in the feed solution can dissolve the emulsion liquid membrane; it is a chemical reaction with the internal phase reagent Na_2CO_3 .



Chemical reactions maintain a low concentration of Br_2 in internal aqueous phase; thus, the mass transfer rate remains at a high level until the internal phase reagent Na_2CO_3 is exhausted.

Fig. 10.1 The schematic diagram of emulsion liquid membrane

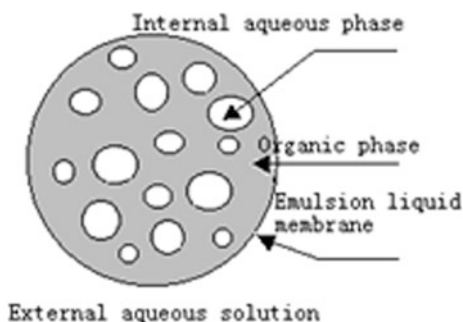


Table 10.1 The results of voltage electric breakdown

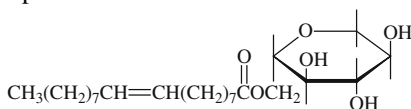
Voltage (V)	Current (A)	Time (min)	Emulsion-breaking rate (%)	The number of reuse
110	10–3	10	95	30

10.3 The Choice of Surfactant

Surfactant is one of the main components of emulsion liquid membrane. It can control the stability of emulsion liquid membrane. In the emulsion liquid membrane separation process, a suitable surfactant should have the following properties [3]: (1) In the mixing process, the emulsion breakdown rate should be lower; (2) Swelling rate of the emulsion liquid membrane caused by the osmotic pressure should be smaller; (3) Should treat the separation of metal ions with high extraction rate and high selectivity; (4) The emulsion breaking by static electricity should be easy; (5) It has chemical stability and security, it should also be easy to synthesize and have low prices.

For emulsion liquid membrane, water in oil-type surfactant HLB value of (HLB value) range is 3–6, and oil in water surfactant of HLB values range is from 8 to 18. Surfactants commonly used in the water phase separation are: Span80 (Secretary of the 80), L113A(Single-succinimide), L113B (double-succinimide), and the amine 185 (multi-succinimide) etc.

Span80



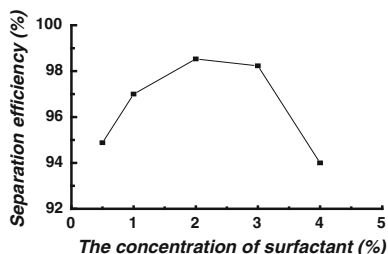
Molecular weight = 428

The amount of surfactant will directly affect the stability and penetration rates. Emulsion liquid membrane stability and membrane permeation rate have a direct impact on the migration rate; therefore, the appropriate amount of surfactant is one of the keys to obtain good separation. Table 10.1 lists the amount of surfactant on separation efficiency. In case of low content of surfactant, membrane body instability and extraction efficiency is low; the high content of surfactant, membrane stability, but the large supplies in practical application reduce the economic efficiency. Figure 10.2 shows that: The blue-113B surfactant is used in the amount of 2.0–3.0 % (volume fraction) to achieve the best extraction efficiency of bromine.

10.4 Solvent

Membrane solvent constitutes the membrane matrix. The main consideration when selecting the membrane is stability and solubility of the solute. In order to maintain the appropriate stability of emulsion liquid membrane, the solvent should have a

Fig. 10.2 The concentration of surfactant



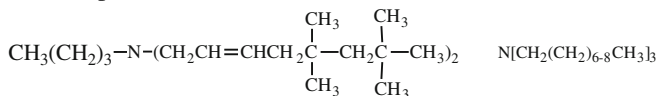
certain viscosity. A solvent should have a good solubility for surfactant, carrier, and the membrane fraction, but should not be soluble in the organic phase and external aqueous solution in order to reduce solvent loss. Kerosene and paraffin are often used as solvents.

In addition, usually liquid paraffin, nonionic polyamines, and neutral oil as a thickener are added to improve the membrane stability. In this paper, kerosene is the membrane solvent.

10.5 Vector

A vector is a nonvolatile organic complexing agent. It can selectively perform reversible reaction with the solute. Carrier plays a key role in the process of emulsion liquid membrane separation. Separation mobile carrier in the membrane external interface selectively separates complexing substances, then diffuses in the emulsion liquid membrane and separates decomplexing substances in the membrane internal interface; separated substances are enriched into the membrane phase, the mobile carrier returns external interface of emulsion liquid membrane, and so the process is ongoing. The addition of carrier material can be separated through the membrane selectivity and greatly improve the circulation [4, 5].

The carrier must have the following conditions: (1) Vector and its complex formation with the solute must be soluble in membrane phase, but not in internal and external membrane; (2) Complex substances formed by carrier and separated material with appropriate stability; (3) Carrier is not with the other components of membrane phase reaction.

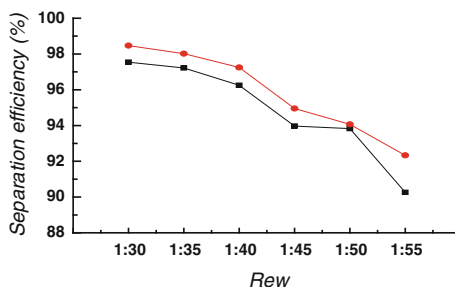


XE204

N7301

The common carriers are: ionic organic amine carrier (such as amine, tertiary amine, quaternary ammonium); nonionic carrier type, such as the crown structure of crown ethers, in separation and transmission in neutral salt structure. The ratio of cation radius and cavity radius of the crown compounds' center is closer to one and the selectivity is higher.

Fig. 10.3 N7301 as a carrier to experiment



The experiment adds N7301 as a carrier to experiment. The results are shown in Fig. 10.3.

10.6 The Proportion of Emulsion and Water

The ratio of liquid emulsion volume (V_e) and liquid volume (V_w) is the proportion of emulsion and water (R_{ew}). It is related to the processing efficiency and processing costs. Increasing the proportion of emulsion and water increases the amount of emulsion used for enrichment of bromine-containing substances, which increase the mass flux per unit time and mobility, thus improving the extraction. But it is noneconomic to consume more emulsion, so a high extraction efficiency in the appropriate proportion of emulsion and water must be ensured. The results are shown in Fig. 10.4: the appropriate proportion of emulsion and water is 1:30.

10.7 The Proportion of Oil and Internal Phase Reagent

The smaller the proportion of oil and internal phase reagent, the thinner the emulsion liquid membrane. If the emulsion liquid membrane is thin, extraction efficiency of bromine is not high. On the contrary, if the emulsion liquid membrane is thick, the emulsion layer will reduce the infiltration rate. But the permeation rate, at low bromine content, does not affect the separation. Under the experimental conditions, Fig. 10.5 shows the appropriate proportion of oil and internal phase reagent to be 5:5.

10.8 Demulsification

After demulsification, oil phase can be reused, which not only reduces the production costs and continuous production, but mainly, makes wastewater treatment to reduce the secondary pollution. From the industrial point of view, use the

Fig. 10.4 The proportion of emulsion and water

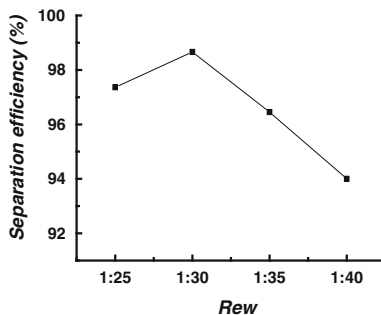
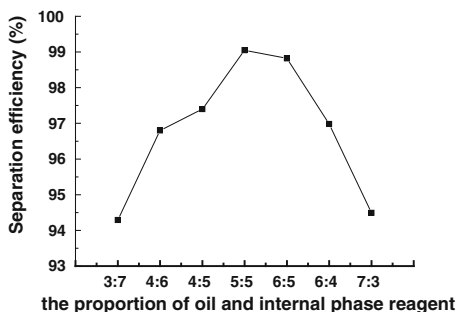


Fig. 10.5 The proportion of oil and internal phase reagent



low-voltage electric demulsification method for emulsion breaking [6]. The results of breaking, shown in Table 10.1, in the ambient temperature and pressure of the experimental low-voltage electric demulsification are entirely feasible.

10.9 Summary

With Blue 113-B as surfactant, kerosene as the membrane solvent, Na_2CO_3 as the internal phase reagent, and N7301 as the carrier, bromine is extracted by emulsion liquid membrane system. The best operating conditions for the separation are: the surface-active agent dosage Blue 113-B is 2–3 %, N7301 dosage as carrier is 2 %, the appropriate proportion of emulsion and water is 1:30, and the appropriate proportion of oil and internal phase reagent is 5:5. In the best operating conditions, the extraction efficiency could achieve 98 %; after the breaking and bromine recovery can reach 95 %.

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Chapter 11

Research on Location and Time of Serial Criminals

Yun Hua Qu and Guan Chen Zhou

Abstract Twisted souls and antisocial spirits have resulted in serial murders. In order to prevent such crimes which cause great harm to public security, this paper has established effective early warning systems and efficient detection programs using mathematical models, so that we can reduce the number of potential victims significantly.

Keywords Principal factor analysis · Time-series analysis · Adaptive network-based fuzzy inference system · Fuzzy matter-element analysis · Commensurability

11.1 Introduction

In view of the increasing crime rate in the world, the police's final goal is to increase their case solving rate. Based on this, a model is established under the premise of serial criminal cases, which is used to predict the time and location of the criminal cases [1, 2]. There are two schemes in the model, which can be used to predict the geographic profile and to predict the time of the crime. The first scheme can predict the circular region of the next crime by using the Time-Series Analysis Model, and further reduces the predicted region by using the Principal Factor Analysis method. The second scheme can predict the next possible location of similar cases by using the Adaptive Network-based Fuzzy Inference System [3]. Then a Fuzzy Matter-Element Analysis is made out of the common characteristics

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of the victims in the serial crimes, so that the prediction region can be further reduced. While predicting the geographic files, the commensurability of ternary, quaternion, and quintuple is used to determine the time of the next criminal offense. In this way, the suspected serial criminal can be determined from the two aspects: time and space [4].

This model has the following advantages.

11.1.1 The Simplicity of its Applying Method

Scheme One:

This paper primarily confirms each accurate location where the crimes have emerged, following that step. It calculates the distance between neighboring places, then puts the figures into statistical software of SPSS by adopting its predicted function of time series to predict the distance between the address of this crime and the next one. Meanwhile, it can be identified that the predicted distance will move within a domain, predicting it as an annular region on the map, which can be defined as the potential place where the next crime may happen. By analyzing the environment of the crime and the accurate characters of each criminal, the main attacking targets of the criminals are ensured [5, 6]. Furthermore, by carrying out the experienced analysis in the annular region, it can reduce the crime regions where the next crime may happen.

Scheme Two:

First, the researchers compile the ANFIS fuzzy systematic procedure into the Matlab software, and input the times of crimes in its complete crime category which belongs to the studied city; subsequently, it can produce the list of possible crime regions of all kinds of crimes in each city [7]. Moreover, the researchers compile the subtractive clustering initialization fuzzy deducing ANFIS model into the Matlab software, and input the data of serial crimes and the potential crime regions got from the above procedure into this software; then it can produce the possibly occurring regions of the crime rate of the definite criminals. Therefore, it is necessary to check in the regions with high crime rates [8, 9].

Assurance of Time Prediction

Sorting out the cases' time of occurrence is done according to the month's sequence, for e.g., "The Yorkshire Ripper", for the first time happened on 5 July 1975, and so the number is 7. Adopting it as a standard, it can deduce a figure for each happened region. Once again, the researchers compile the procedures of commensurability of ternary, quaternion, and quintuple in the Matlab software, and then by inputting these dates it can predict the time of crime (limited to the month accurately, e.g., January 1975, as the standard of the model) [10, 11].

11.1.2 The High Reliability

The predictive domain in the geographic files of Scheme One is made under the circumstance of its SIGNIFICANT TEST level to be 5 %, that is to say, the reliability of Scheme One is 95 %. Scheme Two carries out the error testament by using the data of Dallas, thus, it can obtain the permitting error's difference to be 0.0683, in other words, the reliability is 93.2 %. As it is impossible to enlarge the error's difference by combining the two methods, the least value of reliability is 93.2 % [12].

The time prediction adopts the method of commensurability of ternary, quaternion, and quintuple; the acquired predictive time is the largest figure among all possible times of crime, which proves to be the possible time of crime [13].

11.1.3 The Wide Range of its Application

Scheme One testifies the possibility of the model by adopting two kinds of psychological crime types (murder is identified as emotional crime, while robbery is identified as profitable crime). It proves that Scheme One is accurately right in most of the cases.

Scheme Two primarily calculates the regions where the similar crimes happened; it can be applied into the prediction of nonserial criminals instead of selection which does not take advantage of serial crimes, and therefore, its application is wider [14].

As these two methods take applications into consideration from different aspects and the repeating factors can be neglected, then it is impossible to increase the error's difference by combining the two methods, on the contrary, it may reduce the difference. When the researchers predict, it can take advantage of the commensurability method to increase the probability of arresting criminals and decrease the loss of property and the labor. This method effectively reduces the waiting time of policemen in the predictive regions [15].

11.2 Construction

We have established effective early warning systems and efficient detection programs.

Warning preparations: first, this paper makes a statistical analysis of the victims' personality characteristics (such as physical characteristics, clothing, occupations, etc.), locations, and time of the criminal offenses, then this paper has a Principal Factor Analysis of those factors, so that we can rule out the obvious or nonintrinsic factors. The principal factors obtained above are the characteristics of

the crime targets in the serial murders. According to the conclusions arrived at, early warnings are given to the vulnerable groups and residents with similar situation, residence, and daily schedule so as to strengthen their vigilance.

Scheme One: The Establishment of Geographical Profile Based on Time-Series Analysis Model

According to the statistics of the locations of serial crimes, this paper predicts the distance between adjacent cases via Global Positioning System (GPS) and establishes a time-series analysis model. This paper uses SPSS software to predict the distance between the possible locations of the next crime and the past crime scenes. The data of the serial murders committed by Peter Sutcliffe and of the serial robberies in Dallas are used to verify the model: at 95 % confidence level, the data obtained tally with the real circumstances.

After looking up all the venues related to Peter Sutcliffe, use the Google Earth software to label them. Omit those who do not have definite addresses or are far away.

To verify time-series possibility of predicted next crime, first use the Google Earth software to get the distance between the continuous two localities where crimes are committed (Table 11.1).

Take use of insured data among 11 groups and predict the data of Groups 12 and 13, then compare with the actual data.

Use schemes of Maximum Likelihood Estimation or Least Square Estimation and so on to estimate the parameter value of φ, θ and examine their significance.

Enactment Confidence Intervals to be 95 %, choose the scheme to predict result according to the period in column Predict Cases. Run the software SPSS to get the result:

Number of residuals 11.

Standard error 6.1365565.

Thus, next crime range is a circle of radius between 4.9 and 17.1 km, actual data are 15.32 which belong to the range.

Number of residuals 12.

Standard error 5.8946936.

Next crime radius is between 6.1 and 17.9 km, and the actual data are 10.07 which belong to the range.

Scheme Two: The Establishment of Geographical Profile Based on the Adaptive Network-Based Fuzzy Inference System (ANFIS) and Fuzzy Matter-Element Analysis

Table 11.1 The distance between the continuous two localities where crimes are committed

Tag number	Distance	Tag number	Distance	Tag number	Distance
1-2	16.10	6-7	0.75	14-16	7.23
2-3	21.52	7-9	5.43	16-18	15.32
3-4	29.25	9-10	13.23	18-19	10.07
4-5	0.88	10-13	1.46	19-20	23.15
5-6	3.92	13-14	17.01	20-21	23.01

Based on a large number of crime statistics, this paper has established the Adaptive Network-Based Fuzzy Inference System (ANFIS) model and the Subtractive Clustering Initializing Fuzzy Inference System (SCIFIS) model. The crime data in Dallas from 1992 to 2007 are taken as the sample to verify the accuracy of the ANFIS model for the prediction of the distribution of the city's high crime areas and the areas where similar criminal cases take place. Then, based on results of neural network training, the crime areas obtained go through further screening. The complex element matrix is established using Fuzzy Matter-Element Analysis. Thus the associated vector is generated through the relationship among the three elements of matter element. The possible locations of the next crime are screened through comparison of correlation. This paper predicts the serial robberies in Dallas and compares the data with the facts using the model reaching 95 % confidence level. Therefore, the model is also reasonable and reliable.

Let us define the error function as $E = \frac{1}{2}(y - t)^2$

The fuzzy subordinate function in the collection adopts Gauss function.

$$A_{ik}(x_k) = \exp \left[-\frac{(x_k - a_{ik})^2}{\sigma_{ik}^2} \right] \quad (11.1)$$

Let us define v_i as parameter vector of the model, $v_i = [a_i, \sigma_i, c_i]^T$

$$v_i(k+1) = v(k) + \eta \Delta v_i = v(k) - \eta \frac{\partial E_n}{\partial v_i} \quad (11.2)$$

Here, η is the learning efficiency.

$$c_i(k+1) = c_i(k) - \eta \frac{\partial E_n}{\partial c_i} = c_i(k) - \eta(y - t)\bar{w}_i \quad (11.3)$$

$$a_i(k+1) = a_i(k) - \eta \frac{\partial E_n}{\partial a_i} = a_i(k) - \frac{2\eta}{\sigma_i^2}(y - t)(c_i - y)(x_k - a_i)\bar{w}_i \quad (11.4)$$

$$\begin{aligned} \sigma_i(k+1) &= \sigma_i(k) - \eta \frac{\partial E_n}{\partial \sigma_i} \\ &= \sigma_i(k) - \frac{2\eta}{\sigma_i^3}(y - t)(c_i - y)\bar{w} \sum_{i=1}^n (x_k - a_i)^2 \end{aligned} \quad (11.5)$$

$$\bar{w}_i = \frac{w_i}{\sum_{i=1}^l w_i} \quad (11.6)$$

It can be regarded as safety if the crime is less than one case per day. It can be regarded as middle level if the crime is limited in the domain of 3–5 cases. If the crime overpasses three, it can be regarded as danger.

Putting the given sample figures into ANFIS's fuzzy system, let us check by using the figures of 2009; it can get the tested error $TextRMse = 0.0683$; it is clear

that the ANFIS's fuzzy system connects logical thought and linguistic expressing ability with the ability of self-study, it mixes the advantages of neural network and vague theory, respectively, and at the same time, it also brings up their disadvantages.

Fuzzy Matter-Element Analysis: matter element has three essential factors which include object, character, and magnitude. If the magnitude factor has fuzzy character, this can be called as Fuzzy Matter element

$$\text{fuzzy matter} = \begin{bmatrix} \text{object} \\ \text{character} \quad \text{vague magnitude} \end{bmatrix}, \text{ that is, } \underline{R} = \begin{bmatrix} M \\ C \quad \mu(x) \end{bmatrix}.$$

Here, M represents object, C represents the object's character, and $\mu(x)$ represents the degree of membership of object C's character which is relative to magnitude x .

Therefore, it can express the n dimension's complex fuzzy matter element of the numbers of m 's relative object as follows:

$$\underline{R} = \begin{bmatrix} M_1 & M_2 & \dots & M_m \\ C_1 & \mu(x_{11}) & \mu(x_{21}) & \dots & \mu(x_{m1}) \\ \dots & \dots & \dots & \dots & \dots \\ C_n & \mu(x_{1n}) & \mu(x_{2n}) & \dots & \mu(x_{mn}) \end{bmatrix} \tag{11.7}$$

According to the same theory, it can construct the n dimension's complex vague matter-element matrix of the numbers of m 's standard object. If the equation adopts R_w to represent each object's all characters' weighting complex matter element, and taking $w_i (i = 1, 2, \dots, n)$ to represent each object's the number i 's characteristic weighting, then, it can get:

$$R_w = \begin{bmatrix} C_1 & C_2 & \dots & C_n \\ w_i & w_1 & w_2 & \dots & w_n \end{bmatrix} \tag{11.8}$$

By the same scheme, it can obtain the double-deck weighting complex matter element:

$$R_w = \begin{bmatrix} C_1 & C_2 & \dots & C_n \\ w_i & w_1 & w_2 & \dots & w_n \\ C_{11}C_{12} \dots C_{1p} & C_{21}C_{22} \dots C_{2p} & \dots & C_{n1}C_{n1} \dots C_{np} \\ w_{ik} & w_{11}w_{12} \dots w_{1p} & w_{21}w_{22} \dots w_{2p} & \dots & w_{n1}w_{n2} \dots w_{np} \end{bmatrix} \tag{11.9}$$

Steps of Fuzzy Matter-Element Analysis

By using Fuzzy Matter-Element Analysis Scheme to analyze the characteristics of the objects of the serial crimes, and making the next place's selection which is predicted by neural network, the purpose is to select with high accuracy the degree of association places; these places proved to be the potential serial crimes' highly happened places.

The prediction of the time of crime is based on the time-series formula; this paper predicts the time of the next crime by commensurability of ternary, quaternion, and quintuple and the existing time of criminal offenses.

The criminal is predicted over time and space based on the geographic profile generated by the two schemes and time prediction method mentioned above. In this way, the case solving rate can be significantly increased, which is also helpful to build a harmonious society.

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Part II
Control Engineering and Applications

Chapter 12

EGR Control System Based on ANN

Guan Qiang Ruan, Zheng Dong Zhang and Qiang Wang

Abstract Design principle of exhaust gas recirculation (EGR) control for modern diesel engine is based on MAP which is available to experiment. The MAP is a need to a number of experiments with engine load characteristic curve, which is a heavy work. The MAP available cannot be used for all the range exactly in the experiments including changes of engine running conditions. Therefore, it is very difficult to design a PID controller based on MAP to adjust the controller with a bad robustness. Directing against the existing situation, a controller on the basis of an artificial neural network (ANN), which is of rapid adjustment and good robustness, is proposed in this chapter. It is experimentally proved to apply the control system that implements exhaust emission effectively controlled and reduced.

Keywords ANN · EGR · Modeling · Experiment

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12.1 Introduction

Design principle of EGR control for modern diesel engine is that the engine running conditions are defined real time on the basis of sensor signals, which come from rpm, throttle pedal, and temperature of coolant liquid, and output signals are controlled on the basis of MAP. The actuator is a vacuum electromagnetic valve that transforms the control signal into a physical shift of EGR valve position which is fixed to optimize the conditions. MAP of the position need to experiment with engine load characteristic curve and choose EGR rate of conditions according to position of EGR valve. MAP is saved on ECU [1]. Because of differences of engine running conditions and load, MAP based on experiment demands a large amount of spadework, meanwhile does not apply to the whole conditions. A great progress is made in the research on applying artificial neural network, which is of nonlinearity, uncertainty, and good self-learning capability, to control system in recent years. According to self-learning capability by training artificial neural network, it is convenient for us to obtain system structure and parameters without an exact mathematical model on the basis of the plant. Therefore, the controller based on artificial neural network is of good robustness and adjustment effect. In this paper, artificial neural network combined with classical PID controller is used to devise a PID controller based on ANN. It is found that it is easily available not only for controlled system with uncertain changes of the parameters and time delay to apply that the controller compared with classical PID controller calibrates parameters online, but also for nonlinear time varying system to succeed in adaptability and robustness.

12.2 Traditional EGR Electronic Control System

12.2.1 Basic Equation

EGR system uses air mass flow as feedback variable. It is generally established that air mass flow meter is of robustness. Therefore, EGR feedback system relies on air mass flow meter as feedback. Mass flow of EGR is expressed as follows [2].

$$\dot{m}_{\text{egr}} = A_{\text{egr}}(a_{\text{egr}})c_{\text{egr}} \frac{p_1}{\sqrt{R\vartheta_3}} \psi_{\text{egr}}(p_1, p_2) \quad (12.1)$$

where a_{egr} is EGR valve aperture opening ratio, c_{egr} is aperture coefficient.

$$\psi_{\text{egr}}(p_1, p_2) = \begin{cases} \frac{1}{\sqrt{2}} & 0 \leq \frac{p_1}{p_2} < 0.5 \\ \sqrt{2 \frac{p_1}{p_2} \left(1 - \frac{p_1}{p_2}\right)} & 0 \leq \frac{p_1}{p_2} < 0.5 \end{cases} \quad (12.2)$$

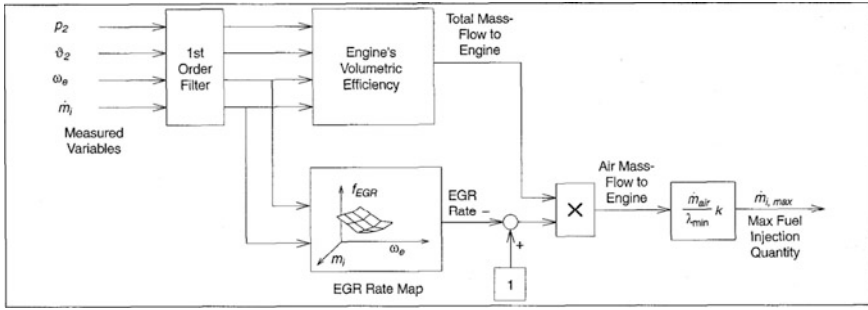


Fig. 12.1 EGR control flow

Feedback system provides A/F ratio control to indirectly control EGR operation on the stable condition. It is very necessary that the feedback avoids transient back-flow. In EGR mode, the exhaust gas in intake manifold is not less than 40 %. In the event of intense acceleration, system mistake that mass flow in engine is air. It is very limited for precise control of exhaust gas mass flow meter to adjust engine maximum injection in intake manifold (Fig. 12.1).

12.3 PID ANN Control Based on Dynamic Nonlinearity

12.3.1 Principle of Control

Aimed at nonlinear time varying system, dynamic nonlinear ANN is proposed in this chapter. According to the modifications the connection weight of an ANN is trained, its merit is not to demand too much prior control experience. The main idea of the chapter is as follows: To begin with, proportional coefficient, integral coefficient, and derivative coefficient of traditional PID control followed change of error are expressed as nonlinear error functions, respectively, by exponential error functions. Second, dynamic nonlinear PID control law is designed. Finally, nonlinear intelligent control is implemented through online training of an ANN for the three coefficients of PID. PID control law is expressed as follows [3].

$$u(k) = w_p(1.3 - e^{-|e(k)|})e(k) + w_i e^{-1.3|e(k)|}s(k) + w_d e^{-e(k)} \Delta e(k) \quad (12.3)$$

12.3.2 Artificial Neural Network (ANN) Model

Prior to entering an ANN model, error function e_k must be processed by antisaturation so that error function e_k is limited within $-1 < e_k < 1$. Error signal must be

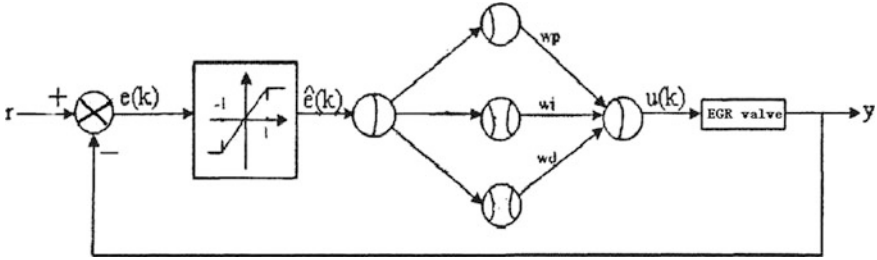


Fig. 12.2 Modeling dynamic nonlinear PID ANN

normalized so as not to control variable staying in saturation region for a long time. Accordingly, modeling dynamic nonlinear PID ANN is shown in the Fig. 12.2.

12.4 Neural Network Layer

12.4.1 Input Layer

Neurons in the input layer of the input and output, respectively, are [4, 5]

$$neti^{(1)}(k) = \hat{e}(k) \tag{12.4}$$

$$neto^{(1)}(k) = \hat{e}(k) \tag{12.5}$$

12.4.2 Hidden Layer

Hidden layer is determined by the ratio of element, integral, and differential elements which is composed of three parts, each hidden layer neurons in addition to input and output, have the nonlinear proportional element, integral and differential element. The input

$$neti_i^{(2)}(k) = neto^{(1)}(k), \quad i = 1,2,3 \tag{12.6}$$

Nonlinear proportional element

$$s_p(k) = (1.3 - e^{-|neto^{(1)}(k)|})neto^{(1)}(k) \tag{12.7}$$

Nonlinear integral element

$$s_i(k) = e^{-1.3|neto^{(1)}(k)|}s(k) \tag{12.8}$$

The hidden layer of each neuron outputs, is respectively

$$neto_1^{(2)}(k) = \begin{cases} 1, & s_p(k) \leq 1 \\ s_p(k), & -1 \leq s_p(k) \leq 1 \\ -1, & s_p(k) \leq -1 \end{cases} \quad (12.9)$$

$$neto_2^{(2)}(k) = \begin{cases} 1, & s_i(k) \leq 1 \\ s_i(k), & -1 \leq s_i(k) \leq 1 \\ -1, & s_i(k) \leq -1 \end{cases} \quad (12.10)$$

$$neto_3^{(2)}(k) = \begin{cases} 1, & s_d(k) \leq 1 \\ s_d(k), & -1 \leq s_d(k) \leq 1 \\ -1, & s_d(k) \leq -1 \end{cases} \quad (12.11)$$

12.4.3 Output Layer

The model shows the output layer to the input

$$neti^{(3)}(k) = w_p neto_1^{(2)}(k) + w_i neto_2^{(2)}(k) + w_d neto_3^{(2)}(k) \quad (12.12)$$

The model shows the output layer to the input

$$neto^{(3)}(k) = neti^{(3)}(k) \quad (12.13)$$

Nonlinear dynamic PID control output is equal to the output layer neurons of the output, That is

$$u(k) = neto^{(3)}(k) \quad (12.14)$$

12.5 Test Results

In order to verify whether the nonlinear dynamic PID neural network model is effective, we will test whether the nonlinear dynamic model of PID neural network controller is correct. In order to evaluation index, this book uses traces oxides of nitrogen density method. Figures 12.3 and 12.4 show the results of the use of conventional methods (PID controller) and the use of nonlinear dynamic model of PID neural network controller in gray and black lines, respectively. Figure 12.3 is the traditional model and neural network control test comparison chart of the traditional control method of EGR valve response delay (about 5, 7, or 12 s) and the nonlinear dynamic model of PID neural network controller, in response to a smoother and more quickly relative to traditional way. Figure 12.4 is the comparison chart of the emission test by the traditional control model and neural network model. The traditional control method of nitrogen oxides produced the

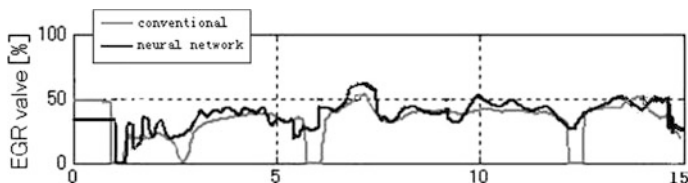


Fig. 12.3 Traditional model and neural network control test comparison

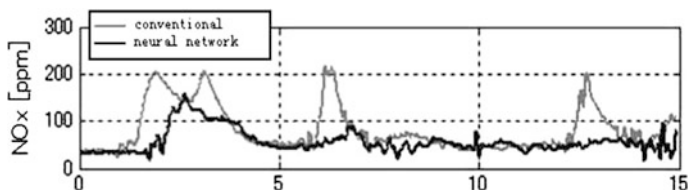


Fig. 12.4 Traditional control and neural network model of emission test comparison

density peak many times (about 3, 4, 6, or 13 s). But the nonlinear dynamic model of PID neural network controller produced relatively rare density peaks of nitrogen oxides. So the nonlinear dynamic model of PID neural network controller can significantly reduce nitrogen oxides emission density.

12.6 Conclusions

In this paper, according to the nonlinear, time-varying system presented for the nonlinear neural network control model, complete control system model is formulated and the neural network definition. It is proved by test, PID neural network model control system compared with the traditional control methods, can improve the response delay and can reduce NO_x emissions.

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Chapter 13

Control System of GSM Communication Network Based on Remote Household Appliances

Jing Li

Abstract This paper introduces a system that can remotely control household appliances by sending short messages using GSM communication network, which is suitable for intelligent home. It discusses the family control network and the system configuration, and describes the system hardware and software design. The system adopts Philips' LPC2131 chip and Siemens' TC35iGSM communication module. It makes an analysis of the AT instructions of GSM communication module and the software process of the control terminal of remote household appliances.

Keywords Household appliances · GSM communication network · Control system · Remote

13.1 Introduction

With the development of modern Internet and communication technology, the improvement of people's living standard, people living environment demand is increasingly high [1]. Intelligent home furnishing concept gradually coming into people's vision, people's life safety and comfort improve greatly [2, 3]. The household appliances remote control that can be thought of as the comfort of people's living is a revolution; as today information technology develop rapidly, telecommunications and Internet technology brought great progress in the human living standard; as in modern life, household appliances category increases continuously

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and has various communication interface and line, remote switch control intelligent home furnishing of the telecommunications' equipment of all kinds of household appliances must become the direction of home furnishing development.

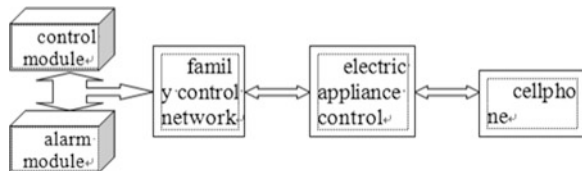
The remote household appliances control system can be made with contemporary universal communication mobile phone network and Internet network or combination of two kinds; so outside the family in any place, any time all of the household electrical appliances can be in operation and control, such as, television, electric rice cooker, water heater for remote operation and control [4]. For example, at the work before arriving home putting electric rice cooker on and water heater open, greatly improve the comfort degree and reflect the modern intelligence. Modern communication and control technology is developing rapidly; with the wide use of intelligent mobile phone, remote home appliances based on GSM communication network control system will greatly change people's family life style. This paper introduces a kind of communication network based on GSM home appliances remote control system; the system through the GSM module in communication network of short message sending, at the same time using single chip microcomputer as the control core of information transmission and the wireless remote control operation.

13.2 Home Control Network and System Composition

Home control network is designed for low-speed control of the transmission of information, to achieve various household electrical operation states, such as switches and brightness of the lights or air conditioning and temperature control and regulation, and temperature humidity and gas content measurement acquisition alarm auxiliary function of family. The remote control system of household appliances as such are shown in Fig. 13.1.

Remote control system of household appliances control network because of its belonging to the local areas, the information transmission environment is reliable; in the control of the information in the network for the control of information even with some parameter data, so the actual amount of data is very small, and with simple network structure, the data are usually in the 3 node within the network, the occupancy rate is not high. At the same time, the remote control system for household appliances control network does not require a larger scale, usually meet family requirements, can be set corresponding to the number of nodes, and these nodes are not more than 20 or 30 m distance. As the low-speed control information

Fig. 13.1 Remote control system of household appliances



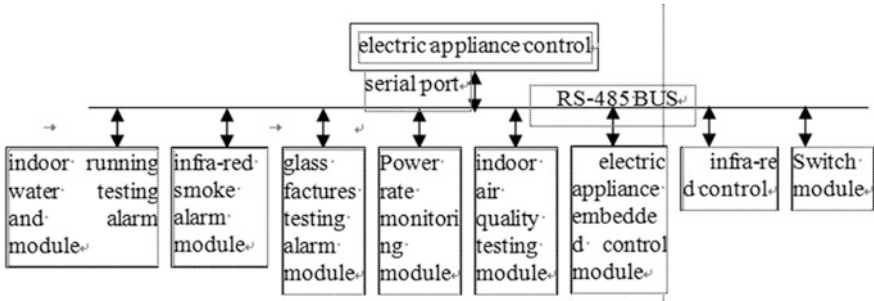


Fig. 13.2 The structure of the remote household appliance control system

transmitted in network, the frequency of the control signal rate is relatively low, the speed of the network generally above 10 Kbps can completely meet the requirements of remote control system for household appliances control network standards. But as a result of control network of various household electrical appliances control operation, the reliability of information transmission is very important, once the data transmission errors are likely to directly cause electrical damage, the choice of reliable information exchange is the key. Based on the existing wireless transmission technology maturity, usually used by the Bluetooth, infrared wireless transmission method in this paper is not used, decided to adopt the RS485 bus transmission control. Remote control system structure is shown in Fig. 13.2.

Remote control system structure includes a control module and an alarm module. The control module includes electrical power monitoring, temperature and humidity detection, wireless remote control, and a switch module, the family of electrical switches and parameters for remote control. Alarm module comprises smoke gas detection, glass doors and windows broken and water leakage detection of pipeline detection alarm. The remote control system can realize the family electric appliance centralized control, can open various electrical appliances, and corresponds to the set in a desired position, detect and control the load power, and through family air content detect indoor air regulation for family life as healthy living conditions. A variety of RS485 module MCU are added in the device, in a state of waiting can be set to a dormant state, saving power, when required to start work again wake up and work. Remote control system will control module and an alarm module independent of each other, the whole part of the module of the circuit structure is simple, independent module can individually repair processing components, is conducive to the breakdown of equipment repair and management. The RS485 bus communication mode is convenient and flexible; according to different user needs, corresponding to a modified installation of different functional modules in the system after the installation is complete, and according to the situation of home can also increase or decrease the corresponding function modules timely.

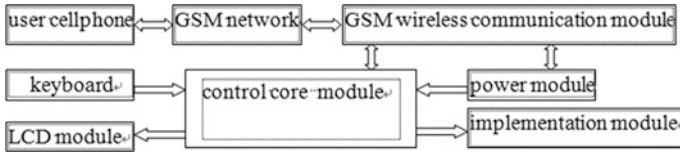


Fig. 13.3 The components of system

Remote control system for household appliances is completed with GSM communication network; they are combined to form a complete set of home appliances based on GSM communication network control system. The control system includes a control module and an execution module, wherein the control module comprises a user terminal mobile phone, GSM communication network and its module, the user only needs to send SMS messages through mobile phone wireless control communication. The components of the system are shown in Fig. 13.3.

The GSM network system is a communication platform for wireless connection of mobile phone users and control core module. Mobile phone users can send control information on domestic electrical appliances, including switches and electrical parameter settings, and also can accept the monitoring information of the GSM network feedback of household electrical appliances. In GSM module of the independent operating system, the information sent in the GSM network transmission function is an important module to control the transmission of information; including GSM RF and baseband processor chip, memory and power amplifier device, GSM RF and baseband processor set marked data interface operable. In which the module is sent by the user, operating instructions, including analog switches, relays, and in the family setting to participate in the control electrical appliances. In addition to the control of core modules and implementation modules, the system also includes a power supply module, keyboard, and LCD display section.

13.3 The Hardware Design of the System

The hardware of system adopts embedded microprocessor as the main control unit, analysis of the transmission control signal data. Make the communication through the serial port and GSM communication module connected. Since the system is likely to require a constant feature upgrade and expansion, decided to adopt the PHILIPS company LPC2131 chip, the chip is 16/32ARM7TDMI-S kernel, the data computing faster, higher stability, high performance-price ratio.

LPC2131 chips use a small LQFP64 package; 8/16/32 kB on-chip static RAM and 32/64/128/256/512 kB chip Flash program memory; 128-bit width interface/accelerator to achieve up to the working frequency of 60 MHz; the on-chip boot loading procedures for the realization of in-system programming and application

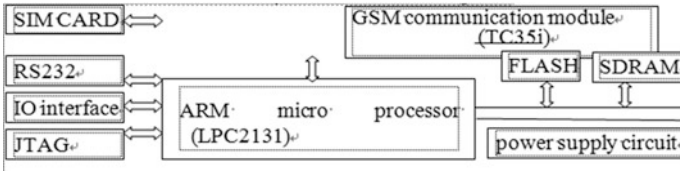


Fig. 13.4 The hardware structure of the system

programming (ISP/IAP); Flash sector or single chip erase time of 400 ms, 256 byte line programming time is 1 ms; embedded ICE RT and embedded tracking interface via the on-chip Real Monitor software code debugging and high-speed real-time tracking; low power real-time clock having a separate power and specific 32 kHz clock input; multiple serial interface, including two industrial standard 16C550UART, two high-speed I2C bus (400 kbit/s), SPI and has buffer action and the data length variable function of SSP; vector interrupt controller, a configurable priority and vector address; small LQFP64 package contains up to 47 common I/O (under 5 V); up to 9 edge or level trigger external interrupt pin; through individual enable/disable external function and peripheral clock frequency to optimize power consumption; through the external interrupt or BOD processor from the power-down mode.

Hardware system consists of LPC2131 chip, power supply circuit, reset circuit, clock circuit, JTAG interface, and a serial port level conversion circuit. The power is only 3.3 V single power supply on the LPC2131 chip and L/O port power supply. Analog and digital power through the chip simulation power supply pins are isolated from each other, can prevent noise interference. Reset circuit using CAT1025JI-30 chip, can realize the power monitoring. A clock signal using a baud rate more accurate crystal, the crystal can be matched with the LPC2131 chip ISP function. A serial port level conversion circuit and GSM module connected to the communication, data transmission. Using SP3232E to realize RS-232 conversion. The hardware structure of the system is shown in Fig. 13.4.

Hardware design of GSM communication module adopts Siemens company TC35i module, TC35i module to support Chinese short message of industrial grade GSM module, the working frequency at EGSM900 and GSM1800 dual band, the range of values is DC 3.3–4.8 V, current consumption to a dormant state 3.5, idle state 25,300 mA (average), launching state the peak is 2.5 A; can be a safe and reliable voice transmission and data transmission, power of EGSM900(4) and GSM1800(1) are 2 and 1 W, with 40 pin ZIF connector, can realize the power connection interruption instruction, voice and other data signals or other control signal to the bidirectional transmission. Through the interface connector or an antenna connector and SIM card reader and the antenna connection. SIM voltage is 3/1.8 V, TC35i data interface (CMOS level) by the AT command can be two-way transmission instruction and data, selectable baud rate is 300 b/s–115 kb/s, 1.2–115 kb/s automatic baud rate. It supports Text and PDU format Short Message Service, short message (SMS), through the AT command or a shutdown signal to

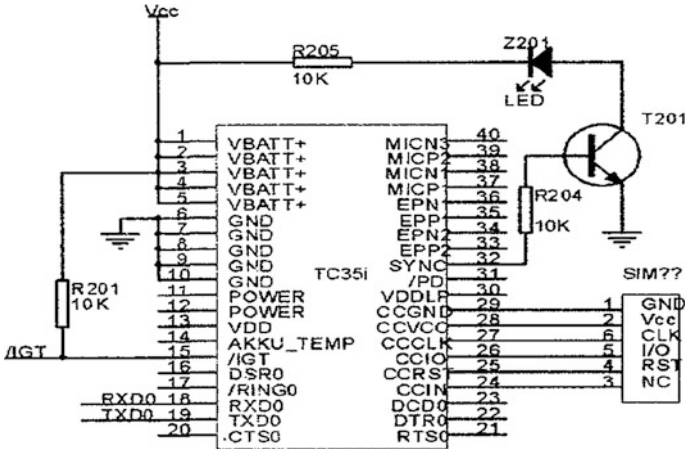


Fig. 13.5 TC35i module connected graph

achieve restart and recovery. TC35i module includes GSM baseband processor and RF module, power supply module (ASIC), hardware flash, and ZIF connector and antenna. The data parameters need to set the parity bit, just set 8 data plus a stop baud rate range for 30 obps–115 kbps, according to the actual need to select the module hardware handshake and software flow control, respectively RTS0/CTS0 and XON/XOFF, the interface mode of operation using the AT command to switch, receiving and processing the short message, data, voice. TC35i module connected graph is shown in Fig. 13.5.

The system also includes a switch control circuit, and switch control household appliances power switch control circuit can be completed. The switch control circuit for the relay circuit, the circuit input, and the circuit I/O ports directly connected to complete the relay switch transistor drive.

13.4 The Software Design of the System

GSM communication module has a variety of control instructions, because of its strong growth performance, the AT instruction is not a single command mode, it also includes standard instruction, AT and FAX extended instruction as well as short message instruction. The remote control communication short message instruction definition of this system as follows:

- AT + CMGF = 1: set the short message format to text.
- AT + CMGS = recipient number of short message receiver: transmission short message of control.
- AT + CMGR = n: reading No. n mobile short message.
- AT + CMGD = m: delete No. m mobile short message.

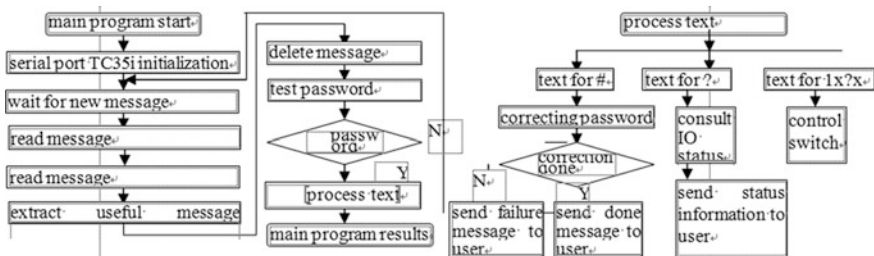


Fig. 13.6 Flow diagram of software

Usually, the system can transmit and receive GSM character set and the 8 data in the Text mode, but cannot realize Chinese and ucs2 character transmission. The solution method General using PDU model, first to receive Chinese and ucs2 character to code under PDU mode, after sending to decode, this method is relatively complex. The system in the user mobile message terminal using simple control commands such as 1 and 0, 1 and 0, respectively, corresponding electrical switching operation, which not only can directly use Text format mode, but also can greatly simplify the user mobile phone preparation of complex Chinese control short message.

Remote control terminal software of household appliances processes is shown in Fig. 13.6. First, the main program started on TC35i module initialization setting, its format is set to Text; then through the short message it detects module and the main control unit of TC35i communication is normal or not; Confirmation of normal communication on L/O port initialization settings, completion of the L/O port of register control; after the communication mode set baud rate is 9,600 bps asynchronous serial mode, data serial transmission which without the parity bit, simply set the 8 data bits and one stop bit; Finally, make the receiving mode of UART1 to receive interrupt mode, Make sure when the GSM communication module transmits the data can receiving feedback information successfully.

13.5 Conclusions

The design of system adopts GSM network communication technology and microcomputer control technology for household appliances remote control and monitoring. This system has the advantages of small volume, low cost, low power consumption, simple operation, reliable, and safe, have greater economic value and practical value, very suitable for the direction of intelligent home furnishing development, can provide the people a high quality of life.

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Chapter 14

A Novel MPPT Control Scheme in PV System Based on Super Capacitor Energy Storage

Hang Zhang and Nan Li

Abstract A maximum power point tracking (MPPT) control scheme in photovoltaic (PV) system based on super capacitor energy storage is put forward in this paper. Compared with the normal parallel-connected DC/DC MPPT circuit, the proposed scheme can resolve the coupling problem in order to improve the efficiency and stability of MPPT control.

Keywords PV system • MPPT • Super capacitors

14.1 Introduction

As conventional sources of energy are rapidly decreasing and the cost of energy is rising, photovoltaic (PV) energy becomes a promising alternative source. Since it has some of the advantages, i.e., available in bulk, free of cost, pollution free, and distributed throughout the earth [1]. The main drawback is that the energy conversion efficiency is relatively low. The main reasons for the disadvantage are the nonlinear variation of output voltage and current with solar radiation levels, operating temperature, aging, and load current [2]. In order to improve the PV array efficiency and short the recycle of the system cost, it is the fundamental function and requirement of the PV power control circuit to make the PV array

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output maximum power under any circumstance. Many maximum power point tracking (MPPT) methods for PV power generation systems have been reported, and most of them are based on DC/DC chopper circuit which, however, can hardly resolve the decoupling problem in the MPPT control process.

In this paper, a novel MPPT control scheme based on super capacitor energy storage system (SCES) connected to DC grid will be proposed to resolve the problem mentioned earlier to improve the stability and efficiency of MPPT control.

14.2 PV Module Characteristics

The voltage–current characteristic equation of a solar cell is composed of the light generated current source, diode, series resistance, and parallel resistance. The terminal equation for the current and voltage of the solar cell is given as follows:

$$I = I_{ph} - I_0 \left\{ \exp \left[\frac{q}{nkT} (U + IR_s) \right] - 1 \right\} - \frac{U + IR_s}{R_{sh}} \quad (14.1)$$

where I and U are the cell output current and voltage, and the definitions of the parameters are given in nomenclature. The output P - U characteristic curves of PV array with different irradiation obtained by experiments are shown in Fig. 14.1. From the P - U characteristics, it can be observed that for a given insolation and temperature, there exists a unique operating point corresponding to the maximum power point (MPP) of the PV array. Therefore, to extract maximum power from the PV array, it is necessary to operate at the corresponding MPP as insolation and temperature vary. This is called simply MPPT.

Fig. 14.1 Output P - U characteristic curves of PV array with different insolation

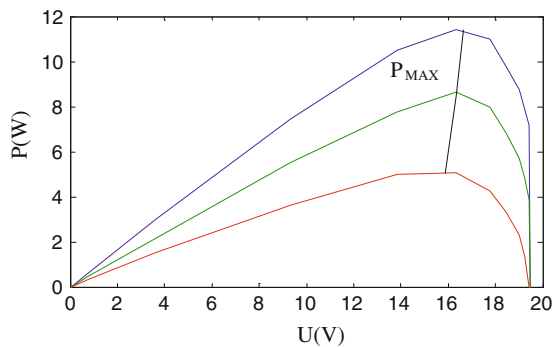
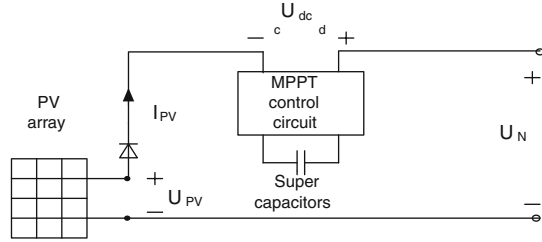


Fig. 14.2 Overall system configuration



14.3 Control Scheme for Performing MPPT

14.3.1 Overall System Configuration

The overall system configuration of proposed MPPT control scheme is shown in Fig. 14.2. The MPPT control circuit is series-connected with the PV array and the DC load bus. And the super capacitor is shunt-connected with the MPPT control circuit.

The output voltage, current, and power of the PV panels in the grid-connected system are defined as U_{PV} , I_{PV} , and P_{PV} , respectively. Based on U_{PV} and I_{PV} , the voltage of MPP (U_{MPP}) can be calculated by algorithms, which will be introduced in the next section. According to Kirchhoff's law, the relationship of three voltage parameters is as follows:

$$U_{PV} = U_N - U_{dc} \quad (14.2)$$

where U_{PV} is the voltage of PV array (U_{PV}), U_N is the voltage of DC load bus, U_{dc} is the output voltage of the MPPT control circuit, which can compensate for the difference of U_{PV} and U_{MPP} . By regulating U_{dc} U_{MPP} of PV array can be obtained rapidly and precisely without considering the relationship of U_{PV} and I_{PV} [3].

DC/DC converters transform a given DC voltage to another level of regulated DC voltage. This is achieved with the help of energy storage elements like the inductor and capacitor and ON/OFF switching devices like transistors and diodes [4]. Usually, the ON/OFF sequence is repeated in a periodic manner at a certain frequency $f_s (=1/T_s)$, where $T_s = T_{ON} + T_{OFF}$. There are three basic types of DC/DC converters:

(1) buck converter; (2) boost converter; (3) buck–boost converter.

where D is $T_{ON}/(T_{ON} + T_{OFF})$, U_{out} , and I_{out} are the input voltage and the output voltage, respectively, I_{in} and I_{out} are the input current and the output current, similarly [5].

As the relationships showed above, the function of DC/DC converter is a DC transformer. The output voltage of the converter will be influenced by the system voltage badly, which caused oscillation and low efficiency of MPPT control.

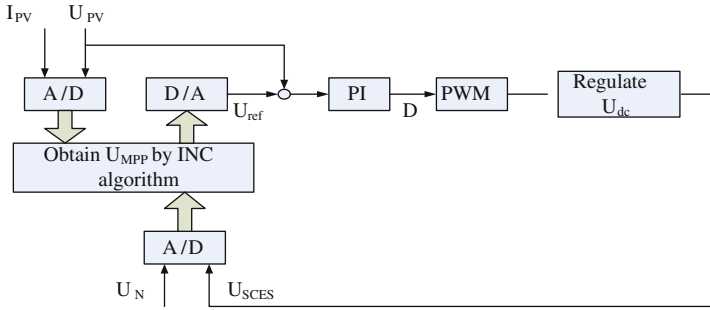


Fig. 14.3 MPPT control diagram

Due to the proposed MPPT scheme based on series-connected configuration, no matter how the system voltage changes, the super capacitors will compensate the difference between U_{MPP} and U_N . This is the key point that makes them decoupled [6].

14.3.2 Control Method of the Proposed MPPT System

In respect that U_{MPP} calculated by algorithms (the incremental conductance method, INC in case of this paper) can be higher or lower than U_{PV} detected by sensors, U_{dc} is required to be positive or negative in the circuit. Therefore, the MPPT control circuit is designed as follows, where USCES is the output voltage of super capacitor energy storage, L is the smoothing reactance that can smooth the wave of output current.

Based on the calculated U_{MPP} and detected U_N , the tracking process takes decisions of increasing or decreasing the duty ratio, so that control progress can keep U_{dc} , which is supplied by super capacitors, equal to the difference of U_{MPP} and U_N . There is a pair of IGBTs on the state of breakover or shutoff, respectively, every moment that make the direction of output current from PV array unalterable. And the duty of an IGBT is the same as the other one of the pair. The MPPT control diagram is shown in Fig. 14.3.

When the insolation is so deficient or the temperature is so low, such as at night or in the winter, that the DC load bus voltage U_N (300 V in case of this paper), is higher than the obtained U_{MPP} , super capacitors will discharge. IGBT Q2, Q3 breakover, Q1, Q4 shutoff at the same time. The output current of the circuit flows from terminal c to terminal d, and the direction of U_{dc} is positive as shown in Fig. 14.4.

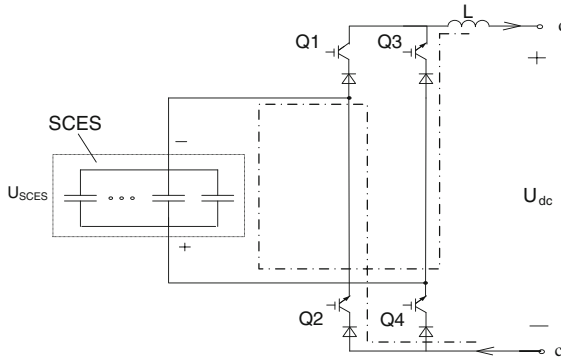


Fig. 14.4 Direction of output voltage and current when discharging

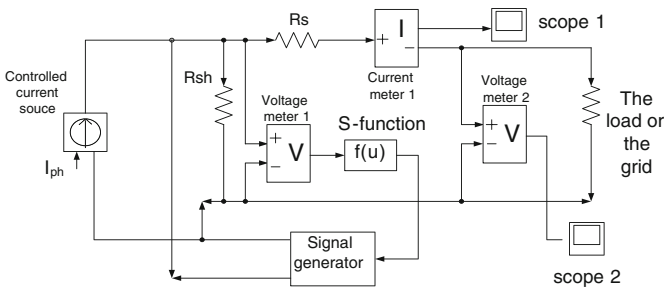


Fig. 14.5 The simulation model of PV array

Similarly, when U_{MPP} is higher than U_N in weather conditions of sufficient insolation and high temperature, the super capacitors will be charged by the power from PV array. IGBT Q1, Q4 breakover, Q2, Q3 shutoff at the same time. The output current of the circuit still flows from terminal c to terminal d, and the direction of U_{dc} is negative.

14.4 Simulation

Based on the simulation software MATLAB/Simulink, the simulation model of PV arrays, which can simulate both the P-U and I-U characteristics of PV arrays, was established as shown in Fig. 14.5 according to the Eq. (14.1) in Sect. 14.2. I_{ph} is the control signal. Different I_{ph} represents different ambient insolation and temperature [7, 8].

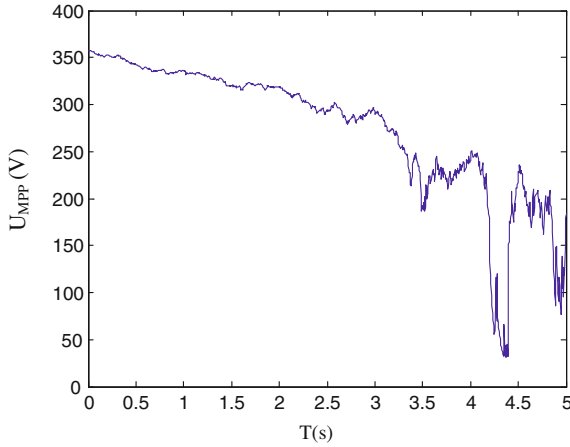


Fig. 14.6 The curve of calculated U_{MPP}

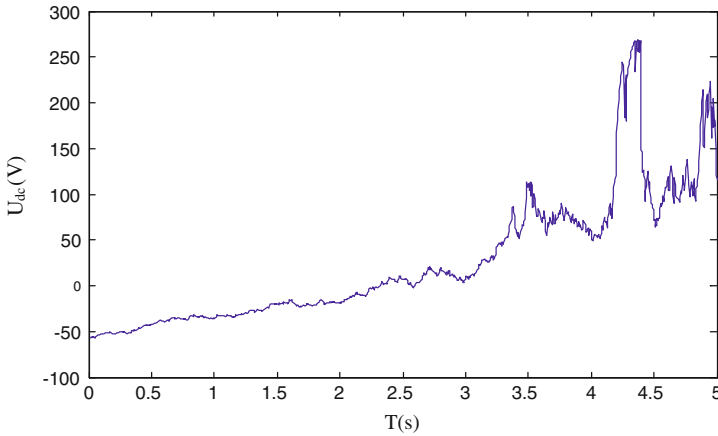


Fig. 14.7 The curve of U_{dc}

First, it is proposed that I_{ph} is a series of random signal. The curve of calculated U_{MPP} and U_{dc} is shown in Figs. 14.6 and 14.7, respectively. It is obvious that U_{dc} can track the difference between U_{MPP} and U_N (300 V) of DC bus voltage, in case of this paper [9].

Compared with power generated from PV arrays without MPPT control shown in Fig. 14.8, more power can be generated by PV arrays with proposed MPPT method shown in Fig. 14.9. As the simulation results indicated above, the control method based on super capacitors can realize MPPT function rapidly and precisely [10].

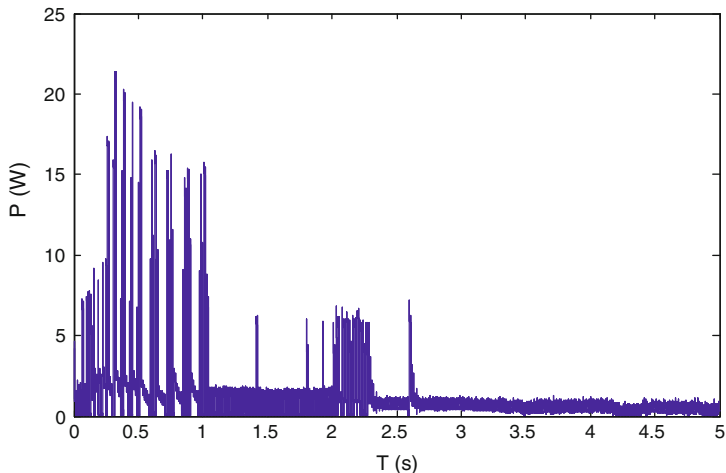


Fig. 14.8 P generated by PV arrays without MPPT control

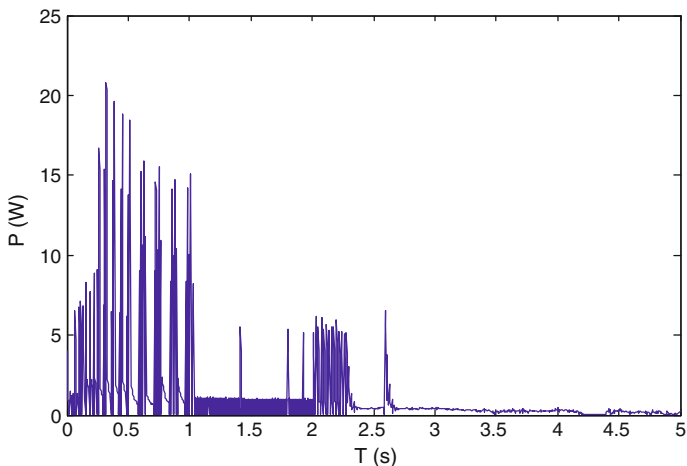


Fig. 14.9 P generated by PV arrays with proposed MPPT method

14.5 Conclusions

A novel MPPT control scheme based on super capacitors for PV generation system has been proposed. The proposed system consists of a new MPPT control circuit series-connected with PV array and DC load bus, and super capacitor energy storage parallel-connected with the control circuit. The voltage, which can be directly generated from the proposed MPPT control circuit, is the difference between the PV array voltage and DC load bus voltage. The output voltage is regulated by duty of IGBTs with PWM. Besides, the proposed system can reduce

the magnitude of oscillation when the abrupt change of ambient environment conditions happened. Meanwhile, MPPT control can resolve the coupling problem in order to improve the efficiency and stability. The optimal design is simple and shows superior performance under parameter variation environments. The validity is verified by the simulation and experimental results mentioned above.

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Chapter 15

Measurement and Control System of Steel Furnace Based on OPC Technology

Liping Liu, Yongli An and Jingtao Yin

Abstract The presented system used for measurement and control of a steel furnace's product parameters is composed of an industrial PC, a RS-485 network, an ADAM-5000 DA and C system, and necessary sensors, etc. Its HMI software is programmed using KingView6.0. Because it is needed for the monitoring system to interchange data with the factory's MIS, an OPC server is configured to support such an application, and an OPC client software is programmed to get and send data through an Ethernet.

Keywords OPC technology · Measurement and control system · Data communication · Kingview

15.1 Blast Furnace Control System

The blast furnace production system is composed of an industrial control computer, RS-485 networks, ADAM-5000 data acquisition system and the sensor transmitter, and other equipment components, as shown in Fig. 15.1. Its role is to blast furnace operation when the process parameters of the real-time acquisition,

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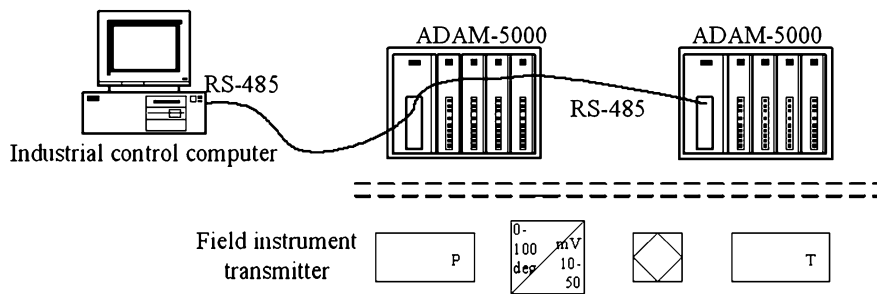


Fig. 15.1 Schematic diagram of parameters measurements and control system of blast furnace production

display, recording, alarm, and statistics and so on, for the normal production and provide effective protection [1, 2].

ADAM-5000 data acquisition system from the host ADAM-5000 and various I/O module. ADAM-5000 on the host RS-485 interface can be easily composed of multiple ADAM-5000 and host computer measuring and control network. Each ADAM-5000 plate can be inserted in 4 I/O module; the user can, according to the specific needs, choose the appropriate configuration. In this system, 2 ADAM-5000 configuration 3.5018 thermocouple input module, a 1.5013 thermal input module, a 2.5017 analog input module, and a 1.5068 relay output module are used. System acquisition of the blast furnace process parameters mainly include: body temperature, temperature, temperature of cold air delivery tube, the blast furnace material, reducing tube pressure, hot air pipe pressure, and cooling water pressure [3, 4].

The system monitoring software used is the Kingview 6 configuration system. Due to the need for and factory management information network of interactive data, the monitoring system is set up in the OPC data server by writing an OPC client program to invoke the blast furnace production process parameters in real time [5, 6].

15.2 Introduction to OPC Technology

OPC technology is the realization of a control system of field equipment level and management level of information interaction, achieve control system key technology. In addition, a heterogeneous computing environment using OPC technology, can simplify the process control system integration [7].

OPC OLE for Process Control for OLE, which is applied in industrial control field. OLE is the object linking and embedding, with the release of OLE 2, its scope has been far beyond the concept. OLE now includes many new features, such as the unified data transmission, storage, and automation, has become independent from the computer language, operating system and hardware platform is a

specification, object-oriented programming concepts to further promote. OPC based on OLE specification for industrial control field, provides a kind of standard data access mechanism [8, 9].

The field of industrial control used in lots of field equipment,; OPC, appeared in the past, software developers need to develop a large number of drivers to connect these devices. Even if the hardware suppliers have to do some small changes in the hardware, the application may need to be overridden; at the same time, because of the different equipment and even the same of different equipment unit driver may also be different, software developers have a difficult time for the equipment access to optimize operation. Hardware vendors are trying to solve this problem, however, because different customers have different needs, and the existence of different data transmission protocols, there has been no complete solution [10].

Since OPC was put forward, the problem was finally solved. The OPC specification includes an OPC server and an OPC client in two parts, its essence is to establish a complete set of “rules” between the hardware vendors and software developers. As long as we follow a set of rules, data interaction for both is transparent, hardware vendors without considering the application of a variety of needs and transmission protocol, software developers without understanding the essence and the operation process of the hardware [11, 12].

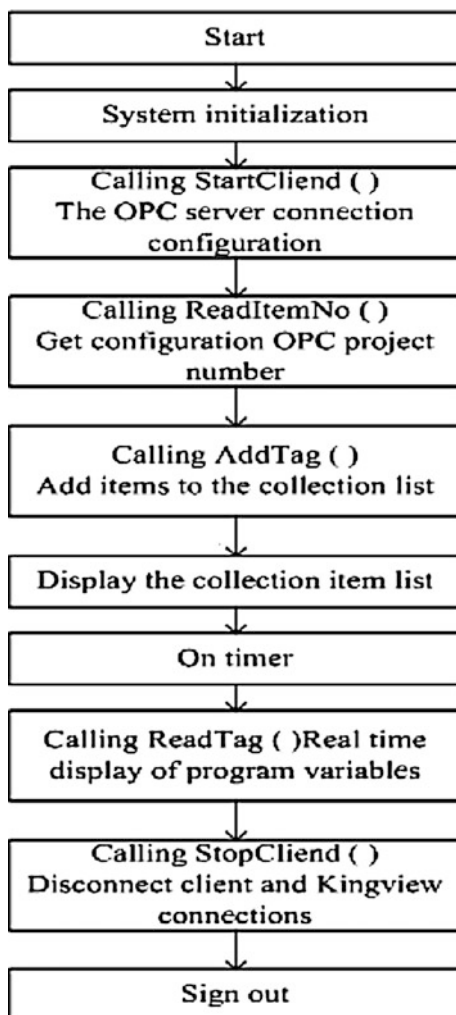
15.3 OPC Function of Kingview 6

Configuration makes full use of OPC powerful server performance, convenient for engineering personnel to provide efficient data access capability. In Kingview, simultaneously hanging arbitrary multiple OPC servers, each OPC server is used as an external equipment, engineering personnel can be defined, add or delete it, like a PLC or instrumentation [13].

Kingview in the original OPC client based on the OPC server function, realizes the configuration of OPC server and client of the united. Through the configuration of OPC server function, users can easily realize the other OPC client support applications and data communication between the Kingview and call [14, 15].

In order to facilitate the users to use the OPC server configuration function, make the user (need not in the absence of other requirements under the circumstances) to purchase another OPC client software of Kingview, provides a set of configuration and connection to the OPC server interface functions, these functions can be provided via a dynamic library to achieve KingviewCliend.dll. Users using the dynamic library can use VB, VC programming language and produce their own OPC client program [16].

Fig. 15.2 Flow chart of OPC client routines



15.4 OPC Client Program

OPC client program is prepared to use VB6.0. Figure 15.2 shows an OPC client routine flow chart, which is briefly described as follows:

In the works, user should first state the KingviewCliend.dll interface reference on the dynamic library function.

- Declare Function StartCliend Lib "C:\kingviewcliend.dll" (ByVal pNode As String) As Integer
- Declare Function StopCliend Lib "C:\kingviewcliend.dll" () As Integer
- Declare Function ReadItemNo Lib "C:\kingviewcliend.dll" () As Integer

- Declare Function GetItemNames Lib “C:\kingviewcliend.dll” (ByVal ItemName As String, ByVal Index As Integer) As Integer
- Declare Function AddTag Lib “C:\kingviewcliend.dll” (ByVal pNode As String, ByVal TagID As Integer, ByVal DataType As Integer) As Integer
- Declare Function ReadTag Lib “C:\kingviewcliend.dll” (ByVal TagID As Integer, ByVal bVal As Boolean, ByVal lVal As Long, ByVal fVal As Double, ByVal sVal As String) As Integer.

Define two global variables ginta, gintb as the system project of reading, reading acquisition column variable real-time values of the cycle number [17].

Based on the design of good user form, each function is connected to a corresponding predefined process: first, calling the StartCliend () function to start a connection to the OPC server, through the function of the pNode parameter to control with which computer the Kingview are connected; then, calling the ReadItemNo () function will return the Kingview OPC, the total number of items assigned to ginta; to ginta cycles, called GetItemNames () function to obtain the name of the project, and the list box displays all the project name; then, calling the AddTag () function will add user selectable acquisition variables to the collection, and is used in data display control MSHFlexGrid to display the selected project variables, variable data type, and variable collection identification number, while the cumulative acquisition items in the column number are assigned to the gintb; finally, use the timer data acquisition frequency, when the timer event occurs, with gintb as the cycle number, variable collection ID as a parameter, called ReadTag () function the reading of the selected project variables, data, and display in the MSHFlexGrid control; exit client program. By calling the StopCliend () function, disconnect Kingview OPC server connection [18].

15.5 The End

At present, OPC technology and standard is widely used in various fields, OPC technology gives modern industrial control software with stronger vitality. This paper describes the blast furnace monitoring system using the Kingview 6 as OPC server client program, preparation method, It can meet the requirements of blast furnace process parameters and factory management information network of interactive data needs, and fully display the system open and has the widespread application prospect.

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Chapter 16

Concurrency Control of Real-Time Distributed Web Applications Based on J2EE Multi-Tier Architecture

Chang-e Dong

Abstract In this paper we presented the strategy and method to design and analyze resource-oriented concurrency control in Web application systems, so as to improve the correctness and performance of concurrent systems through resource-oriented interface programming. The approach comprises three steps: first, business extraction is implemented to provide the resource for concurrency control; second, the resources that are related to the business process need to be classified and registered, so as to be recognized by the control system; third, a dynamic link between the registered resource and strategy warehouse should be established, and then the concurrent resource and concurrency mechanism can be connected to solve the conflict in using the resources among different users.

Keywords Concurrency control · J2EE · Resources registration

16.1 Introduction

Web application systems with J2EE-based multi-tier architecture usually run in concurrent environments during the developing process or when applied by different networked users. When some operations related to database are made by different system roles or users without reasonable concurrency control, this might cause data temporal consistency and logical consistency, and the complexity for implementing, testing, and tracking these systems is significantly increased when

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there are resource concurrency problems. However, in fact currently, most concurrency control strategies and programs mainly focus on databases, while they lack the effective and integrated concurrency control strategies to manage and allocate different resource types, and therefore cannot solve the concurrency and operational issues between the various resources in the Web application and development for servicing business systems. Modern software development projects show that concurrency control and transactions are not simply the domain of databases, instead they are issues that are potentially pertinent to all of the architectural tiers and resources.

16.2 Related Background Knowledge

16.2.1 Resource-Oriented Concurrency Control

Concurrency control deals with the issues involved with allowing multiple people simultaneous access to shared entities, objects, data records, or some other representation. In computer science, especially in the fields of computer programming, operating systems, concurrency control ensures that correct results for concurrent operations are generated, while getting those results as quickly as possible [1]. Concurrency control in database management systems (DBMS), other transactional objects, and related distributed applications ensures that database transactions are performed concurrently without the concurrency violating the data integrity of a database. The main categories of concurrency control mechanisms are optimistic and pessimistic [2]. Besides, many methods for concurrency control exist; include two-phase locking, conflict, graph checking, timestamp ordering, commitment ordering, multiversion concurrency control, and index concurrency control [3].

16.2.2 J2EE-Based Multi-Tier Architecture

J2EE-based multi-tier architecture technology can also be utilized for resource-oriented concurrency control programming. And in this paper, we use multi-tiered structure in application: presentation layer, business logic layer, persistence layer, and domain layer. A well-architected application is crafted into distinct layers, each of which encapsulates a particular role and has its own functions as different independent layers, so we can build a effective combination framework, that is: the presentation layer, based on Model View Controller (MVC) design pattern, is implemented by Web Work framework, while the business layer is implemented by Spring framework, which is an IOC/AOP container [4]. Each layer maintains a clear separation to make them independent existence with different functions. multi-tier architecture is shown as Fig. 16.1.

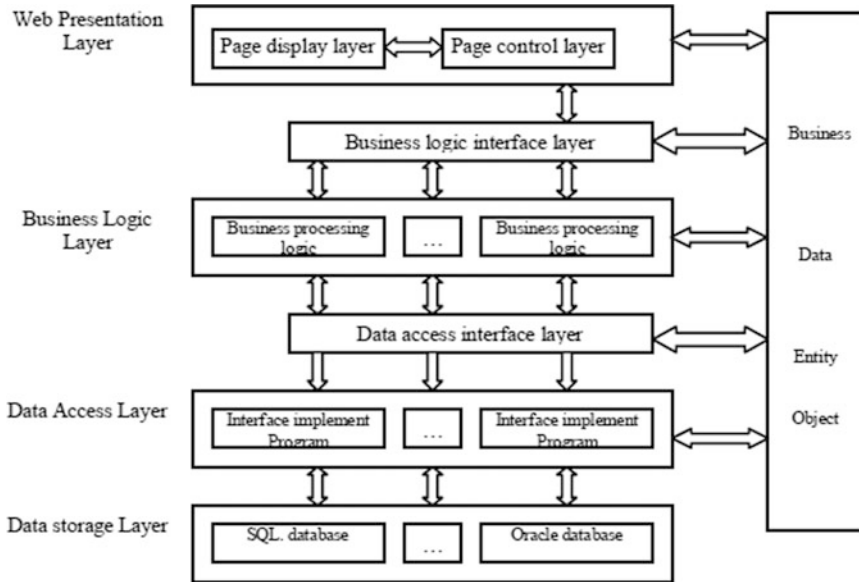


Fig. 16.1 Improved multi-tier architecture

16.2.3 Improved Multi-Tier Architecture

The problem of the traditional multi-tier architecture above is: Web presentation layer depends on the concrete realization of business process logic, while business process logic depends on the concrete realization of data access operations [5]. Thus, this paper introduces “interface-oriented” design concept to solve the resource-oriented concurrency control, puts forward a type of new Web application framework, its structure is shown in Fig. 16.1.

16.3 Overall Analysis and Design of Resource-Oriented Concurrency Control

16.3.1 Business Extraction

Business extraction is the first step in constructing the resource-oriented concurrency control, which is the discipline of identifying business needs and determining solutions to business problems. Solutions often include a systems development component, but may also consist of process improvement or organizational change or strategic planning and policy development. Through business process analysis, we can extract critical business. In this paper, we take Web content management system (WCMS) as an example, describe the basic steps and

methods of business process analysis, utilize use case diagram to analyze the main business processes by UML, and then build functional structure and extract the main functions and processes to prepare for the resource registration.

16.3.1.1 Use Case Diagram

Use case diagram is the description of system functionality from the user’s point of view and points out each function of the operator and the dynamic description of system behavior [6].

16.3.1.2 Functional Structure Chart

A complete content management system should have four major functions: content draft management, content edit management, content audit management, and content publish management. According to the use case diagram of content management system described above, we can attain function structure diagram of Web content management system after optimizing and optimal decomposing of the functional structure to satisfy the relevant principles; an optimized functional structure has been acquired as shown in Fig. 16.2.

16.3.2 Resource Classification and Registration

The main purpose of resources registration is to find suitable concurrency control strategies according to the registered resource when such kinds of resource

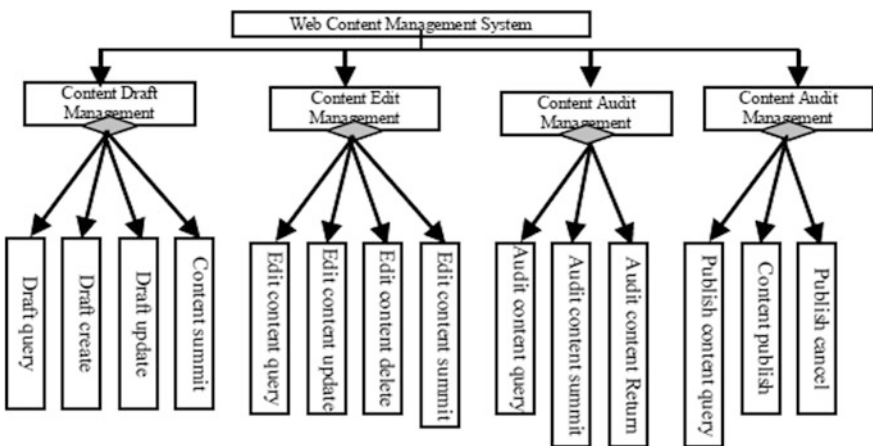


Fig. 16.2 WCMS functional structure chart

concurrency issues occur [7]. Before registration resources, we need to classify the resources into the different types that have been contained in the development and implementation process of Web application. In this paper, first, we acquire a basic resource collection by business extraction and functional analysis and then the resource collection is separated into different resource types; second, the classification method that is applied here primarily bases on the resources access actions that led to concurrency issues and the form and location where the resources are stored; finally, we use the resource classification flowchart to give details of how to categorize the initial resource collection and as Fig. 16.3 shows, there are totally five categories of resources: database resources, upload or download resources, program code resources, interface display resources, and other resources.

After the resources have been classified into different types, we can realize resources registration primarily on the business logic layer, according to the classified resources. The concurrency actions of different resource types are listed in Table 16.1. The table shows that when more than one actions work on the same resource simultaneously, it may cause resource concurrency problems, thus beforehand, we should register the resources so that the control system can recognize the resource types and take corresponding control mechanisms to solve the concurrency issues.

16.3.3 Establishment of a Dynamic Link

A dynamic link between the registered resources and the strategy warehouse has been utilized to support the requirement of different concurrency resources. When we establish the dynamic link, the strategy warehouse should be encapsulated in java package. Besides, encapsulated strategy warehouse can be described as a protective barrier that prevents the code and data from being randomly accessed by other code defined outside the class. An interface is used to control the access to the data and code tightly.

The main benefit of encapsulated strategy warehouse is the ability to modify the system's implemented code without breaking the code of others. With this feature, different kinds of users should take part in the process of the establishment of dynamic link, so as to link the extensive concurrency resources to its corresponding strategy warehouse together between different users to choose the concurrency control strategy. In the paper, we utilize business flowchart to analyze the resource process, so as to create a dynamic link between registered resource and warehouse strategy; the detailed process is shown in Fig. 16.4.

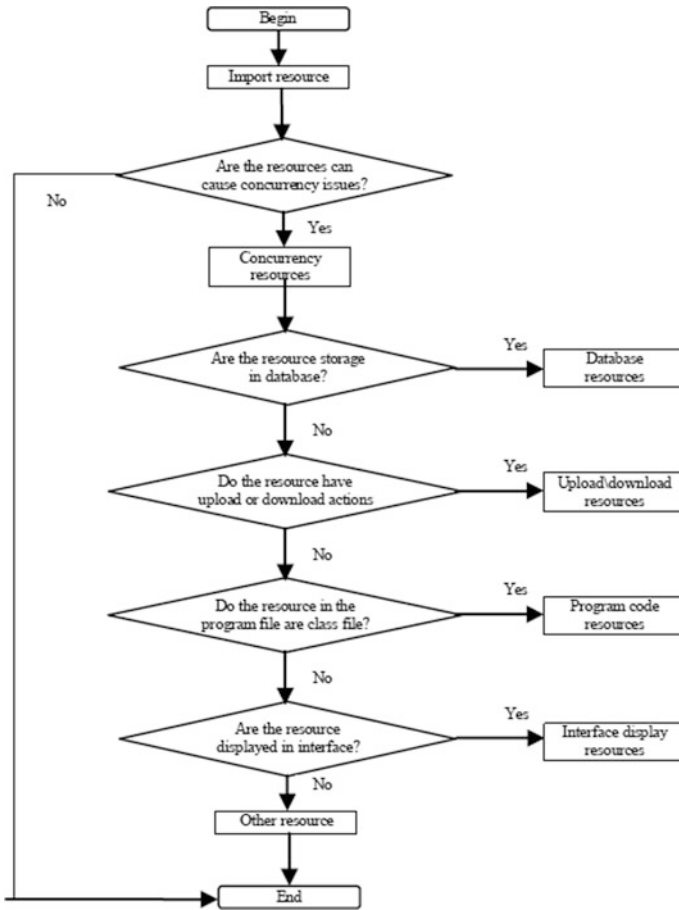


Fig. 16.3 Resource classification flowchart

Table 16.1 Project selection matrix rules

Resource types	Concurrency actions
Web pages	Publish, update, search, delete
Data records	Update, search, delete
Document files	Download, upload, update, search, delete
Images or pictures	Download, upload, update, search, delete
Program codes	Call, update, search, delete
Java classes	Call, update, search, delete
Variables	Access, update, search, delete

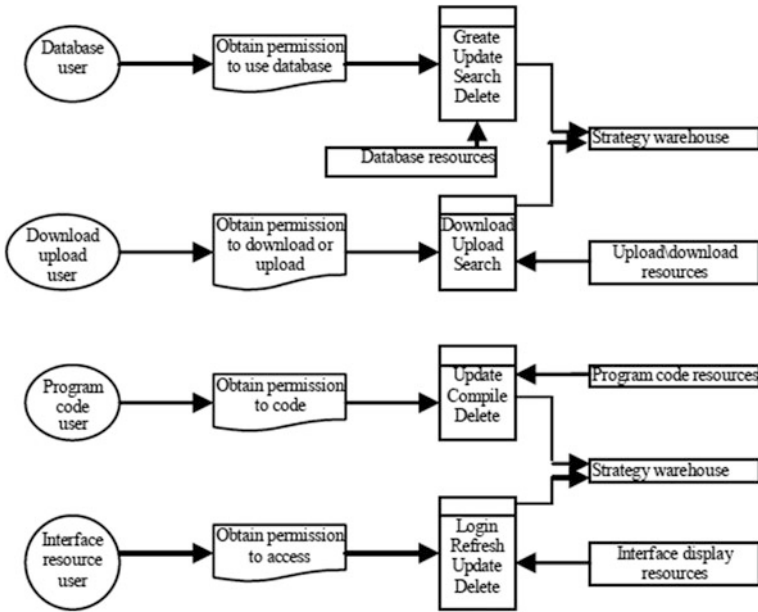


Fig. 16.4 Class diagram for caching simulator using FIFO, LRU, and LRU with related content

16.4 Implementation Process and Related Key Technologies

16.4.1 Resource-Oriented Concurrency Control Interface

In this part, we will define a resource-oriented interface allowing a resource class to become more formal about the behavior it promises to provide [8]. Interfaces form a contract between the class and the outside users that want to access resource, and this contract is enforced at build time by the compiler. The lock and unlock resource interface which has been defined below is in the business layer, so as to improve the flexibility and simplicity of resource concurrency control. By implementing this interface, we can implement some basic methods and measures for the resource-oriented concurrency control and resource management.

16.4.2 Key Technologies

16.4.2.1 multi-tiered Implementation

In practical applications, WCMS adopt J2EE-based multi-tier technical architecture to design and analyze concurrency control strategy, which comprises the presentation, business logic, persistence, and domain layers. The presentation layer

displays the interface resources to users, and input database resources, interface display resources can be transmitted through this layer to the business layer. Such frameworks can be utilized to reduce the coupling of control system [9]. The benefits of multi-tier architecture are that it has lowered coupling problems for the whole program structure to implement a valid and simple concurrency control mechanism. In addition, the maintainability and flexibility have also been improved, thus eliminating the deficiency while using each separate framework to develop a concurrency control program.

16.4.2.2 Locking Mechanism

Pessimistic locking is an approach generally used to lock the entity in the database for the entire time that it is in application memory. But for the resource-oriented concurrency control, we can also utilize the pessimistic locking mechanism to limit or prevent other users from working with the resource in the system, and the write lock indicates that the holder of the lock intends to update the resource and disallows anyone from reading, updating, or deleting the resource. A read lock indicates that the holder of the lock does not want the resource to change while he holds the lock, allowing others to read the resource but not update or delete it. The advantages of pessimistic locking are that it is easy to implement and guarantees that your changes to the resources are made consistently and safely.

16.5 Conclusions and Future Work

The main contributions of this chapter are summarized below: Method to establish dynamic link between registered resource and strategies warehouse for resource-oriented concurrency control issues; Design and analysis of the strategy to implement resource-oriented concurrency control; Propose a J2EE-based multi-tier architecture that can be used in Web applications for resource-oriented concurrency control; Examples of concurrency control strategy that can be used as resource-oriented concurrency control strategy, and related key technologies.

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Chapter 17

Electric Power Automation Control System Based on SCADA Protocols

Shihai Tan

Abstract The operation of the power failure can be catastrophic national security and economy. Due to complex, the dispersed of assets of dependent relationship among computer, communication, and power systems, to meet the safety requirements and quality requirements of the operation is a challenging problem. In recent years, the cyber security standards jointly sponsored cyber security utility, in compliance with the control system-CIP 1200. Common to this standard, identification of the existing security hole, a few cyber-that will offer an control system, and introduces several measures (for example, best practice). This paper summarizes cyber security problems control and automation systems, power control structures, and the possible existence of vulnerability assessment system.

Keywords Electric power automation control • SCADA • Security

17.1 Introduction

Electric power system is connected through a highly automated network. Some communication networks interconnected to power grid for the purpose of sensor, monitoring, and control. The computer and communications equipment is widely installed in power plants, transformer substation, energy control center, the headquarters of the company, regional operating office, and big load sites. These devices and systems become more network and complex [1].

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Computer, communication, electric power infrastructure are dependent on the grid. Measurement and control signal is obtained using SCADA energy management system (EMS) power system for a wide range of system function, including real-time control power grid. Failure of an important communication channel operation environment, can lead to control or operate important facilities, which can lead to possible power outages. Communication network congestion could delay the transfer of power system data and control signals, and, in some cases may be critical [2].

Another hacking scene is a breakthrough of the substation and other change settings protection relay, which may lead to bad switch action. At present, the system may not have strong measures to network attack, thus the existence of the loopholes. Therefore, there is a growing demand cyber security to solve these problems, in an overall and systematic way.

It has the advanced SCADA agreement from point-to-point links update the agreement and communication method [3]. The new method allows a higher level of redundancy and the spread of speed. The important question is, the practice is a mixture of the original 1970s and today's standards of practice. The reason for this may be expected of SCADA equipment. Life of the operation equipment is from 15 to 20 years, some variety of equipment may different according to the areas of technology. Some may be "smart" devices and other processor "stupid" with hard wiring group tasks. Sometimes a place may be amended and reconstruction, but in most cases, only occur in other of the maintenance requirements and equipment is coming to an end its life. The understanding of the integration is an important time, the past and the future of the SCADA agreement.

17.2 Evolution of SCADA System

SCADA system structure has evolved in the 1960s as one of the new computing grid environment. The evolution of the SCADA system includes three phases: (1) the monolithic, (2) distributed, and (3) network. Participate in using TCP/IP network has become a prominent because of the economic and common deployment [4].

This is the first to use host system and SCADA redundant construction and installation of the same host system. This is a separate system which has no connection to others. Each machine redundancy can pass through the other device provide network. Earlier should focus on the system than the attention of communication protocols and control center field between them is similar. As a matter of fact, the system can still be supply support hardware, software, and peripheral equipment. Network architecture has been widely used because of natural open system structure arranged three parties connected device compatibility, though some still vendor-proprietary. Its main improvement is completely open system structure, using a standardized agreement.

Table 17.1 Evolutions of the SCADA protocols

Years	Protocols
1970s	No standard protocol: point to point, hardwired remote control, and tone telemetry
1980s	Proprietary and industrial protocols: Modbus, Modbus plus, and proprietary or vendor specific protocols
1990s	Open protocols: DNP by Westronics (GE); UCA by EPRI for EMS mainly in North America; IEC 60870 by international electro technical commission (IEC).
2000s	Promoting standard protocols: DNP primarily in North America. UCA merged into the main stream of standard protocols, IEC61,850.

We put forward the communication protocol and the point-to-point links update the agreement and communication method [5]. The new method has more redundancy and the spread of speed. As mentioned previously, a big part of the problem is, the current practice of today's standards is the 1970s mixed practice. The understanding of the integration is an important time, the past and the future of the SCADA agreement. Table 17.1 summarizes the SCADA agreement evolution since the 1970s.

For technical transformation in the past 10 years, this trend has been refined agreement and become more flexible, adapt to the industrial need, especially in an open system structure of the high speed communications. Interoperability and maintainability of standard protocol that the communication security [6].

17.3 SCADA System Securities

This section provides a discussion of the SCADA system security with a broader consideration of the existing SCADA standards. Salient features of the security solutions are also discussed.

17.3.1 Escalating Cyber Security

The digital revolution quickly reduced the cost of computer peripherals. The Internet protocol can make heterogeneous components, reduce cost in SCADA communication and improve system performance, interoperability, and reliability. Merger computing technology, however, use of Ethernet network security problem causes SCADA system. And the convenience of Internet and the possible attack cyber-threat can perform exposure through TCP/IP. In addition, the commonly used information technology (IT) security solutions may not be sufficient due to the power grid environment of the dependencies between information and power infrastructure. Because of the specific areas, the power facilities must be considered [7].

Key network assets in power infrastructure to include: (1) sales management system (DMS), (2) substation automation system (SAS), (3) power plant process control system (PCS), and (4) the control center. The first three are thought to be in the transformer substation or regional level framework in the control center involves the system level [8]. For the purpose of maintaining the assets shall not set up, with dial-up network. Wireless network can be used for local communication. The access point can be used to develop network vulnerability of the network security is not tightly implemented and enforced [9].

17.3.2 CIP 1,200 and Other Standards

Constitute the standard for 1,200 terms with the power system network safety requirements to meet. The standards for general reference line to keep alert, and training of personnel. Guidelines include physical and network parameters identification, critical network assets; however, they does not provide system vulnerability assessment based on true. Some other SCADA safety standards BS7799 is available, for example, by British standards association (BSI), the international electro technical commission (IEC)ISO 17799, by the United States, is AGA12 TR 99.00.02 gas association, the department 21 steps. Some of these standards provide guidance, including domain specific defense example [10].

17.4 Power-Cyber Security Framework

Common development network safety standards and requirements for grid, reduce the risk, improve the power system reliability from any compromise most of the key network assets grid [11]. It is difficult to deploy security barriers on network attack robust control center network, and points out the attack, they centralized widely the nature of the control mechanism, the potential for a lack of coordination each entity. In order to achieve the goals of the safety of a control center network and electrical power infrastructure, comprehensive strategy including policy, technology, and the cost benefit with the development of new aspects to the security needs. To this goal, we mainly study the following tasks:

Threats and vulnerability assessment: the task is to establish a comprehensive understanding of all possible threats and vulnerabilities to network power grid and all kinds of ways to use the loopholes malicious attacks [12].

Security framework: this design is a comprehensive security framework that encompasses security policy, defense mechanism, and strategy use and optimal security measures [13].

17.5 Security Modeling and Evaluation

In this section, three methodologies of security modeling and evaluations are discussed. Although the metrics provided on each method varies, the common goals of security modeling and evaluations are fundamentally based on identification of attack objectives, and attack steps characterization. The methodologies include: (1) attack trees, (2) PENET, (3) integrated modeling of cyber and power security, and (4) SCADA test-bed development and validation.

17.5.1 Attack Trees

This is a kind of methodology, cyber security vulnerability evaluation with attack tree. Against a tree is a multi-level structure and based on logic or operation. The top node is the ultimate goal subgoals and different groups. But by grouping and many attack leaves, this is because the operators and logic “and” or “or”. This is a different invasion. The three vulnerability indexes, the characterization introduced: system, the script, and leaves vulnerabilities. This is determined from the power system control framework based on the existing cyber security conditions. Danger evaluation index in a systematic manner, the next step [14]:

1. The enemy’s attack target recognition.
2. Find out the attack and construction safety may be dangerous trees.
3. Surely, the combination of the invasion scene conditions cyber security each attack leaves.
4. In computing, fragile and the existing technology to achieve leaves password execution, because cyber security conditions determined.
5. According to the combination of dangerous scene calculating the corresponding blade dangerous index.

The framework can extend to the securities investment analysis.

17.5.2 Penet

A new attack modeling framework based on the understanding called the nets PENET development up, its goal is to improve modeling ability against the tree. Moreover, it tried to find a balance the ease of use and provides a set of power performance building, technical parameters, performance index, and the time domain analysis of attacks. This can help assess the system output survivability and defense strategy. This framework implements a software tool, called PENET tool, it lets users model of drawing a given system through the intuitive user

interface, in the time domain and implement safety evaluation; the simulation to the interaction method is to improve the viability of the system.

17.5.3 SCADA Test-Bed Development and Validation

In order to evaluate the SCADA system robustness and electronic intrusion and other malicious activity, a reality needs test-bed development including SCADA equipment, network equipment, application server, and workstations with the simulator. This test can be used to practice, not only for attack-defense means the safety performance of the assessment of the current system, but also can cause system. Sandia national laboratory with the Idaho national laboratory have already set up national SCADA test bed to create, test and evaluate the safety of electric power infrastructure solutions. Similar efforts and a goal to set up a pilot areas have to platform the simulation environment of electric tools and learning became both attack and defense strategy [15].

17.6 Conclusion

Cyber power system security problems are important today, for future reference. In this context, several studies challenge problems to be solved, including vulnerability assessment, security framework, model, and verified. To be specific, the future of the work, including: (1) integrated modeling the causal relationships between cyber-physical capture system; (2) the quantitative evaluation indexes system of survival ability of securities investment cost benefit analysis of quantitative; (3) the actual data and test, and verifies the evaluation model of the bed.

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Chapter 18

Predictive Functional Control for Tension of Cold Continuous Rolling Mill

Haisu Zhi

Abstract The predictive functional control (PFC) method is a new predictive control algorithm, with the following advantages: simple algorithm, less calculation on line, and high control precision. PFC can deal with the system of time delay, unstable, and restrain, especially the fast process. This paper applies the PFC method to the tension of cold continuous rolling mill, which is a fast process, and analyzes the stability, robustness, and real time. The simulation results show that the PFC method has high control precision.

Keywords Predictive functional control (PFC) · Tension systems · Stability · Robustness · Real time

18.1 Introduction

The predictive functional control (PFC) method was presented by Richalet and Kuntze in 1987 [1]; it is a third generation predictive control method. PFC has the same principle with the classical predictive control strategy, i.e., uses a model to predict future process output, to conduct receding optimization, and to make feedback correction [2]. The main difference from the other predictive control methods is the PFC method concerning the structure of the control law, which is considered as a liner combination of a set of base functions. The control law can be obtained by calculating the weight coefficients of base functions' linear

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combination. Because the equation of control law is simple, the calculation of real time is little, PFC is suited to the control of the fast system, and can deal with the systems of time delay, unstable, and restrain. This method has gained success in industrial robot, industrial furnace, defense, and so on.

18.2 Predictive Functional Control Principle

18.2.1 Base Function

For fast follow-up process, the classical predictive control strategy can gain satisfied output response, but has irregular input. The PFC method considers the structure of input which is the key of control system. So the new control input can be considered as a linear combination of a set of base functions f_n ($n = 1 \dots N$):

$$u(k+i) = \sum_{n=1}^N \mu_n f_n(i) \quad i = 0, \dots, p-1 \quad (18.1)$$

where f_n is the base function; μ_n is the coefficients of base function's linear combination; $f_n(i)$ is the value of base function in time $t = iT$; P is the length of predictive and optimize time domain, characteristic of the process and the desired setpoint. Generally steps, ramp, exponential are used. The output is the weight combination of the process response under the aforementioned base functions. So as to calculate the future control input, the aim of optimization on line is to calculate the weight coefficients of base functions' linear combination. To the selected base functions, we can calculate off line the process output response under it.

18.2.2 Predictive Model

Predictive model generally refers to pulse response or step response of the controlled object. We can directly predict its output by the input use of this model. Suppose a single input and single output (SISO) system composed two parts the value of model predictive is the freedom output and the functional output.

18.2.2.1 Freedom Output

$$y_m = F_i(x(k)) \quad i = 1, \dots, p-1 \quad (18.2)$$

where $x(k)$ is the known information in time k , includes the past input and output and the known supposition of future control input; F_i is the expression of

predictive model. The word ‘freedom’ means the predictive output of in time k is got before the new control input acts on.

18.2.2.2 Functional Output

$$\omega_i = \sum_{n=1}^N \mu_n g_n(i) \quad i = 1, \dots, p-1 \quad (18.3)$$

It is the new model response from the time k when the control input $u(k+i)$ acts on. This is the difference between PFC and the general predictive control method. The new control input is not respectively, but the linear combination of functions. Neither the output is the accumulation of the functions, nor the control effect of the time. $g_n(i)$ is known in Eq. (18.3), and the linear combination coefficient μ_n is unknown.

The aforementioned predictive model is aimed at the asymptotic stable object. To the other object, we can first make it stable by general control strategy, for example PID moderator, then set the generalized object model.

18.2.3 Error Predictive and Compensation

The error between process and model is sent to the predictor, then the predictive error of future optimization time domain introduces to reference trajectory and compensation as feedforward. There are many kinds of error predictive ways; we suppose future error predictive way $e(k+i)$:

$$e(k+i) = y(k) - y_m(k) \quad (18.4)$$

where $y_m(k)$ is model output in time k .

We can obtain predicted output after the compensation based on it:

$$y_p(k+i) = y_m(k+i) + \omega(i) + e(k+i) \quad i = 1, \dots, p-1 \quad (18.5)$$

18.2.4 Optimize Calculation

Suppose future reference trajectory $y_r(k+i)$:

$$y_r(k+i) = F_i(y(k), c(k+i)) \quad i = 1, \dots, p-1 \quad (18.6)$$

where $c(k+i)$ is the future value in time $k+i$.

A general reference trajectory is:

$$y_r(k + i) = a^k y(k) + (1 - a^k) c(k + i) \tag{18.7}$$

The aim of optimization is to find a group coefficient μ_1, \dots, μ_n , and make predicted output close to the reference trajectory as far as possible in the whole optimization time domain. Consider quadratic form performance index J :

$$J = \min \left\{ \sum_{i=1}^P [y_r(k + i) - y_p(k + i)]^2 \right\} \tag{18.8}$$

This is a problem of parameter optimization. We can get the functional input $u(k + i)$ ($i = 0, \dots, P-1$) in time k after calculating μ_n ($n = 1, \dots, N$), $u(k)$ is the control input, the other input can accumulate the supposed future control input, and is taken as the base of the next step model's freedom output. This optimize process can obtain the new control input by rolling on line.

18.2.5 Characteristic Analysis

We discussed the basic principle of PFC in five ways; they show the essence character of PFC, the relation of them is shown in Fig. 18.1.

The introduction of the base function not only makes control law clearer, but also makes response faster. We only need to optimize on line the less weight coefficients, because the sampling value of base function and its response can be worked out off line. We can also modify the fast parameters by request because they each has its own strong points. Thus, PFC method is suitable to fast process.

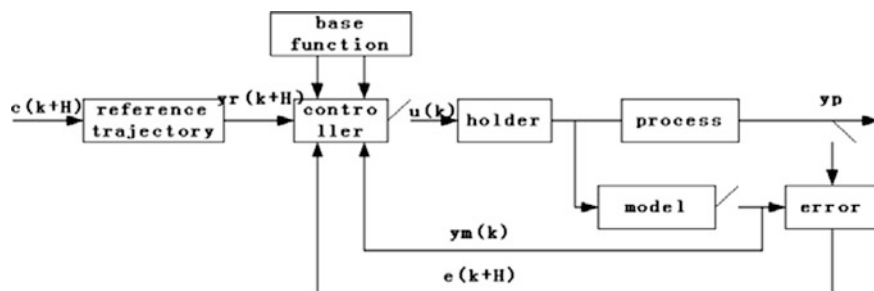


Fig. 18.1 Block diagram of the structure of the PFC method

18.3 Numerical Simulation

The control precision of the tension system of cold continuous rolling mill affects greatly the stability of rolling and the quality of the steel. Because it is a fast and real-time process, the general control strategy cannot satisfy the request of industry. We take PFC method into the tension system of cold continuous rolling mill as simulation in this paper. By comparing with the other strategies, we can conclude that the PFC control method has the following advantages: strong robustness, good stability, and real time.

We have known that the transfer function of the tension system of cold continuous rolling mill is a first-order process.

$$P(s) = M(s) = \frac{y(s)}{u(s)} = \frac{K}{Ts + 1} \quad (18.9)$$

where P , M are the process and model; u , y are the input and output; K , T are the plateau gain and time constant; K_m , T_m are model parameters when the process is different from the model.

Sample time takes T_s , we can get the difference equation:

$$y(k) = a * y(k - 1) + k * (1 - a) * u(k - 1) \quad (18.10)$$

where $a = e^{-T_s/T}$, the object outputs are composed by two parts: the freedom output response $a*y(k-1)$ and the functional output response $k*(1-a)*u(k-1)$.

To satisfy the request many steps need predictive control method, suppose the length of predictive step is H , and $u(k) = u(k + 1) = \dots = u(k + H - 1)$, we can calculate the process output predictive value in step H from model output and control input:

$$y_m(k + H) = a_m^H * y_m(k) + k_m * (1 - a_m^H) * u(k) \quad (18.11)$$

We can choose the step function under first-order process as the setpoint which changes by step, suppose the reference trajectory is first-order curve whose time constant is T_r . If we define $\beta = e^{-T_s/T_r}$, the value of reference trajectory is:

$$y_r(k + H) = \beta^H * y_p(k) + (1 - \beta^H) * c \quad (18.12)$$

According the theory of predictive control, we introduce an error feedback compensation to insure that the system has the strong robustness. Thus, the optimization index is:

$$J = \min(y_m(k + H) + e(k) - y_r(k + H))^2 \quad (18.13)$$

That is:

$$y_m(k + H) + e(k) = y_r(k + H) \quad (18.14)$$

Where $e(k)$ is the error between the model output and process output in step k :

$$e(k) = y_p(k) - y_m(k) \tag{18.15}$$

By using the Eqs. (18.11), (18.12), (18.14), and (18.15), we can get the calculated equation of the PFC control law:

$$u(k) = \frac{(c - y_p(k)) * (1 - \beta^H) + y_m(k) * (1 - a_m^H)}{K_m * (1 - a_m^H)} \tag{18.16}$$

Where plateau gain K takes 1, time constant T takes 0.1 s, sample time takes 0.02 s, we can get the different equation:

$$y(k) = 0.1813 * u(k - 1) + 0.8187 * y(k - 1) \tag{18.17}$$

The simulation parameters are as follows when there is no error between the model and process:

Time constant of reference trajectory takes 1 s, predictive step length takes 10; base function takes step signal, setpoint takes 1.

The simulation results of the generalized predictive control (GPC) and the (PFC) are shown in Fig. 18.2.

As shown in Fig. 18.2, the PFC method has better control result and track faster than the GPC.

The simulation parameters are as follows when there is error between the model and process:

Plateau gain takes 2; time constant takes 0.3 s; constant of reference trajectory takes 3 s, the others are the same as above. The simulation results of the (PFC) are shown in Fig. 18.3.

As shown in Fig. 18.3, we can conclude that the system is still stable. We also conclude that the PFC method can eliminate error to the step signal even though when there is difference between model and process.

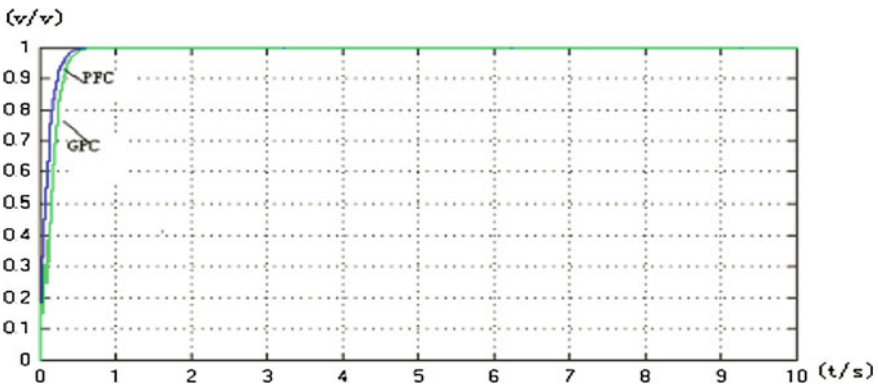


Fig 18.2 Response of the GPC method and the PFC method



Fig 18.3 Output and error of the PFC method

18.4 Conclusion

We can conclude that the PFC method retrains the advantages of predictive control from the theory analysis. It makes the system with good stability and strong robustness, and satisfies the request of the tension system of cold continuous rolling mill because of simple calculation. The simulation result shown in the PFC method has high control precision and is suitable for the fast and real-time tracking system.

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Chapter 19

Study on Numerical Control Machines Performance Test Platform

Juan Song and Ming Li

Abstract Research on the dynamic performance test platform of high-grade numerical control equipment has guaranteed that numerical control machines run with reliable quality and machining, effectively predict the occurrence of equipment failure, save a lot in terms of cost of maintenance, and improve the level of management of equipment. It is significantly safe and reliable in the production of numerical control equipment and modern scientific maintenance and management. The purpose of this research is first, to provide test equipment work that shows the dynamic performance of high-grade numerical control machines, and second to provide the critical test technology to reveal the faults and factors that lead to the deterioration in accuracy of dynamic performance and development.

Keywords Numerical control machine · Performance test platform · Test research

19.1 Introduction

The prosperous development of the manufacturing industry, large numerical control machines processing key equipment in the manufacturing industry, and the rapid development of automation is not entirely satisfactory; instead it has only brought in more flexibility and integration, and intelligence information and network. Currently, modernization of production processing equipment and requirements of the increasingly complex traditional numerical control machine

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tool cannot meet the machining precision of high-quality equipment; high-speed and high-precision CNC machine tool is gradually becoming the leader in the modern manufacturing industry. However, the current technology of the study testing machine is in the process of facing more challenges; thus, the traditional numerical control machine processing state test system cannot meet the requirements of modern production. Therefore, real-time, intelligent, and informative dynamic testing systems, with high precision and consistency, have become the focus of research [1].

19.2 Construction Technology of Dynamic Performance Test Platform

Numerical control machine processing is complex and changeable, and state test and fault diagnosis of a numerical control machine will involve a lot of related technologies [2]. A test of the construction of the platform, state test, and fault diagnosis of a numerical control machine processing basically includes the following four parts: equipment testing instrument, collection of data and information, the characteristics of the extraction of the base, and establishment of a sample. Refer to the details in Fig. 19.1.

To create a dynamic performance test platform to test the numerical control mechanism, it must be equipped with dynamic performance testing instrument, reflecting the numerical control equipment, such as laser interferometers to measure cells, and vibration, *m*. The running situation of the signal, including numerical control machine processing precision, vibration, and noise, force and

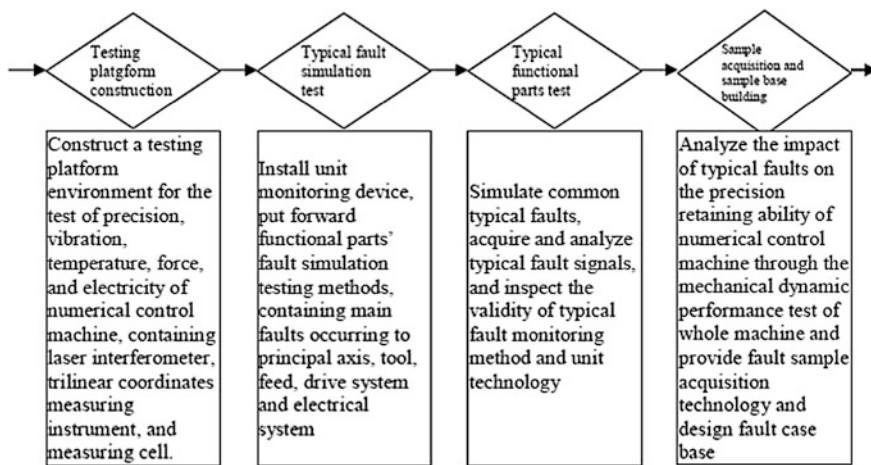


Fig. 19.1 Schematic diagram of the construction of dynamic performance monitoring platform for typical functional parts of numerical control machine

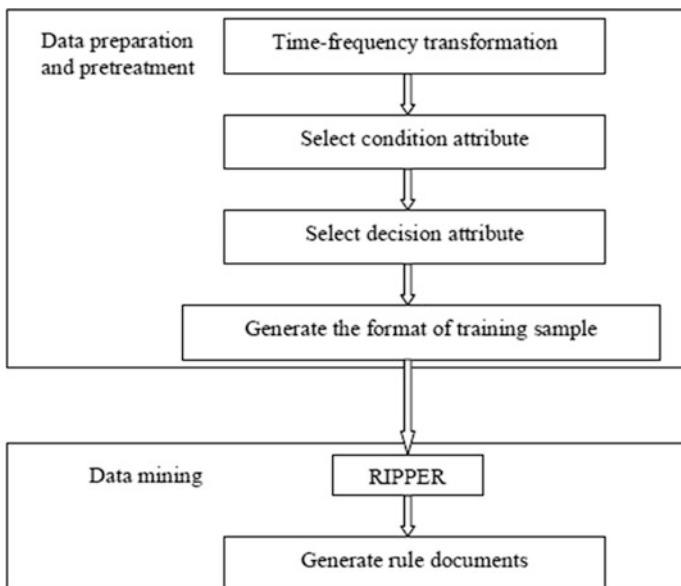


Fig. 19.2 Block diagram of sample knowledge acquisition based on ripper

displacement, through the testing instrument collection signal and experimental samples provide reliable data for the research and development of unit monitoring technology. Performance numerical control machine tools accurately work out these signal acquisitions that directly affect the success of the signal of the monitoring system.

According to the effective access data, the key is to build a dynamic performance test platform to realize the dynamic testing nc machinery and the basis of performance, analysis, and evaluation [3]. A numerical control machine tool has large data collection capacity in the actual processing process; in this case the characteristics and attributes of the relationship among attributes can have a rule when a fault occurs. Rule is the data mining technology that rules samples. A regular set application ripper training sort algorithm can be regarded as the extraction (or) of expression; each rule number of several features' rule is connected to express entry. The main contents of the sampling ripper method is as follows: filter in the development law, stop/accelerate the stage and the cause of the process, filtering rules in the clip process, etc. Figure 19.2 is a block diagram of the sample for knowledge acquisition.

The purpose of dynamic test performance of numerical control machine processing is to establish a flexible, open, and reconfigurable database and knowledge base fault analysis of influence factors in nc machine tools machining precision and confirms fault diagnosis and effective warning methods. Inductive analysis of the sample data acquisition and design fault samples of the sample under test database can realize storage and retrieval, management and maintenance of the

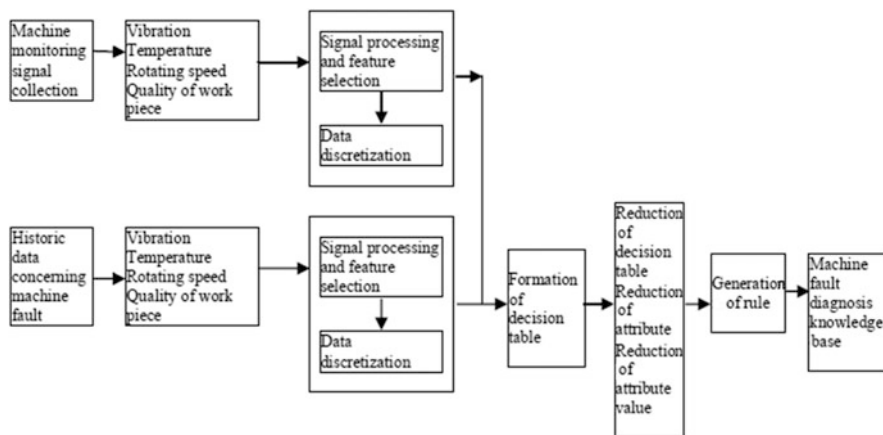


Fig. 19.3 Establishing method of sample data knowledge base

data and samples, and help realize sample data using data and information integration, and reconstruction base construction. Using a rough set theory on the basic construction in a sample of fault samples and historic test data attributes group fault diagnosis and state prediction, as fault diagnosis and fault mode decision, and establish stable diagnosis information decision table. Application based on granularity binary matrix calculates their principle and property of value reduction, evaluation and attribute rules of scope and confidence, and then establishes knowledge base of rule and fault diagnosis and prediction. See Fig. 19.3 for capital constructing knowledge foundation.

19.3 Experimental Study

We take DMC75V linear high-speed five-axis machining center as the research object; the machine is a five-axis blocking high-grade machining center made in Germany. All axes of the machine point at motor drive, the acceleration is up to 2G, the rapid movement speed reaches 90 m/min, and the rotation speed of electric main shaft can reach 28000 rpm. Mechanical dynamic performance sample data collection system is equipped with PCI-2 acoustic emission testing system (DISP system researched and developed by American Physical Acoustics Company), 9257B piezoelectric-type machining force measuring system, HG9200 intelligent signal collection and processing system, vibration noise testing and analysis system, SCM05-SCM-V8 researched by LMS (Belgium), and INV-USB high-speed data collection, analysis, and treatment system researched by Beijing Dongfang Vibration Noise Research Institute. Dynamic performance sample data acquisition on the characteristic signals of the machine, such as displacement, speed, acceleration, amplitude of vibration, frequency, and workpiece stress, is performed.

1. Apply Belgian SCM05-SCM-V8 vibration noise testing and analysis system to the measurement and sample acquisition test of vibration condition of main axis in the practical machining process of the machine.
2. Conduct a loading test on workpieces in the machining process of the machine, adopt SwissKis + Le Company's 9257B piezoelectric type machining force measuring system to perform a loading test and sample acquisition test.

19.4 Conclusion

This chapter gives construction machinery for dynamic performance test platform inspection sample collection and refers to the base construction concentrated in DMC75V linear five-axis high-speed machining center, and equipped with sample collection and testing system, such as the machine performance and cutting force, in view of the typical vibration signal functional tool and parts of main shaft system construction, complete sample testing system, and design case base fault. It provides knowledge of fault samples of database construction method.

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Chapter 20

Minimum Entropy Fault-Tolerant Control of the Non-Gaussian Stochastic Distribution System

Lina Yao, Wei Cao and Hong Wang

Abstract Stochastic distribution control (SDC) systems are a group of systems where the outputs considered are the measured probability density functions (PDFs) of the system output while subjected to a normal crisp input. The linear B-spline model is used for the shape control of the system output probability density functions (PDFs). If target PDF cannot be determined in advance, entropy is first introduced to design the fault tolerant controller of SDC systems. The mean represents the center location of the stochastic variable; it is reasonable that minimum entropy fault tolerant controller can be designed subjected to mean constraints. Through the controller reconfiguration, the system entropy subjected to mean restriction can still be minimized when fault occurs. An illustrative example is utilized to demonstrate the use of fault diagnosis and minimum entropy fault tolerant control algorithms.

Keywords Fault tolerant control · Minimum entropy · Mean constraints · Probability density functions (PDF)

20.1 Introduction

In order to improve the reliability of the control system, the research on fault diagnosis and fault-tolerance for stochastic dynamic systems has long been recognized as an important area in control theory and practice [1, 2]. For stochastic systems, the so far obtained FDD approaches can be classified as [3, 4]

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1. the system identification technique [5];
2. observer or filter-based method [6];
3. the statistic approach based on the Bayesian theorem, Monte Carlo approach, likelihood method, and hypothesis test technique [7].

For most control algorithms, it is supposed that system noise obeys Gaussian distribution. However, all kinds of stochastic disturbances (such as sensors, the random noise disturbance, or system parameter of the random changes) exist in practical systems [8]. For non-Gaussian systems, the variance cannot fully represent the randomness in the system output. Therefore entropy concept, an alternative method, is proposed to measure the uncertainty of the stochastic system [9]. In existing FTC results of SDC systems, it is assumed that the target PDF is pre-specified. In [10], a nonlinear adaptive observer-based fault diagnosis algorithm is proposed to diagnose the fault through the controller re-configuration; a good output PDF tracking can still be realized when fault occurs. In recent work by Wang, the purpose of the control algorithm design was to choose a control input such that output PDF can follow a pre-specified PDF as close as possible [11, 12]. However, in most cases, the objective PDF cannot be determined in advance and as a result, the reasonable fault tolerant tracking controller cannot be designed. This forms the point of this paper, where the entropy concept in stochastic systems will be used for the design of the required fault tolerant controllers.

In this paper, using the linear B-spline model to represent the dynamics between the output PDF and input, a nonlinear adaptive observer-based fault diagnosis algorithm is proposed to diagnose the fault. Through the controller reconfiguration, the system entropy can still be minimized when fault occurs.

20.2 System Model Description

Denote $\eta \in [a, b]$ as a uniformly bounded stochastic process variable. Denote $u(t)$ as the control input which controls the distribution of $\eta(t)$. At any time, $\eta(t)$ can be characterized by its probability density function $\gamma(y, u(t))$, which is defined by

$$P(a \leq \eta(t) < \varepsilon | u(t)) = \int_a^\varepsilon \gamma(y, u(t)) dy$$

where $P(a \leq \eta(t) < \varepsilon | u(t))$ represents the probability of the output $y(t)$ lying inside the interval $(a, \varepsilon]$ when $u(t)$ is applied to the system. It is assumed that interval $[a, b]$ is known and the output probability density function $\gamma(y, u(t))$ is continuous and bounded. Using the B-spline function approximation principle, the following B-spline expansion

$$\gamma(y, u(k)) = \sum_{i=1}^n \omega_i(u_k) B_i(y) + e_0 \quad (20.1)$$

can be used to represent the output probability density functions $\gamma(y, u(t))$. In (20.1), $B_i(y)$ ($i = 1, 2, \dots, n, n \geq 2$) is the pre-specified basis function defined on $[a, b]$, ω_i ($i = 1, 2, \dots, n$) are the expansion coefficients which only link control input $u(t)$ and e_0 representing the approximation error which satisfies $e_0 \leq \delta$. To simplify the presentation, in the rest of this paper, e_0 in (20.1) will be neglected. This means that the output probability density function of the considered stochastic system can be expressed as

$$\gamma(y, u(k)) = \sum_{i=1}^n \omega_i(u_k) B_i(y) \quad (20.2)$$

For most systems, a dynamic relationship between ω_i and u is expressed. In this paper, only the linear dynamic relationship will be considered. This leads to the following model for the considered dynamic stochastic system:

$$\begin{aligned} \dot{x}(t) &= Ax(t) + Bu(t) + GF(t) \\ V(t) &= Dx(t) \end{aligned} \quad (20.3)$$

$$\gamma(y, u(t)) = C(y)V(t) + L(y) \quad (20.4)$$

where $x \in R^n$ is the state vector, $V(t) \in R^{n-1}$ is the output weight vector, $u(t) \in R^m$ is the control input vector and $F \in R^m$ is the fault vector. $A \in R^{n \times n}$, $B \in R^{n \times m}$, $D \in R^{(n-1) \times n}$, $E \in R^{(n-1) \times m}$ and $G \in R^{n \times m}$ are system parameter matrices. Equation (20.3) represents the dynamic model of the weights vector. Equation (20.4) describes the static output PDF model using the B-spline expression, where

$$L(y) = b_n^{-1} B_n(y) \in R^{1 \times 1} \quad C(y) = \left[\phi_1(y) - \frac{\phi_3(y)b_1}{b_3} \quad \phi_2(y) - \frac{\phi_3(y)b_2}{b_3} \right]$$

20.3 Fault Tolerant Control

It is supposed that the fault has been estimated [10]. The controller which is designed for the healthy system should be modified so as to compensate the performance losses caused by the fault in the system.

When the position of the output variable's PDF is not to be determined, the minimum entropy of the output variables is generally difficult to be determined in practice. Therefore, control target subjected to mean constraint will be suitable for the solution of the minimum entropy controller. For this purpose, the following performance function is used:

$$J(u_1(t)) = (\mu - \mu_g)^2 - \int_a^b \gamma(y, u_1(t)) \ln \gamma(y, u_1(t)) dy + \frac{1}{2} u_1^T(t) R u_1(t) \quad (20.5)$$

It can be seen that the first term in (20.5) is the error between the mean μ and its target value μ_g , where $\mu = \int_a^b y\gamma(y, u)dy$. The second term is the Shannon entropy of the output variables, and the third term is a natural quadratic constraint for the faultless control input u_1 , where $R = R^T > 0$.

The purpose of the controller design is to find out u_1 such that the performance index function is minimized. In order to minimize J in (20.5), the first order derivative of J can be readily formulated to read

$$\frac{dJ}{dt} = \frac{\partial(\mu - \mu_g)^2}{\partial V} \dot{V} + u_1^T(t)R\dot{u}_1(t) - \int_a^b \frac{\partial\gamma(y, u_1(t))}{\partial V} \dot{V}(\ln \gamma(y, u_1(t)) + 1)dy \quad (20.6)$$

At this stage, by selecting the following control input:

$$\begin{aligned} u_1^T(t)R\dot{u}_1(t) &= -\lambda|\mu - \mu_g| - \frac{\partial(\mu - \mu_g)}{\partial V} \dot{V} \\ &\quad + \int_a^b \frac{\partial\gamma(y, u_1(t))}{\partial V} \dot{V}(\ln \gamma(y, u_1(t)) + 1)dy \\ &= \left(\int_a^b \frac{\partial\gamma(y, u_1(t))}{\partial V} \ln \gamma(y, u_1(t))dy + \frac{\partial(\mu - \mu_g)^2}{\partial V} \right) \dot{V} - \lambda|\mu - \mu_g| \end{aligned} \quad (20.7)$$

where $\lambda > 0$, then

$$\frac{dJ}{dt} = -\lambda|\mu - \mu_g| < 0 \quad (20.8)$$

Therefore, the stability of the closed-loop system is guaranteed.

Using (20.3), it can be obtained that

$$\dot{V}(t) = D\dot{x}(t) = DAx(t) + DBu(t) + DGF(t) \quad (20.9)$$

When no fault occurs, $F = 0$, using (20.9), it can be obtained that

$$\begin{aligned} u_1^T(t)R\dot{u}_1(t) &= \int_a^b \frac{\partial\gamma(y, u_1(t))}{\partial V} \ln \gamma(y, u_1(t))dy + \frac{\partial(\mu - \mu_g)^2}{\partial V} \dot{V} - \lambda|\mu - \mu_g| \\ &= \int_a^b \frac{\partial\gamma(y, u_1(t))}{\partial V} \ln \gamma(y, u_1(t))dy + \frac{\partial(\mu - \mu_g)^2}{\partial V} \\ &\quad (DAx(t) + DBu_1(t)) - \lambda|\mu - \mu_g| \end{aligned} \quad (20.10)$$

When the fault has been diagnosed [10], it can then be rewritten as

$$\begin{aligned}
 u_2^T(t)R\dot{u}_2(t) &= \int_a^b \frac{\partial \gamma(y, u_2(t))}{\partial V} \ln \gamma(y, u_2(t)) dy + \frac{\partial(\mu - \mu_g)^2}{\partial V} \dot{V} - \lambda |\mu - \mu_g| \\
 &= \left(\int_a^b \frac{\partial \gamma(y, u_2(t))}{\partial V} \ln \gamma(y, u_2(t)) dy + \frac{\partial(\mu - \mu_g)^2}{\partial V} \right) \\
 &\quad (DAx(t) + DBu_2(t)) + DGF(t) - \lambda |\mu - \mu_g|
 \end{aligned} \tag{20.11}$$

where u_2 is the reconfigured controller.

The state x and fault F can be substituted by the state of the fault diagnosis observer state \hat{x} and the fault estimation \hat{F} [10], respectively, leading to the practical reconfigured controller u'_2 .

$$\begin{aligned}
 u_2^T(t)R\dot{u}'_2(t) &= \int_a^b \frac{\partial \gamma(y, u'_2(t))}{\partial V} \ln \gamma(y, u'_2(t)) dy + \frac{\partial(\mu - \mu_g)^2}{\partial V} \dot{V} - \lambda |\mu - \mu_g| \\
 &= \left(\int_a^b \frac{\partial \gamma(y, u'_2(t))}{\partial V} \ln \gamma(y, u'_2(t)) dy + \frac{\partial(\mu - \mu_g)^2}{\partial V} \right) \\
 &\quad (DA\hat{x}(t) + DBu'_2(t)) + DG\hat{F}(t) - \lambda |\mu - \mu_g|
 \end{aligned} \tag{20.12}$$

20.4 Computer Simulation Example

To illustrate the effectiveness of the proposed fault diagnosis and fault tolerant control algorithms, a stochastic system is considered as follows:

$$y(t, u(t)) = \omega_1 \phi_1(y) + \omega_2 \phi_2(y) + \omega_3 \phi_3(y) \tag{20.13}$$

whose output PDF can be approximated by the following B-spline:

$$\begin{cases} \phi_1(y) = \frac{1}{2}y^2f_1 + (-y^2 + 3y - \frac{3}{2})f_2 + \frac{1}{2}(y - 3)^2f_3 \\ \phi_2(y) = \frac{1}{2}(y - 1)^2f_2 + (-y^2 + 5y - \frac{1}{2})f_3 + \frac{1}{2}(y - 4)^2f_4 \\ \phi_3(y) = \frac{1}{2}(y - 2)^2f_3 + (-y^2 + 7y - \frac{33}{2})f_4 + \frac{1}{2}(y - 5)^2f_5 \end{cases} \tag{20.14}$$

where $f_i (i = 1, 2, 3, 4, 5)$ is the interval function defined as follows:

$$f_i(y) = \begin{cases} 1 & y \in [i - 4, i - 3] \\ 0 & \text{otherwise} \end{cases} \tag{20.15}$$

According to the system dynamics (20.3) and the observer with system fault (20.5), the system parameter matrices are considered as follows: $A =$

$$\begin{pmatrix} 0 & 1 \\ -0.8 & -2.5 \end{pmatrix}, B = \begin{pmatrix} 0 \\ 1 \end{pmatrix}, G = \begin{pmatrix} 1.5 \\ 1 \end{pmatrix}, D = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}.$$

Positive definite matrices P and Q are selected as follows:

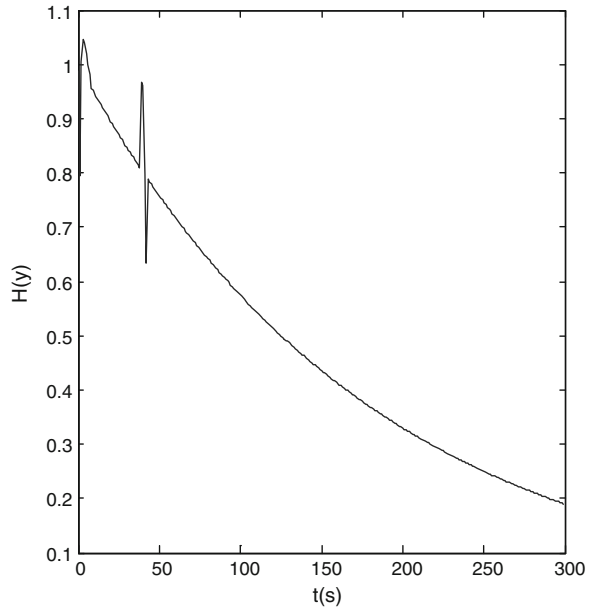
$$P = \begin{pmatrix} 1.01 & 0.08 \\ 0.08 & 2.81 \end{pmatrix}, Q = \begin{pmatrix} 0.1665 & 1.5024 \\ 1.5024 & 13.9975 \end{pmatrix} \quad (20.16)$$

To simulate the algorithm, it is assumed that the fault is constructed as follows:

$$F = \begin{cases} 0 & t < 40s \\ 0.5 & t \geq 40s \end{cases} \quad (20.17)$$

When a fault occurs in the system after 40 s, Fig. 20.1 shows the entropy change in the system when a fault has occurred. From Fig. 20.2, it can be seen that the post-fault PDF can still follow the faultless PDF, leading to good fault tolerant control results. Figure 20.3 presents the response of the mean where it can be seen that the mean remains unchanged. From the above figures it can be seen that the desired fault tolerant control results have been obtained.

Fig. 20.1 The response of entropy after a fault-tolerant control



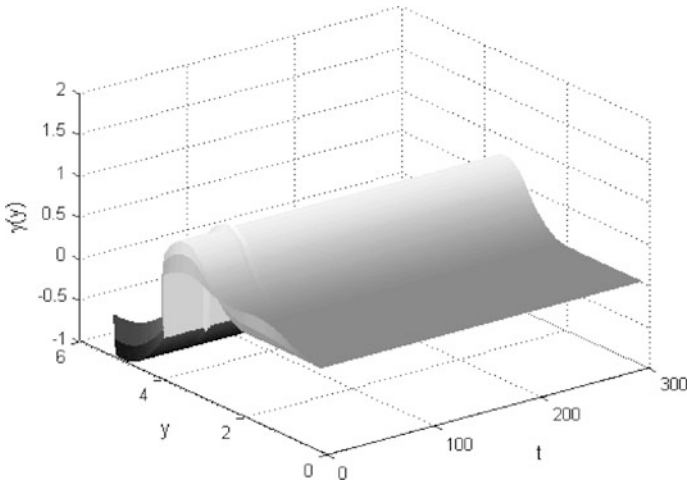
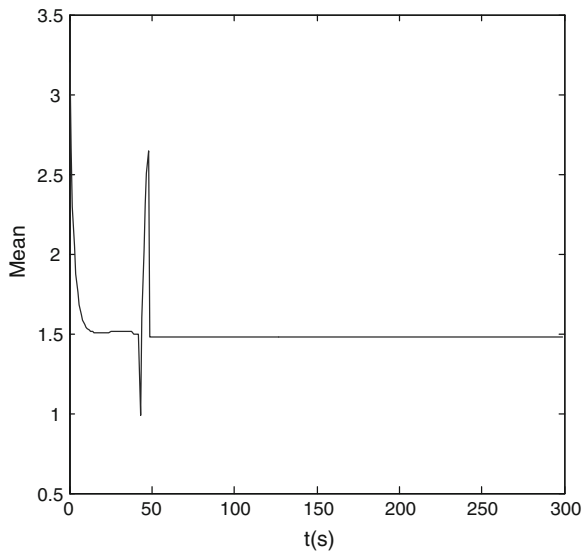


Fig. 20.2 The fault-tolerant effect of output PDF

Fig. 20.3 The response of the mean after a fault-tolerant control



20.5 Conclusion

In this paper, when objective PDF cannot be determined in advance, the entropy concept is applied to the design of fault tolerant controller for a non-Gaussian stochastic distribution system. The mean represents the center location of the stochastic variable; it is reasonable that minimum entropy fault tolerant controller can be designed under the restriction of the mean. A linear B-spline approximation method has been used to formulate the system. A performance function which

includes the entropy term and a mean constraint term is used to design the fault tolerant controller. The performance index is regarded as a Lyapunov function. Using the Lyapunov stability criterion, the stability of the whole system can be guaranteed. Furthermore, through the controller reconfiguration, the system entropy can still be minimized. The simulations have further confirmed the proposed fault tolerant control algorithm results.

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Part III
Web Science, Engineering
and Applications

Chapter 21

Real-Time Ray Tracing Dynamic Scenes Based on WebGL

Sam At Chea and Fuyan Liu

Abstract WebGL is an immediate mode 3D rendering API designed for the Web. Ray tracing is a method that can generate photo-realistic image. For the past decades, ray tracing on the Internet browsers is an impossible task. WebGL's appearance gives this impossible task coming true. In this paper, we introduced a WebGL-based ray tracing for small dynamic scenes (about 3 K triangles) in real time.

Keywords Ray tracing · WebGL · Illumination model · Uniform grid

21.1 Introduction

Internet browser becomes more and more important in our life. In the past years, most of the contents which were shown on browsers are two dimensional. It is very difficult to draw three-dimensional (3D) contents on the browsers, still using less ray tracing method.

WebGL's appearance gives this impossible task coming true. WebGL is the abbreviation of Web Graphics Library [1]. It is a new technology and was released on December 10, 2009. WebGL is a low-level 3D graphic JavaScript API for developing 3D Web applications. It is based on OpenGL ES 2.0, but there are

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some differences. By using WebGL, we can construct 3D graphics on the webpage without any external plug-in.

Ray-tracing method is a hotspot of study in computer graphics area. It is an important method for generating realistic images. This method was proposed by Turner Whitted, in the paper of “An Improved Illumination Model for Shaded Display” in 1980 [2].

The concept of Turner Whitted ray-tracing algorithm is very simple. In brief, generated rays intersect with objects in the scene, rays that intersected with objects will have an intersection point, the color of the ray and the object at this point accumulates again and again until the last ray traced.

Ray-tracing method is simple, but there are also some barricades in rendering photo-realistic images on browsers. In the ray-tracing method, the most time consuming process is doing ray-triangle intersection. Even in some professional ray-tracing software, it is hard to achieve real time for some complex scenes. In this paper, we focus on the implementation of ray-tracing method on webpages, and achieve real time for simple scenes.

21.2 Improved Uniform Grid Construction on Webpage

Uniform grid is the best spatial subdivision structure on GPU. The main idea of this spatial subdivision structure is to subdivide the axis aligned bounding box of the whole scene into the same size units along each of the three axes X, Y, and Z. The critical factor for constructing the best uniform grid is to determine the number of units of the whole scenes. The number of units is not permanent for different scenes. If the number of units is too much, this means fewer triangles in each unit, and fewer intersection tests per unit. However, it will spend much more time on traversing the uniform grid [3, 4]. So it is hard to choose a once and for all method.

Another problem is that our ray-tracing program is based on webpages, there are more limitations compared to the traditional way. So, in our program, the number of triangles of the scene is confined to 3,000. We improved the construction method of the uniform grid for our particular scenes.

Wald 3 proposed a general equation to determine the number of units:

$$U_x = d_x \sqrt[3]{\frac{kT}{V}} \quad U_y = d_y \sqrt[3]{\frac{kT}{V}} \quad U_z = d_z \sqrt[3]{\frac{kT}{V}} \quad (21.1)$$

- U_x, U_y, U_z represent the number of units in X, Y, and Z dimension;
- d_x, d_y, d_z represent the diagonal of the axis aligned bounding box of the whole scene;
- k is a self-defined constant number, used to determine the sparse degree of the units in the box;

T represents the total number of triangles in the scene;
 V represents the volume of the axis aligned bounding box of the whole scene;

This equation was widely used for determining the number of units in each dimension. But it is a little complex for our scenes. After the experimental study, we found it is inappropriate for the simple scenes (about 3 K triangles). In order to achieve real-time ray tracing on webpages, we simplified this equation. The improved equation as follow

$$U_x = L_x \sqrt[3]{T} \quad U_y = L_y \sqrt[3]{T} \quad U_z = L_z \sqrt[3]{T} \quad (21.2)$$

U_x, U_y, U_z and T is identical in meaning to the equation above;
 L_x, L_y, L_z represent the length of the axis aligned bounding box of the whole scene along each axis.

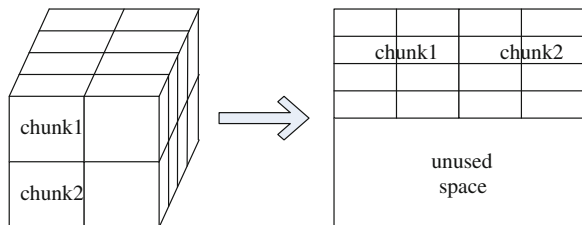
This improved equation decreases the complexity of the uniform grid. Following are the steps for constructing the improved uniform grid:

- Calculate the axis bounding box of the whole scene.
- Computer the number of units on each axis, using Eq. (21.2);
- Subdivide the axis bounding box of the scene; create a triangle list for each unit.

After the uniform grid construction completes, we should map the data structure to a texture layout that can use as input on the GPU. Because WebGL is derived from OpenGL ES 2.0, 3D texture is not supported. We use 2D texture to store the uniform grid structure, see Fig 21.1.

In the Fig. 21.1, left part is the constructed uniform grid of the scene; this structure is consisting of two chunks. Two chunks are mapped to a texture, look at the right part of Fig. 21.1. Each chunk contains a pointer to a list of triangles. Because the width and height of texture in WebGL must be the power of 2, unused space is used to pad the width and height to the power of 2.

Fig. 21.1 Storing the uniform grid structure in texture



21.3 Headers Ray-Tracing Implementation by Using WebGL

WebGL is different to OpenGL in rendering pipeline. It is designed as a rendering context for the HTML Canvas element. Look at Fig. 21.2, it shows the simple process of rendering 3D scene by using WebGL [2] and [5].

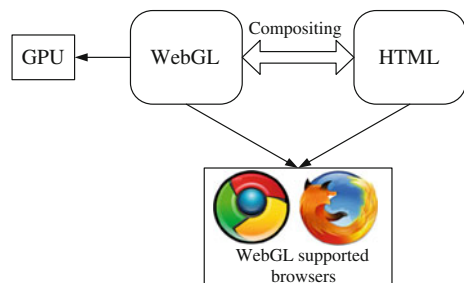
First, browsers (such as Google Chrome, Mozilla Firefox, and Apple Safari) render the scene by using the graphics card on GPU, and then render the HTML. At last, images are combined on the CPU.

After the description of the background knowledge of uniform grid and simple rendering process, next is the implementation steps of our ray-tracing program. There are four basic steps for the whole process of our ray-tracing program:

1. Initial WebGL context and loading scene. WebGL serves as a binding between high-level JavaScript and low-level GPU operations.
2. Primary rays generate and traversal. Rays generate and traversal are completely on GPU. In fragment shader, ray-triangle intersection test is in parallel running. We use the 3D-DDA [6] traversal algorithm to find the closet intersection point.
3. Second rays traversal and shadow test. Second ray mainly includes reflection ray and refraction ray. These rays are similar with primary rays. Shadow test is used to determine if an intersection point is in shadow. Shadow rays are cast from the intersection point toward a light source, this ray also need to do intersection tests, if the closer intersection point is found, then this intersection point must be in shadow.
4. Computer shader. In steps 2 and 3, the intersection points are stored in a buffer. These points have some attributes, such as color, normal. In this step, we will accumulate the color of the intersection point, and then render the color to the screen.

The termination of one ray tracing decides by the tracing depth or when the ray hits a light source at last.

Fig. 21.2 Rendering process on webpages



21.4 Result

In our experiment, we use Mozilla Firefox to render the scene. The rendering result can be seen from Fig. 21.3. The scene consists of 2.3 K triangles and the rendering performance is 21.3FPS. Our image rendered at image resolution 640×320 .

21.5 Future Work

We have successfully implemented a ray-tracing algorithm based on WebGL and generated some realistic images, but it is far from the end. WebGL is a new technology, only GLSL ES is supported, there are a lot of high-efficiency API cannot be used on WebGL. JavaScript also has some problems in execution speed. In our future work, we will find other ways to depress these problems.

Another future work is to improve the ray-tracing algorithm and implement some special effects. Ray tracing on webpages has some difference from traditional way, there is no way to designate the same for ray tracing on webpages. We will concentrate on the algorithm improvement in the future. Some special effects, such as refraction, depth of field, motion blur, and caustics are the important parts of ray tracing, we are missing a lot in this aspect right now. We will increase efforts to expand algorithms for implementing these special effects.

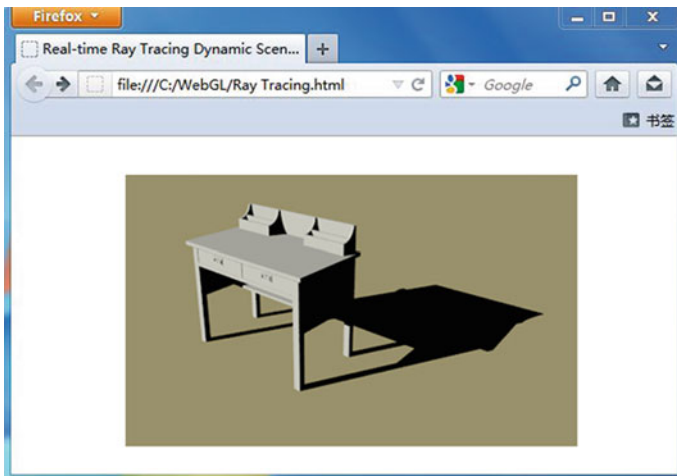


Fig. 21.3 Rendering result image

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Chapter 22

Dynamic Optimization of Web Services Composition using Scale-Free Network

Yang Zhang and Yan Ma

Abstract The process of Web services composition at present is static and predetermined, which could not meet dynamic user requirements and change online environment. Aimed at this problem, we propose a dynamic optimization strategy for Web services composition using Scale-free Network with Partheno-Genetic algorithm based on Flow Tree (SNPGFT). In SNPGFT, the process of Web services composition would be described as a scale free based on flow tree which would be depth-first traversal, and Web services of sequential relationship would be treated with partheno-genetic algorithm to form a bran-new flow of composition. By means of experiments on SNPGFT and common partheno-genetic algorithm, we show that using SNPGFT can improve the effectiveness and feasibility of Web services composition.

Keywords Web services composition · Scale-free network · Flow tree · Partheno-genetic algorithm

22.1 Introduction

Traditional process of Web services composition follows “Definition before Execution”, which means that the static process of Web services composition which meets the business requirements is pre-established by exports [1]. The shortages of such approach reflect in: (1) The order of services of sequence

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structure could not be transformed and (2) Pre-customized process could not meet individual requirements of different users. At present, the researches about Web services composition are mainly based on automated reasoning technology. For example, the domain knowledge and user requirements of Web services are described by Intelligent Process Description Framework to form intelligent process by street vendor problem-solving program [2]; the services process of BPEL4WS is described by DAML-S to find the right Web service for workflow and bind process activity with the Web services to form loosely coupled applications [3].

Complex network is the backbone of a complex system which would be taken as an interaction network between units or individuals. In traditional methods, the network structure is often described as a completely random graph that is E-R random model made by Erdos and Renyi [4]. But with further research on different complex networks in reality, many phenomena cannot be described by E-R random model. Watts proposed a new “Small-World” Network Model [5, 6], in which any linking in an adjacent node ring interconnection network would reestablish a connection with other nodes in accordance with a certain probability. The other major discovery is “Scale-Free” Network Model proposed by Barabasi and Albert [7], in which new nodes are constantly added to the network and select the network nodes with a large degree to establish a connection. But the network structures show inconsistencies in reality [8], because most nodes in the network have only a few connections as well as very few nodes have a large number of connections and the node degree shows some exponential characteristics.

In this paper, we choose genetic algorithm as the model algorithm of scale-free network for its good optimal performance. Genetic algorithm is easier to handle constrain conditions during genetic operation; initial population of parthenogenetic algorithm does not need variety; there is no “premature convergence” [9].

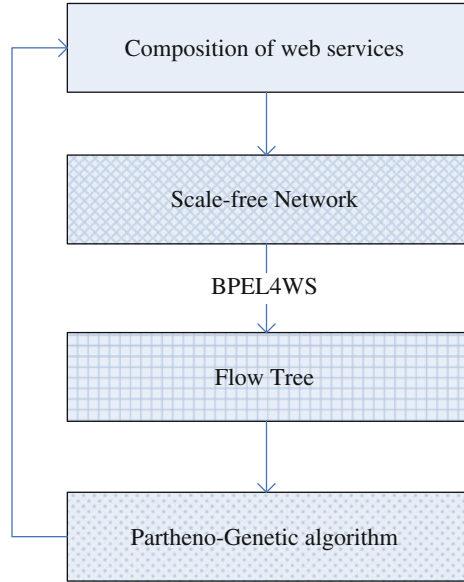
22.2 Scale-Free Network of Web Services Composition Based on Flow Tree

In the scale-free network, most nodes have only a few links with other nodes, so there is no representative node; but some nodes which are called hubs link with a number of other nodes, so the whole network could be dominated by these hubs. On the Internet, some nodes connect with a large number of other nodes to become some distribution center, so the Internet could be seen as a scale-free network. Scale-free properties are from two formation mechanisms which are common to many real networks:

Growth: networks make continuous expansion by adding new nodes;

Preferential Attachment: new nodes preferentially attach to nodes with large number of connections.

Fig. 22.1 Basic flow of SNPFGFT



These two elements are also fit for the composition of Web services flow, so we can use scale-free network to describe Web services composition which could be represented by a Scale-free Network with Partheno-Genetic algorithm based on Flow Tree (SNPFGFT) for Web services composition , as shown in Fig. 22.1

Known from Fig. 22.1, the first step of SNPFGFT is to turn the Web services composition on the Internet into a scale-free network. Based on basic knowledge of Web development, when a new composition starts, we can model the flow of Web services composition as follows:

At the beginning in the small number of nodes m_0 , and one new node with m ($m \leq m_0$) edges would be added in each time interval to the m nodes which already exist in the network;

Probability of a new node connecting to node i depends on the degree d_i of node i

$$P(d_i) = \frac{d_i}{\sum_j d_j};$$

After t time intervals, a network with $N(N = t + m_0)$ nodes and mt edges would be produced;

One node in the network would be changed into one vertex in the graph G , and one directed connection in the network would be changed into one directed edge in the graph G .

Let the degree d_i of node i to meet the Eq. (22.1)

$$\frac{\partial d_i}{\partial t} = m\pi(d_i) = m \frac{d_i}{\sum_{j=1}^{n-1} d_j} \tag{22.1}$$

All the nodes in the system except the new nodes would be done with the denominator of the summation by the Eq. (22.2)

$$\sum_j d_i = 2mt - m \quad (22.2)$$

The second step of SNPFGFT is to find a flow tree spanning all vertices of a scale-free network which consists of a set of vertices designated by Web service user vertices. In the scale-free network all vertices are connected to other vertices by a set of arcs, each of which having associated a nonnegative and nonlinear cost function and routing capacity limits. Therefore, SNPFGFT wish to find a flow tree satisfying all user needs. In the flow tree described by BPEL4WS, leaf nodes denote atomic activities, intermediate nodes denote the structure, and root node that denotes the whole process model, so the services of sequence structure would be on the same level of flow tree to ensure that the services of sequence structure have right semantic logic order.

Definition 1 (*Flow Tree*) According to the recursive definition of tree, the flow tree is a regulation node defined as follows:

$$\text{Treenode} ::= \langle \text{Type}, \text{Parent}, \text{Childrenlist}, \text{Exepro}, \text{User exp} \rangle$$

$\text{Type} \in \{SE, PA, PR, LO, CA\}$ means that the types of nodes would be sequence, parallel, probability, loop, call;

$\text{Childrenlist} = \{child_1, child_2, child_3, \dots, child_n\}$ denotes the list of children nodes;

$\text{Exepro} \in R$ denotes the weight of node which is the execution probability of node to its father node, and the sum of all the weight of all the nodes is 1. In loop nodes, the execution probability of node is $1/n$, in which n is cyclic times and concurrent sum is 1;

$\text{UserExp} \in [0, 1]$ denotes psychological expectations of users to the Web services

Different tree structures reflect different service flows between nodes, but all of the problems could be assumed to be a simple connected undirected graph $G = (V, E)$ with the objective to optimize Web service by minimizing the worst service between the request node S and target node sets U which could be expressed in the Eq.(22.3):

$$\max_{i \in S} \max_{j \in U} \{ \omega_{ij} (d_T(i, j) - T_{ij}) \} \quad (22.3)$$

where the parameter ω_{ij} reflects a weight placed on the Web service from node i to node j , and this weight may reflect the flow of Web services from node i to node j ; the parameter T_{ij} represents a service time commitment from node i to node j , so Eq. (22.3) is to minimize the maximum violation of these commitments.

22.3 Metrics Indexes to Optimize Web Services Composition

SNPGFT is a mechanism to monitor and optimize the composition of Web services, and make the process toward a correct optimal direction. In this monitoring optimization mechanism, the metrics indexes model is the basic and key part which can give the calculation data and parameters to optimize the composition.

Known from the practical experience of software development and some related Ref. [11], we consider that a strong well-connected network would be great for Web services composition [12], but too much parameters would make the calculation complex and lower the efficiency of the composition, so SNPGFT designs the following indexes to measure the structure of the network in which Web services work.

Definition 2 (*Natural Connectivity*) To any network which could be seen as a graph with N points, if the subgraph is still connected after removing $k - 1$ points but not connected after removing $k - 1$ points, K is called the connectivity of the network.

$$C(G) \approx \tilde{d} - \ln N$$

$$= \begin{cases} m \frac{\gamma-2}{\gamma-3} - \ln N = \langle k \rangle \frac{(\gamma-2)^2}{(\gamma-1)(\gamma-3)} - \ln N & \gamma > 3 \\ m \frac{\ln N}{2} - \ln N = \langle k \rangle \frac{\ln N}{4} - \ln N & \gamma = 3 \\ m \frac{\gamma-2}{3-\gamma} N^{\frac{3-\gamma}{\gamma-1}} - \ln N = \langle k \rangle \frac{(\gamma-2)^2}{(\gamma-1)(\gamma-3)} N^{\frac{3-\gamma}{\gamma-1}} - \ln N & 2 < \gamma < 3 \end{cases} \quad (22.4)$$

where m is the number of edges, and γ is the minimum of active nodes in the scale-free network.

From the mathematical point of view, $C(G)$ is the particular average of all the eigenvalues about exponential and natural logarithm, so it could be seen as a natural connectivity of the scale-free network.

Definition 3 (*Integrity*) Integrity is one of the important parameters to measure the reliability of the network in which Web services composition would be finished, and the integrity of SNPGFT describes how to minimize the cost suffered damage to the network.

The Vertex-Integrity of SNPGFT is

$$I_V(G) = \min\{|U| + \psi(G - U) : U \subseteq V(G), \omega(G - U) > 1\}$$

The Edge-Integrity of SNPGFT is

$$I_E(G) = \min\{|U'| + \psi(G - U') : U' \subseteq V(G), \omega(G - U') > 1\}$$

To make the calculation simple for the PG, we put $I_V(G)$ and $I_E(G)$ together to create $I(G)$ by the Eq. (22.5).

$$I(G) = I_V(G) + dI_E(G) \quad (22.5)$$

Definition 4 (*Tenacity*) Tenacity is one of the important parameters to measure the stability of the network in which Web services composition would be finished, and the tenacity of SNPFGFT mainly means dependence as well as the satisfaction and loyalty of nodes to the network.

The Vertex-Tenacity of SNPFGFT is

$$T_V(G) = \min\{|U| + m(G - U)/\omega(G - U) : U \subseteq V(G), \omega(G - U) > 1\}$$

The Edge-Tenacity of SNPFGFT is

$$T_E(G) = \min\{|U'| + m(G - U)/\omega(G - U') : U' \subseteq V(G), \omega(G - U') > 1\}$$

Just the same as Integrity $I(G)$, Tenacity $T(G)$ would be created by the Eq. (22.6).

$$T(G) = T_V(G) + dT_E(G) \quad (22.6)$$

The metrics parameters defined above give a basic understanding about some trustworthy properties (such as stability, reliability, etc.) of working conditions and working environment of Web services composition, and the bigger values of these parameters would lead to a better optimization of Web services composition. According to these parameters, SNPFGFT designs an algorithm based on the basic idea of Partheno-Genetic algorithm to optimize Web services composition.

22.4 Partheno-Genetic Algorithm for SNPFGFT

Based on the evaluation the fitness of individuals, Partheno-Genetic algorithm of SNPFGFT could form a bran-new flow of Web services composition of sequential relationship by using the following operators:

Definition 5 (*Selection Operator*) Selection operator is to select the superior and eliminate the inferior for individuals in population, and could take the metrics parameters defined in the Sect. 22.3 as reference by using Eq. (22.7).

$$P_s = C(G) + I(G) + T(G) \quad (22.7)$$

Definition 6 (*Recombination Operator*) Recombination operator is to generate new individuals which could be adopted by recombination rate of hyperbola ascending along with Best Individual's Reservation Generation by using Eq. (22.8).

$$p_r^l = \begin{cases} \frac{p_{r.\min}}{2^{-(b/B_{\min})}} & 38; p_r^l > p_{r.\min} \\ p_{r.\min} & 38; p_r^l \leq p_{r.\min} \end{cases} \quad (22.8)$$

where p_r^l is the recombination rate while the best individuals have evolved 1 generation, $p_{r.\max}$ is the maximum recombination rate, $p_{r.\min}$ is the minimum recombination rate, b is the generation that the best individuals have evolved, and B_{\min} is the least generation that the best individuals are allocated to reserve.

Definition 7 (*Mutation Operator*) Mutation operator is a constant which could be adopted by gene mutation rate of exponent ascending along with Best Individual's Reservation Generation by using Eq. (22.9).

$$p_m^l = \begin{cases} p_{m.\max} \times \exp\left(\rho\left(\frac{b}{B_{\min}} - 1\right)\right) & 38; p_m^l > p_{m.\min} \\ p_{m.\min} & 38; p_m^l \leq p_{m.\min} \end{cases} \quad (22.9)$$

where p_m^l is mutation rate while the best individuals have evolved 1 generation, $p_{m.\max}$ is the maximum mutation rate, $p_{m.\min}$ is the minimum mutation rate, and ρ is a constant?

In SNPGFT, the composition of Web services would be transformed to flow tree first by using Definition 1, and then the nodes of flow tree would be depth-first traversed recursively, and finally all the children nodes of sequence type found in the depth-first traversing would be dynamic composed by the partheno-genetic algorithm described as follows:

DynamicComposition (ROOT)

Input: ROOT of the tree

Output: NULL

if ROOT is not NULL

if type of ROOT is sequence

pg=new pg ();

ROOT.setChildren (pg. CompositionChildren (ROOT. children));

else

if ROOT. Children is not NULL

for each child of ROOT

DynamicComposition (ROOT. child);

Return;

In the traditional genetic algorithm, the next generation would be produced by using parent crossover and gene mutation in evolutionary process would be simulated by mutation. The core of SNPGFT is partheno-genetic algorithm pg(), in which the initial population would be encoded in decimal according to serial number to avoid "Premature Convergence" and recombination operator and selection operator would be used without crossover for the number of gene in the same sequence is 1 to find global optimal solution easier.

PG would take Eq. (22.3) as the adapt degree of the individual and the adapt value function of PG is defined as $F(i) = \frac{P_s^i + P_r^i + P_m^i}{\cos t(i)}$, in which $\cos t(A) = \sum_{i=0}^{n-1} d(i, i+1)$ and $d(i, i+1)$ denote that the interaction cost between the i th Web service and the $(i+1)$ th Web service of the current individual.

22.5 Simulation

According to Web services of sequential relationship of three different sizes, the simulation was done with parameters, such as NP (the size of population), STEP (the speeding weight of execution times of recombination operator) and MAXGEN (the maximum evolution generation to stop PG), and the detailed simulation parameters are shown in Table 22.1. The simulation took a random number in $[0, 1]$ as interaction cost between services used for all the simulation, and the result after 20 times was shown in Table 22.2.

In Table 22.2, B_f denotes the adapt value of the optimum solution, B_w denotes the adapt value of the worst solution, M_f denotes the average adapt value of solutions, AVGTIME denotes the average execution time, and GEN denotes the average evolution generation of the optimum solution.

From the results of simulation, it would be known that:

The relative deviation between the optimum solution and the worst solution as well as the relative deviation between the optimum solution and the average solution are both small, which mean that the convergence of PG is good because PG could relatively stably find the optimum solution each time.

Even if the size of problems increases, PG would also efficiently optimize the relatively large-scale problems only by adjusting the relevant parameters.

In order to validate the effect of SNPGFT, TSP in [10] is used to give a comparative experiment. Given there were nine cities First, Second, Third, Fourth, Fifth, Sixth, Seventh, Eighth, Ninth, the distances between them are shown in Table 22.3.

The experimental parameters in [10] were the population size $N = 10$, the specified evolution generation $EG = 6$, and the maximum evolution generation without the optimum individual $M = 4$, and the results were shown in Table 22.4.

Table 22.1 Parameters of simulation

Case	Problem scale	NP	STEP	MAXGEN
1	5	10	1	20
2	10	15	1	50
3	15	20	2	100

Table 22.2 Results of simulation

Case	B_f	W_f	M_f	AVGTIME(ms)	GEN
1	0.6	0.6	0.6	3.1	1.95
2	0.7	0.9	0.72	28.1	12.65
3	0.9	1.0	0.92	366.4	21.55

Table 22.3 The distance between nine cities

	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth	Ninth
First	0	26	28	4	37	39	8	33	6
Second	26	0	5	22	26	24	20	8	24
Third	28	5	0	24	21	20	21	8	26
Fourth	4	22	24	0	26	36	5	30	5
Fifth	37	26	21	26	0	6	30	26	38
Sixth	39	24	20	36	6	0	32	23	40
Seventh	8	20	21	5	30	32	0	27	9
Eighth	33	8	8	30	26	23	27	0	31
Ninth	6	24	26	5	38	40	9	31	0

Table 22.4 Results of PG to solve TSP in [10]

Loop length	Loop	Evolutionary cycles	Occurrences
111	(1, 9, 2, 8, 3, 6, 5, 7, 4, 1)	10–20	9
	(1, 9, 2, 3, 8, 6, 5, 7, 4, 1)	10–17	5
	(1, 7, 4, 5, 6, 8, 3, 2, 9, 1)	11–18	4
113	(1, 4, 2, 8, 3, 6, 5, 7, 9, 1)	15	1
	(1, 4, 2, 3, 8, 6, 5, 7, 9, 1)	14	1

From Table 22.4, it could be known that the occurrences of global optimal solutions in 20 different initial populations is 18 in 111 and the final optimum solution is 107, which mean that the local optimal solution instead of the real global optimum solution are found on condition of given parameters in [10] due to fast convergence.

22.6 Conclusions

For the complex changing user requirements of Web service, the business process execution order of Web services described by BPEL4WS is optimized by SNPFGFT to improve the flexibility of business process. In SNPFGFT, the composition of Web services would be transferred to a scale-free network based on flow tree which would be dealt with partheno-genetic algorithm. In view of the interaction cost between Web services, SNPFGFT makes the composition process

able to be adjusted according to personalized user requirement and actual dynamic environment. The further work mainly includes the research on process semantic modeling and matching to realize dynamic generation and optimization of Web services business process.

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Chapter 23

Instant Messaging IM Virus Spread of Complex Network

Zongjiang Wang

Abstract This paper explores the complex network viruses propagation behaviors, to reveal the regularity behind them, and then to find the important factor that affects the spread of the virus, First introduced the instant messaging IM worms of relevant knowledge, described the complex network of some basic knowledge. This paper spreads the complex network theory to practice, discrete mathematics method of constructing the instant messaging IM worms propagation model, exploration of IM worms in instant messaging propagation and transmission. Using Netlogo, the complex network modeling simulation software for platform simulation experiment, explore the spread rule of IM worms and explore the main factors of worm spread that influence IM.

Keywords Complex network · Instant messaging · IM viruses · Model

23.1 Introduction

In the twentieth century, Kephart and White inspired by biological popular virology, constructed the finite state automata to set up the computer virus propagation model [1], In this period, the complex network of scientific exploration entered in to the new era. In 2001, Pastor-Satorras and Vespognan explore the complex network computer viruses act and the empirical analysis [2]. They even further to the network and scale-free network Angle to establish the computer viruses act and put forward the immunization strategy, but these are built on their

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own puts forward the basic hypothesis of premise. The complex network theory into computer virus spread study, for us to explore the spread of the virus instant communication provides a new idea and new methods. Instant communication network of scale-free property is a very valuable research result for later people to further explore the spread model of the virus, found that spread rule, make corresponding immunization strategy played a fundamental role.

23.2 Instant Messaging Virus

Instant messaging is a kind of communication network method in real-time instant messaging software (hereinafter referred to as IM software) such as Microsoft's MSN Messenger, Yahoo's Yahoo! Messenger, tencent QQ, and net ease bubbles and communication tools can in real-time transmitt text, image, sound, and other information among users. Therefore, instant messaging software is not only a kind of important communications means of a person, but also gradually become the important tool for the communication of internal staff of an enterprise and customer.

In recent years, on the network produced a special kind of virus-instant messaging virus (IM virus), IM virus is not a new virus, but it spread way are quite special, Mainly through instant messaging software (such as MSN and QQ, etc.) to the user of the contact automatically send malicious news or their own files to achieve the purpose of worms and viruses spread. IM viruses usually have two working modes: One is automatically sending malicious text messages that generally contain one or more web sites, pointing to malicious web page, received news of users when you click on the and open the malicious homepage from malicious web site to download and run virus program. Another kind is to use instant messaging software file transfer function, send out own directly, and this also is the main mode of nowadays popularity.

23.3 The Complex Network Theory

Real life has many complex systems, people are already living between all kinds of complex networks in the world. From Internet network to WWW network, from power network to traffic network, from the biology brain to metabolic network, from the scientific research cooperation network to all kinds of economic, political, and social network, etc. In order to explore the complex network topology structure and laws, scholars have put forth three statistical terms: average path length, clustering coefficient, and distribution of [3]. The complex network theory as the guide to research about the computer virus propagation has the following merits:

- (1) The complex network from network topology structure of the propagation model research, reveals the regularity at the deep, the computer virus spread for research provides powerful guidance.
- (2) The complex network subject can abstract conjecture method to actual network to establish the real and effective depict reality characteristics of network model, no matter how complex the actual network structured, and may through the method of mathematical analysis the model. The research about the computer virus propagation problems have very strong desirable place.
- (3) Using the complex network theory analysis of the entire network topology structure, in some extent could predict the spread of the virus behavior [4].

23.4 The Propagation Model of Instant Messaging Worm

Computer worm virus can travel through the network by itself and can function, since it contains a malicious code. Usually, it is through the network links, sharing storage, Email, instant messaging, or P2P file sharing network for transmission. The worm virus which spreads through the instant messaging (IM) software into enterprises and individual users is a kind of new potential threat. Now the customer software and its function is an increasingly complicated mixture, which is likely to produce some malicious program used by the Bug. Enterprise is especially concerned, because IM agreement often use tunnel through the firewall, causing some malicious acts in the internal enterprise network, such as the denial of service, key logging, etc.

23.4.1 *The Topological Structure of Instant Messaging Network*

In the instant communication network, the software users can also spread main body of network, instant messaging worm virus software users rely on this kind of social relations to spread. We can use when networking as node, At present, there have been some researchers specializing in the reality of instant communication network data collection and research on the work. Smith study the Nioki network, the network were 50158 nodes, the average degree value is 9.6, its degree distribution as shown in Fig. 23.1a. This can show that the Nioki network degree distribution has the power law [5]. Matthew also to the Jabber network data on the research, this network data from a company of internal collection, a total of 710 users, the distribution of as shown in Fig. 23.1b. From this [6], we can clearly see the network has very obvious power-law characteristics. Therefore, we can think of instant messaging network degree distribution follows power-law characteristics, with scale-free topology.

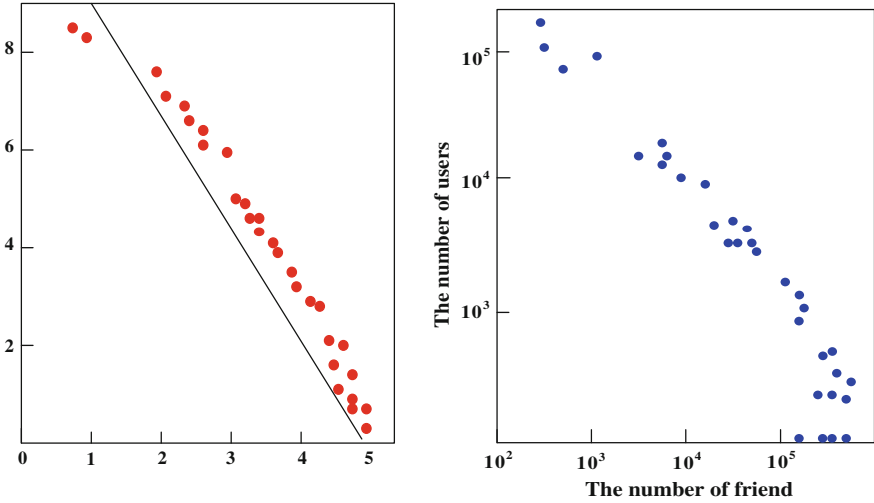


Fig. 23.1 Real instant messaging network degree distribution. **a** Nioki network degree distribution. **b** Jabber network degree distribution

23.4.2 IM Worms Spread Model

In order to simplify the modeling process, this paper gives the hypothesis:

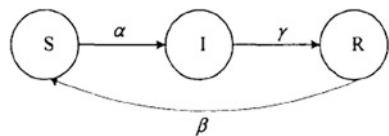
- (1) In the initial IM worm outbreak after IM networks will not have new user log in and out, namely the network topological structure will not change.
- (2) In the model host state only susceptible (S), infection (I), and immunity (R) three, between these three states transform only at the same time to complete the step-by-step.

In the model conveniently described as the following variables and parameters:

- $I(t)$ After t time step the proportions of immunity in the all host nodes;
- $R(t)$ After t time step the proportions of infection in the all host nodes;
- $S(t)$ After t time step the proportions of susceptible in the all host nodes;
- α Susceptible nodes into infection node probability, namely the worm propagation rate;
- β Immune node recovery for susceptible node probability;
- γ The infected host node into immune node probability.

IM worm state changes can be shown in Fig. 23.2:

Fig. 23.2 The IM worm propagation state transition



23.5 The Instant Messaging IM Worm Propagation Simulation Experiment

23.5.1 *The Effects of Infection Rate α on the Instant Messaging IM Worm Propagation*

IM worm infection rate α is based on the worm designer's strategy to execute, if the α value is too small, the worm designers at the strategy of using a slower speed to spread, But that it is safer for the worm, it is not easy to be aware of the user; If the α value is too large, this indicates that the worms designer's intention is to let the worm spread network quickly, But in this case, will enable the use of instant messaging software users frequently received transmit malicious information, thereby enabling a user alert, Improve vigilance. Its rate is smaller, the user receives malicious information frequency becomes smaller, thus increasing the concealment.

Initially, the random network scale for the 150 node network of 3 nodes set to infected nodes, while the average network setting for 6. Due to the addition of IM worm infection rate α . The other main parameters and infected nodes into immune node ratio γ , and temporarily immune node into susceptible node probability β . The γ and β value is set to 5 %, respectively, with $\alpha = 2.5, 3, \text{ and } 3.5$ %, simulation results are as shown in Figs. 23.3 and 23.4.

From the figure we can see, the IM worm propagation rate α is large, node infection ratio is higher. IM worm eruption began, the proportion of infected nodes are basically linear upward, reflecting the once the new IM worm in instant communication network outbreak, at about the time step ticks = 175 when reach the infection peak, After the IM worm ratio will be in a zigzag form gradually reduced, until the infection node all perished. The tortuous change process is infected node, susceptible node, and the immune node mutual conversion process. In this process, the user to take antivirus methods, reflects the user's security consciousness over time accumulation and gradually improve.

23.5.2 *The Effects of Recovery Rate β on the Instant Messaging IM Worm Propagation*

Initially, the random network scale for the 150 node network of 3 nodes set to infected nodes, while the average network setting for 6. Due to the addition of IM worm recovery rate β , the other main parameters have infected nodes into immune node ratio γ (i.e., the immunization rate), and temporarily immune node into susceptible node probability β (i.e., recovery rate). The γ and α value is set to 5 and 2.5 %, respectively, with $\beta = 4.5, 5.0, \text{ and } 5.5$ %, simulation results as shown in Fig. 23.5.

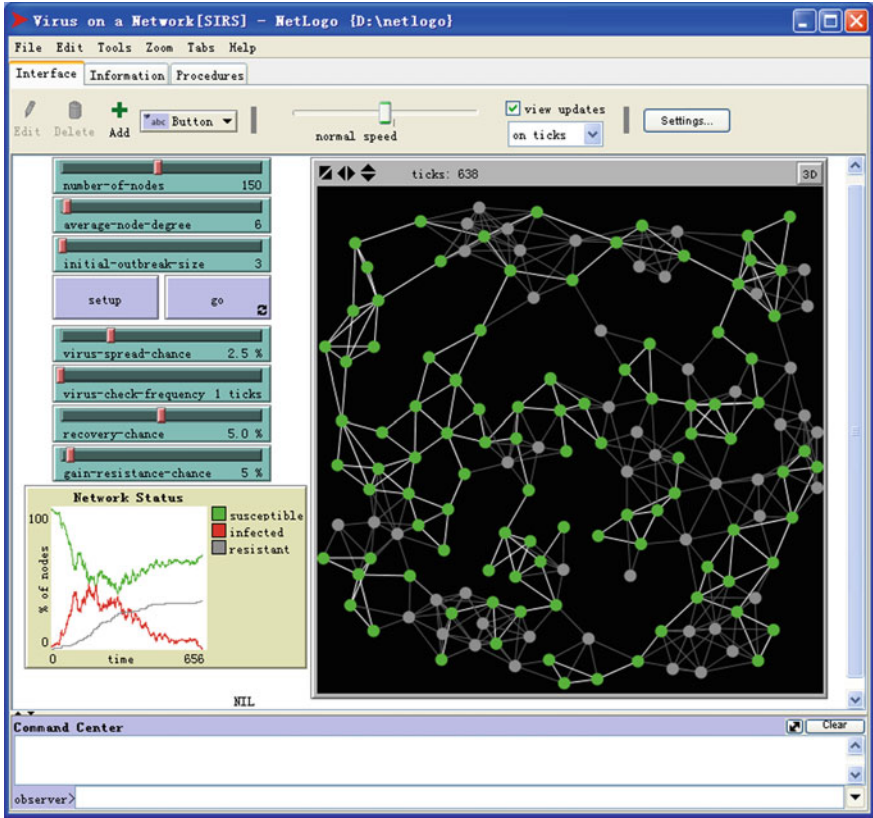


Fig. 23.3 $\alpha = 2.5\%$ simulation effect

From the chart we can see that, no matter the recovery is from small to large change or from big to small changes, the proportion of infected nodes there is no obvious regularity, Show ratio curve is messy, which indicates that the node recovery rate on the instant messaging network I M worm propagation did not have much effect, that is to say the recovery rate is not the instant messaging network I M worm propagation decisive factor.

23.5.3 The Effects of Immune Rate γ on the Instant Messaging IM Worm Propagation

Initially, the random network scale for the 150 node network of 3 nodes set to infected nodes, while the average network setting for 6. Due to the addition of IM worm immune rate γ , the other main parameters nodes recovery rate β And I M

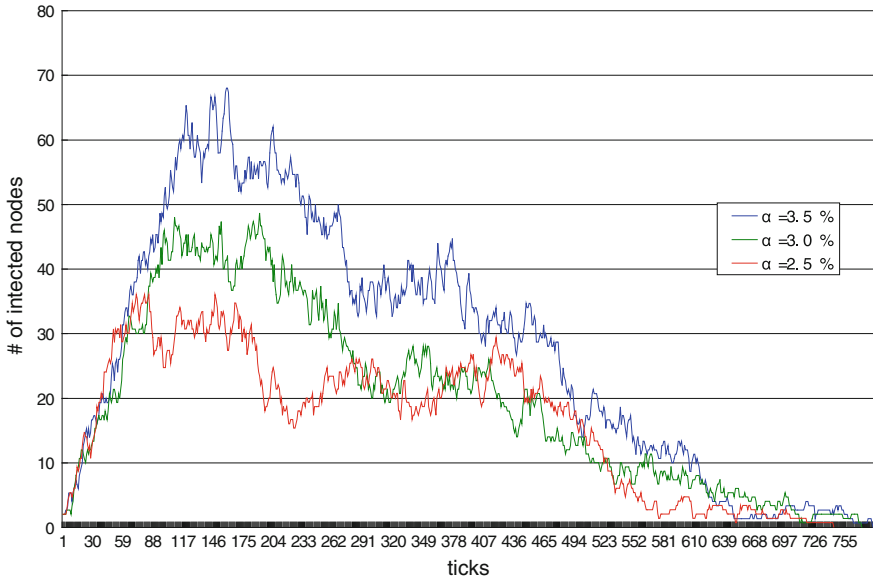


Fig. 23.4 $\alpha = 2.5, 3.0,$ and 3.5% the proportion change of infected nodes (magnified 100 times)

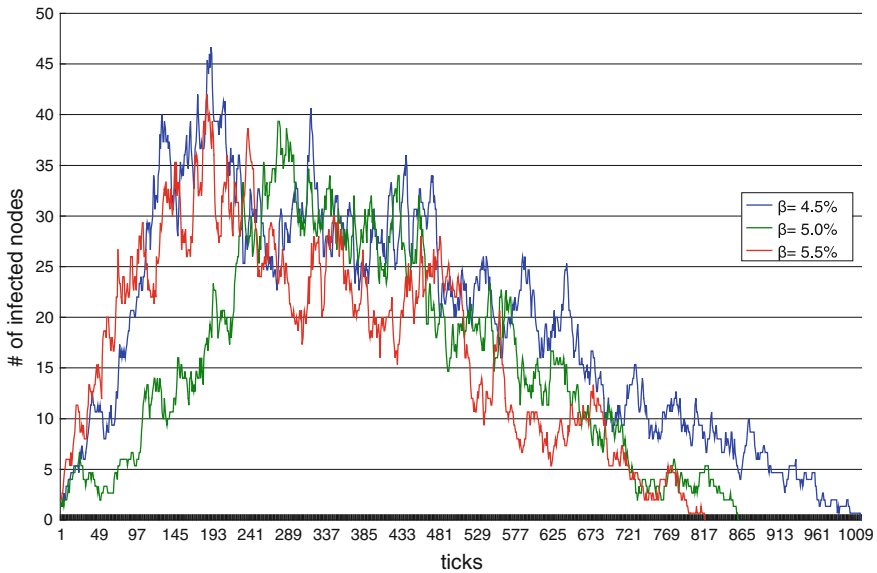


Fig. 23.5 $\beta = 4.5, 5.0,$ and 5.5% the proportion change of infected nodes

worm infection rate. α the β and α value is set to 5 and 2.5 %, respectively, with $\gamma = 4, 5,$ and 6% , simulation results as shown in Fig. 23.6.

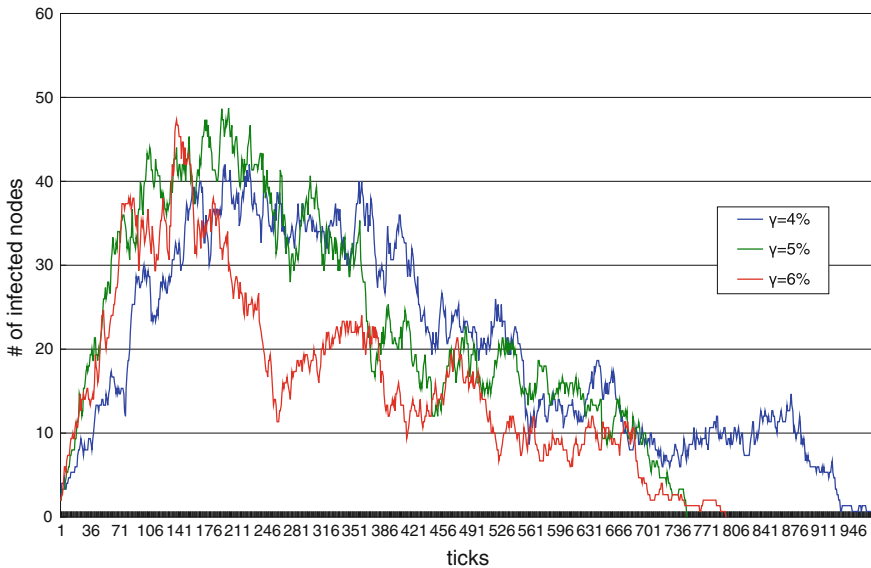


Fig. 23.6 $\gamma = 4, 5, 5.5$ % the proportion change of infected nodes

From the diagram can be seen, the immune rate γ is higher, the proportion of infected nodes is smaller. So immunization rate also is an important factor affects IM worm spread. As the immune rate γ increases gradually, the worms reach their peak time of infection is shorter, after the user safety consciousness is becoming stronger and stronger, Antivirus measures more and more properly, thereby increasing the immunization rate, reduce the proportion of worm transmission becomes more and more obvious,

23.6 Conclusion

Instant messaging IM worm is the Internet a new computer virus, primarily to via the user the buddy list of friends to send the URL link or sending malicious file information, As long as the user clicks the link or receives the transmitted file, will be infected, Based on the complex network based on knowledge, in-depth exploration of complex network instant communication IM worm propagation. This is just a preliminary work, there are many needs further exploration and further improve the work.

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Chapter 24

Transactional Automation Model of Services Selection for Web Service Composition

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Abstract Web Services are the most famous implementation of service-oriented architectures. The performance of the composed application is determined by the performance of the involved Web services. Therefore, selection of every component Web service, meeting the user's requirements and ensuring reliability, is an important challenge. The challenge is that due to the inherent autonomy and heterogeneity of Web services it is difficult to predict the behavior of the overall composite service and ensure reliable execution. In this paper, we build automaton model to implement transactional-aware service selection, and using the model composite Web service can guarantee reliable execution. Proofs and experimental results are presented.

Keywords Web service composition · Transactional use requirements · Automaton model · Reliable execution

24.1 Introduction

Web Services are famous implementation of service-oriented architectures allowing the construction and sharing of independent and autonomous software. A single Web service can hardly satisfy the given request, so a composition of multiple Web services is required to fulfill the goal. Web service composition consists in combining Web services, developed by different organizations and

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offering diverse functional, behavioral, and nonfunctional properties, to offer more complex services. That has become an important means of constructing application platform for Web services.

Although during the last years, the problem of Web service selection and composition has received a lot of attention by many researchers, designing a composite Web service to ensure correct and reliable execution remains an important challenge [1]. In [2], a solution combines the business process adequacy of workflow systems and the reliability of transactional processing. Similarly, in [3–7], transactional properties are considered. However, the authors do not consider the automatic selection step and only analyze the impact of the transactional requirements on the QoS of the composite Web service.

The innovation of this paper mainly lies in a few aspects. First, we present an ensuring transactional reliability service selection approach. The selection of the component Web services is done by matching the Web service properties with the user's desires. More precisely, the selection is realized depending on transactional user requirements. It is established by means of a risk tolerance notion that is given in this paper. This indicates whether the results can be compensated or not. Second, we build automaton model to implement transactional-aware service selection, and using the model composite Web service can guarantee transactional execution. Moreover, our method is scalable because the user has only to define a global transaction requirement and does not have to define the possible termination states of all component Web services.

24.2 Web Service Transaction Descriptions

24.2.1 Web Service Transactional Property

The main transactional properties of a Web service we are considering are retrievable, compensable, and pivot. A service s is said to be retrievable (r for short) if it is sure to successfully complete after several finite activations. Again, s is said to be compensable (c for short) if it offers compensation policies to semantically undo its effects. Then s is said to be pivot (p for short) if once it successfully completes, its effects remain forever and cannot be semantically undone, and if it fails, it has no effect at all. A completed pivot Web service cannot be rolled back. Naturally, a service can combine properties, and the set of all possible combinations is $\{p, c, pr, cr\}$.

24.2.2 Composite Web Service Transactional Property

A composite Web service (CWS for short) is a conglomeration of existing Web services working in tandem to offer a new value-added service [8], which is often long-running, loosely coupled, and cross-organizational applications. It orchestrates

a set of services, as a workflow-based composition, to achieve a common goal [9]. Transactional property of CWS depends on two sides, transactional property of every component service and workgroup patterns. Inspired by Mehrotra et al. [10], we have the following definitions:

Definition 1 Atomic property of CWS (*a* for short) is that if all component services complete successfully, their effects remain forever and cannot be semantically undone, and if one component service cannot compete successfully, previously successful component services have to be compensated (In other word, if one component service fails, the execution result is compensated).

Definition 2 Compensable property of CWS (*c* for short) is that all component services are compensable.

Definition 3 Retriable property of CWS (*r* for short) is that all component services are retrieable.

Definition 4 Transactional Composite Web Service (TCS) is CWS whose transactional property is in $\{a, ar, c, cr\}$.

In this paper, our object of transactional services selection makes composition service to be TCS. TCS can ensure completion of composite service successfully and consistency of component services. TCS is composed of elementary services whose transactional property in $\{p, c, pr, cr\}$, or is composed of CWS whose transactional property in $\{a, ar, c, cr\}$.

24.3 Transactional Automaton Services Selection

Every activity of workgroup selects proper service that makes composition service not only to become TCS but also to satisfy user's requirement. The selection depends on two factors: workgroup pattern and user's transactional requirement. User's transactional requirement is defined in term of risk tolerance in section A dependency between activities in the workgroup is workgroup pattern. That is sequence, parallel split (AND-split), exclusive choice (XOR-split), synchronization (AND-join), and simple merge (XOR-join). When a service WS1 is assigned to activity A1 and a service WS2 is assigned to activity A2, the obtained composite Web service CWS1 is represented by SEQ (WS1, WS2), where symbol SEQ () represents a sequential execution: WS1 is executed before WS2. The obtained composite Web service CWS2 is represented by PAR (WS1, WS2), where symbol PAR () represents the AND-split and AND-join patterns. PAR (WS1, WS2) means that both services are executed in parallel. We do not consider the XOR-pattern (XOR-split and XOR-join) because in a XOR-pattern the resulting "Composite" WS contains only one Web service WSi, and the WS transactional property corresponds to the transactional property of WSi. How to select service to assign each activity in the different workgroup pattern is described in section B.

24.3.1 Definition of Risk Tolerance

Usually, user expresses requirements and constraints of QoS easily, but it is difficult to express user's transactional criteria. In order to explain the transactional Web service selection process, it is necessary to establish how the user can express their transactional criteria. We define risk tolerance which expresses importance of the uncertainty of application completion and recovery. In terms of the transactional properties of CWS, we believe that properties a and ar are riskier than c and cr . Indeed, properties a and ar mean that once a service has been executed, it cannot be rolled back. Therefore, we define two levels of risk tolerance in a transactional system.

Risk tolerance 0: The system guarantees that if the execution is successful, the obtained results can be compensated by the user. In this level, the selecting process generates a compensable workflow.

Risk tolerance 1: The system does not guarantee the successful execution but if it achieves the results cannot be compensated by the user. In this level, the selecting process generates an atomic workflow.

24.3.2 Transactional Automaton Services Selection

We can use transactional automaton selecting transactional property of next service according to workgroup pattern and previous service transactional property. In order to get transactional automaton we will propose some rules below.

The parameters are described as following:

A_i is an activity of workgroup.

$S_i = \{s_{i1}, s_{i2}, \dots, s_{in}\}$, where S_i is set of candidate service for activity A_i .

$P = \{p, a, pr, ar, c, cr\}$ is set of transactional property.

$tp(s)$: If s is a service, $tp(s)$ expresses transactional property of service s , $tp(s) \in P$. If

s is a type of service, $tp(s)$ expresses transactional property of services s , $tp(s) \subseteq P$.

$CWS = (ES, TP, PA)$ expresses composite Web service, where ES is set of component service, and TP transactional property set of component service, and PA is workgroup pattern.

Services Selection Rule in the sequential pattern

Rule 1: $CWS = (ES, TP, PA) \wedge (ES = S_i \cup S_{i+1}) \wedge tp(S_i) = \{p, a, pr, ar\} \wedge PA = SEQ(S_i, S_{i+1}) \rightarrow tp(S_{i+1}) = \{pr, ar, cr\} \wedge ((tp(S_i) = \{pr, ar\} \rightarrow tp(CWS) \in \{ar\}) \vee (tp(S_i) = \{p, a\} \rightarrow tp(CWS) \in \{a\}))$

Proof $tp(S_i) = \{p, a, pr, ar\}$ expresses effects of the previous service cannot be semantically undone, and in the sequential pattern the next should ensure successful execution. Therefore, the next transactional property must be retrievable, pr , ar or cr .

Rule 2: $CWS = (ES, TP, PA) \wedge (ES = S_i \cup S_{i+1}) \wedge tp(S_i) = \{c, cr\} \wedge PA = SEQ(S_i, S_{i+1}) \rightarrow tp(S_{i+1}) = P \wedge ((tp(S_i + 1) = \{c, cr\} \rightarrow tp(CWS) \in \{c, cr\}) \vee (\neg tp(S_{i+1}) = \{c, cr\} \rightarrow tp(CWS) \in \{a, ar\}))$

Proof Because the previous service transactional property is c or cr , if the next service is failed the previous service is compensable. Therefore, whatever transactional property of next activity is, CWS is transactional.

Services Selection Rule in the parallel pattern

Rule 3: $CWS = (ES, TP, PA) \wedge (ES = S_i \cup S_{i+1}) \wedge PA = PAR(S_i, S_{i+1}) \wedge tp(S_i) = \{p, a\} \rightarrow tp(S_{i+1}) = \{cr\} \wedge tp(CWS) = a$

Proof In parallel pattern, when assigned service transactional property of one activity is p or a , if it is completed successfully, and its effect is not semantically undone. Therefore, the other assigned parallel service is retrievable (r), which can guarantee a successful termination. If it is failed, the other should be compensable (c). Thus, to ensure a successful termination and be compensable simultaneously, transactional property of the other selected service should only be cr . From definition 1–3, TCS is a .

Rule 4: $CWS = (ES, TP, PA) \wedge (ES = S_i \cup S_{i+1}) \wedge PA = PAR(S_i, S_{i+1}) \wedge tp(S_i) = \{pr, ar\} \rightarrow tp(S_{i+1}) = \{pr, ar, cr\} \wedge tp(CWS) = ar$

Proof In parallel pattern, when assigned service transactional property of one activity is pr or ar , it can ensure to be completed successfully. Therefore, the other assigned parallel service is pr, ar, cr . From definition 1–3, TCS is ar .

Rule 5: $CWS = (ES, TP, PA) \wedge (ES = S_i \cup S_{i+1}) \wedge PA = PAR(S_i, S_{i+1}) \wedge tp(S_i) = \{c\} \rightarrow tp(S_{i+1}) = \{c, cr\} \wedge tp(CWS) = c$

Proof: In parallel pattern, when assigned service transactional property of one activity is c , it offers compensation policies to semantically undo its effects, but it can fail. Therefore, the other assigned parallel service is c or cr . From definition 2, TCS is c .

Rule 6: $CWS = (ES, TP, PA) \wedge (ES = S_i \cup S_{i+1}) \wedge PA = PAR(S_i, S_{i+1}) \wedge tp(S_i) = \{cr\} \rightarrow (tp(S_{i+1}) = \{p, a\} \rightarrow tp(CWS) = a) \vee (tp(S_{i+1}) = \{pr, ar\} \rightarrow tp(CWS) = ar) \vee (tp(S_{i+1}) = \{c\} \rightarrow tp(CWS) = c) \vee (tp(S_{i+1}) = \{cr\} \rightarrow tp(CWS) = cr)$

Proof In parallel pattern, when assigned service transactional property of one activity is cr , it offers compensation policies to semantically undo its effects, and it can ensure to be completed successfully. Therefore, the other selected parallel service is only transactional service.

To guide service selection that is driven by transactional property, we give transactional automaton model according from rule 1 to 6, and it represents all possible TCSs which could be obtained by the selection process. It is described by using Fig. 24.1. I is initial state which is owned by service of first activity in the $\{p, a, pr, ar, c, cr\}$. $\{SEQ(p), SEQ(a), SEQ(pr), SEQ(ar), SEQ(c), SEQ(cr)$,

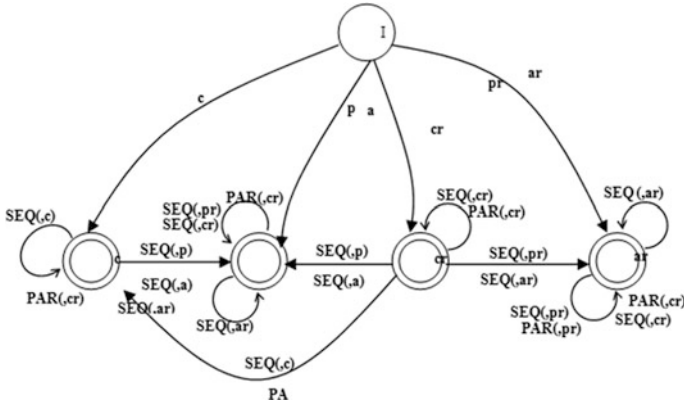


Fig. 24.1 Transactional automaton model

$\{PAR(p), PAR(a), PAR(pr), PAR(ar), PAR(c), PAR(cr)\}$ represents components of different transactional properties that are executed in sequence or in parallel. The final state is in $\{c, a, cr, ar\}$ corresponding to transactional property of a TCS.

24.4 Experimentation

In order to evaluate the behavior of our service selection approach, experiments were conducted by implementing the proposed service selection approach with the program on a PC with Core i3 with 2 GB RAM, Windows 7, and Java 2 Enterprise Edition V1.5.0. The experiments involved composite services varying the number of activities and varying the number of Web services.

Different services can be generated randomly to implement the activities of workflow, so in the experiment each activity uniformly generates 15 Web services. Also the services are transactional whose transactional properties are in the set of $\{p, pr, c, cr, a, ar\}$. For each activity, we randomly generate from 1 to 10 services for each of the transactional properties. For each service, we randomly generate transactional property and a QoS vector, but there are the relations between the two. Particularly, we assume that the execution price of service with c transactional property is more expensive than a p or a one, because the former provides additional functionality in order to guarantee that the result can be undone. Similarly, we believe that a $pr, ar,$ or cr web service has execution duration higher than a nonretriable one, because the former provides additional operation in order to guarantee that it successfully finishes after a finite number of invocations.

In the experiment, we observe relationship of utility value and price weight with different risk tolerance, which is shown in Fig. 24.2. As depicted in Fig. 24.2, the more important the price criteria to the user (which means having high price

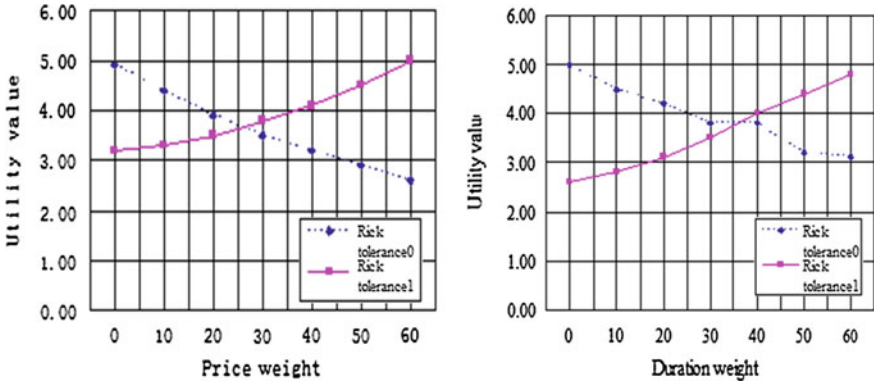


Fig. 24.2 Experimental results for risk tolerance 0 and risk tolerance 1 by varying price weights and by varying duration weights

weight), the better a composition with risk tolerance 1 compared to a composition with risk tolerance 0.

Figure 24.2 shows relationship of utility value and duration weight with different risk tolerance. As depicted in Fig. 24.2, the more important the duration criteria to the user, the better a composition with risk tolerance 0 compared to a composition with risk tolerance 1.

24.5 Conclusion

In this paper, we built automaton model to implement transactional-aware service selection, and with the model composition Web service can guarantee transactional execution. Under the conditions, the implementation shows that the QoS of TCS is in conformity with the user preferences. If the execution price criterion is important to the user, the better solutions are the ones with the lowest level of risk. If the execution duration criterion is more important to the user, then the riskier solutions are the best ones. The results also show that risk 0 is equivalent to risk 1 if compensable services do not cost more than the others.

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Chapter 25

A Formal Transaction Model for Reliable Web Service Composition

Weitao Ha

Abstract A key challenge of Web service composition is how to ensure reliable execution. Due to the inherent autonomy and heterogeneity of Web services, it is difficult to predict the behavior of the overall composite service. The lack of techniques that support nonfunctional features, such as execution reliability, is widely recognized as a barrier preventing widespread adoption. In this paper, we propose a formal transaction model, and modeling method is based on first-order logic. The model uses acceptable state of user as judgment criterion for accuracy, and the validity of the model is proved.

Keywords Web service · The acceptable state for user · Transaction · Well-form

25.1 Introduction

Web services approach is extending the Web from an information support to a B2B middleware. One of the main concepts that offer this technology is the ability to define a new composite service using existing services. In this paper, we are interested in how to ensure reliable Web services compositions. By reliable composition, we mean a composition where all its executions are correct (from a business point of view) [1]. An execution is correct if it reaches its objective or fails according to the designers' requirements. Due to the inherent autonomy and heterogeneity of Web service, it is difficult to predict the overall behavior of a

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composite service. For the long transaction of WSC, strict atomic demands will cause tremendous waste of time and resources. Moreover, traditional locking mechanism may lead to long-term occupation for resources and reducing performance [2]. As stated previously, the traditional transaction processing technology cannot be used in transactions of WSC, and a new transaction model for WSC should be proposed.

25.2 Transaction Model for WSC

Web services have autonomy, heterogeneous and dynamic characteristics in a loosely coupled environment, which is different from traditional transactions [3]. The concept of transaction type and transaction state of Web service should be introduced, and transaction mode which can reflect the actual situation and characteristics of business process can be established. The formal description of model is given.

Definition 1 (*Transaction model for WSC*) Transaction model for WSC is represented by a quadruple $TMWS = (WS, CF, TF, DF)$. WS is a finite set of Web services. CF is Control flow, which represents the structural relationship between Web services. TF is set of transaction relationship, which represents dependencies of transaction between Web services. DF defines the flow of information between Web services.

25.2.1 Transactional Properties of Web Service

The behavioral description of a Web service (WS) is regarding how the functionality of a WS can be achieved in terms of interaction with the other WS. In a composition where several component Web services interact, unexpected behavior from a component WS might not only lead to its failure but also may bring negative impact on all the participants of the composition. Therefore, as for all cross-organizational collaborative systems, the execution of a WSC requires Transactional Properties so that the overall consistency and reliability are ensured. We consider three behavioral properties of WS, pivot (p), compensated (c), and retrievable (r).

Definition 2 (*Pivot WS*) A WS is said to be pivot (p) if once it successfully completes, its effects remain forever and cannot be semantically undone. If it fails, it has no effect at all. A completed pivot WS cannot be rolled back.

Definition 3 (*Compensated WS*) A WS s is compensated (c) if it has another WS si , which can semantically undo the execution of s .

Definition 4 (Retriable WS) A WS is retrieable (r) if it guarantees a successfully termination after a finite number of invocations.

A WS can combine transactional properties (behavioral properties), and then the set of all possible combinations for a WS is $\{p, c, pr, cr\}$. WS transactional properties have the corresponding active state set, which is

$$S = \{initial, active, aborted, cancelled, failed, completed, compensated\} \quad (25.1)$$

and the set of activity behavior is $D = \{activate(), abort(), cancel(), fail(), complete(), compensate(), retry()\}$.

Definition 5 (Acceptable transition state) Acceptable transitions state is that the final state of workflow which is given by process designer is accepted by use, which include the successful final state and the failure final state. It is denoted as ATS. ATSS (ws) is that a set of states appear in the ATS for a Web service which is denoted as ws.

25.2.2 The Set of Control Flow and Transaction Relationship

Definition 6 (The set of control flow) The set of control flow is $CF = \{CF_{seq}, CF_{and}, CF_{pri}, CF_{con}, CF_{rep}\}$.

$$CF_{seq} = \{ \langle a, b \rangle \mid a, b \in WS, \text{ It represents a sequential execution, and } a \text{ is executed before } b \} \quad (25.2)$$

$$CF_{and} = \{ \langle a, b \rangle \mid a, b \in WS, a \text{ and } b \text{ are executed in parallel} \} \quad (25.3)$$

$$CF_{pri} = \{ \langle a, b \rangle \mid a, b \in WS, \text{ the implementation of } a \text{ has priority, and } b \text{ will be executed if } a \text{ fail} \} \quad (25.4)$$

$$CF_{rep} = \{ \langle a, b \rangle \mid a, b \in WS, \exists n, n \in N, \text{ either } a \text{ or } b \text{ is executed} \} \quad (25.5)$$

Definition 7 (The set of transaction relationship) The set of transaction relationship is $TF = \{ \langle a, b \rangle \mid a, b \in WS, \text{ state transition of } a \text{ can trigger } b \text{ transition} \}$. $TF = \{TF_{act}, TF_{alt}, TF_{abo}, TF_{com}, TF_{can}\}$

$$TF_{act} = \{ \langle a, b \rangle \mid a, b \in WS, \text{ completed state of } a \text{ can trigger active state of } b \} \quad (25.6)$$

$$TF_{alt} = \{ \langle a, b \rangle \mid a, b \in WS, \text{ failed state of } a \text{ can trigger active state of } b \} \quad (25.7)$$

$$TF_{abo} = \{ \langle a, b \rangle \mid a, b \in WS, \text{aborted, failed or cancelled state of a can trigger aborted state of b} \} \quad (25.8)$$

$$TF_{com} = \{ \langle a, b \rangle \mid a, b \in WS, \text{failed or compensated state of a can trigger compensated state of b} \} \quad (25.9)$$

$$TF_{can} = \{ \langle a, b \rangle \mid a, b \in WS, \text{failed state of a can trigger cancelled state of b} \} \quad (25.10)$$

25.3 Generating of Transaction Relationship in the Workgroup

TF represents dependencies of transaction among Web services. In order to achieve reliability and consistency of Web services, component services in the workgroup must meet transaction relationship that is defined TF. TF should be generated automatically, which will detail below [4, 5].

25.3.1 Complete Set of TF

Complete Set of TF (CTF) is set of all transaction relationships, but only part of transaction relationships in the CTF will become TF. Corresponding to TF in the workgroup, it consists of five sets, CTF_{act} , CTF_{falt} , CTF_{abo} , CTF_{com} , and CTF_{can} , generated according to rule 1.

Rule 1 CTF generated rule

$$(\forall a)(\forall b)((WS(a) \wedge WS(b) \rightarrow CF_{seq}(a, b) \wedge \neg(\exists c)(WS(c) \wedge CTF_{alt}(c, b))) \rightarrow CTF_{act} \quad (25.11)$$

$$(\forall a)(\forall b)((WS(a) \wedge WS(b) \rightarrow CF_{pri}(a, b) \vee CF_{con}(a, b)) \rightarrow CTF_{alt}(a, b) \quad (25.12)$$

$$(\forall a)(\forall b)((WS(a) \wedge WS(b) \rightarrow CF_{seq}(a, b)) \rightarrow CTF_{abo}(a, b) \quad (25.13)$$

$$(\forall a)(\forall b)((WS(a) \wedge WS(b) \rightarrow CF_{seq}(a, b)) \rightarrow CTF_{con}(b, a) \quad (25.14)$$

$$\begin{aligned}
(\forall a)(\forall b)((WS(a) \wedge WS(b) \rightarrow CF_{pri}(a, b)) \rightarrow CTF_{can}(a, b) \wedge CTF_{can}(b, a) \wedge \\
CTF_{com}(a, b) \wedge CTF_{com}(b, a))
\end{aligned} \tag{25.15}$$

25.3.2 ATS Validation Rule

ATS is the criteria of accurate implementation, which is set by designer of workgroup assisted with the system. Only when the final state of workflow is accepted by user is ATS valid. Validation of ATS specified by the designer takes advantage of rule 2. If ATS is verified invalidly, ATS or Web services of workgroup should be adjusted by designer of workgroup. If Web services of workgroup are adjusted, CTF will rebuild.

ATS is valid if transaction attributes of all services meet the requirements of ATS, and if all atses ($ats \in ATS$) are well-formed.

Rule 2 ATS validation rule

$$\begin{aligned}
(\exists a)(WS(a) \wedge \neg AoS(a, failed) \wedge \neg R(a)) \vee (WS(a) \\
\wedge WS(a, compensated) \wedge \\
(compensated \in ATSS(a) \wedge \neg C(a))) \rightarrow NW
\end{aligned} \tag{25.16}$$

$$\begin{aligned}
(\exists ats)(\exists a)(ATS(ats) \wedge WS(a) \wedge ASS(ats, a, completed) \wedge \neg(\exists b)(WS(b) \wedge \\
(CTF_{alt}(b, a) \vee CTF_{act}(b, a)))) \rightarrow NWF
\end{aligned} \tag{25.17}$$

$$\begin{aligned}
(\exists ats)(\exists a)(ATS(ats) \wedge WS(a) \wedge ASS(ats, a, aborted) \wedge \neg(\exists b)(WS(b) \\
\wedge (CTF_{abo}(b, a))) \rightarrow NWF
\end{aligned} \tag{25.18}$$

$$\begin{aligned}
(\exists ats)(\exists a)(ATS(ats) \wedge WS(a) \wedge ASS(ats, a, compensated) \wedge \\
\neg(\exists b)(WS(b) \wedge (CTF_{com}(b, a)))) \rightarrow NWF
\end{aligned} \tag{25.19}$$

$$\begin{aligned}
(\exists ats)(\exists a)(ATS(ats) \wedge WS(a) \wedge \\
ASS(ats, a, cancelled) \wedge \neg(\exists b)(WS(b) \wedge (CTF_{can}(b, a)))) \rightarrow NWF
\end{aligned} \tag{25.20}$$

$$NW \vee NWF \rightarrow \neg VALID \tag{25.21}$$

Propositions and predicates used in the rule 2 are defined as follows:

$a \in WS$, $ats \in ATS$, $s \in \{\text{initial, active, aborted, cancelled, failed, completed, compensated}\} = S$

ATSS (a) is a set of states appeared in the ATS.

NW is that transaction attribute of all activities cannot meet the requirements of ATS.

WF expresses that all of ATSs are well-form.

VALID expresses that ATS is valid.

R (a) expresses that a is retrievable.

C (a) expresses that a is compensated.

ASS (ats,a,s) expresses that state of a is s in the ATS.

AS (a,s) expresses $s \in S(a)$ and $s \in ATSS(a)$.

25.3.3 Automatic Generation of TF

Use of rule 3 can generate TF automatically. TF plays an important role in the Web service composition. Reliability and consistency of the workflow of WSC are guaranteed by using TF.

Rule 3 Generating rule of transaction relationship in the transactional model

$$(1)(\forall a)(\forall b)((WS(a) \wedge WS(b) \rightarrow CTF_{act}(a, b)) \rightarrow TF_{act}(a, b)) \quad (25.22)$$

$$(2)(\forall a)(\forall b)((WS(a) \wedge WS(b) \rightarrow CTF_{abo}(a, b)) \rightarrow TF_{abo}(a, b)) \quad (25.23)$$

$$(3)(\forall a)(\forall b)((WS(a) \wedge WS(b) \wedge AS(b, completed) \rightarrow CTF_{alt}(a, b)) \rightarrow TF_{alt}(a, b)) \quad (25.24)$$

$$(4)(\forall a)(\forall b)((WS(a) \wedge WS(b) \wedge AS(b, compensated) \rightarrow CTF_{com}(a, b)) \rightarrow TF_{com}(a, b)) \quad (25.25)$$

$$(5)(\forall a)(\forall b)((WS(a) \wedge WS(b) \wedge AS(b, cancelled) \rightarrow CTF_{can}(a, b)) \rightarrow TF_{can}(a, b)) \quad (25.26)$$

25.4 Validation of Transaction Model for Web Service Composition

Definition 8 If there is end state ts in the transaction model that is not an acceptable state for the user, transaction model is invalid, and otherwise transaction model is valid.

Obviously, transaction model is invalid if and only if the following conditions are met:

1. $\exists a \in WS, TSS(a) \notin ATS(a)$.
2. $\exists a \in WS$, There is no transaction relationship in the TF which can change state of a to TSS (a).

TSS (a) is state of a in the ts.

Validation of transaction model for Web service composition:

1. If ts is successful end state of workflow, ts must be an acceptable state for the user.
2. If ts is fail end state of workflow, $TSS(a) \in \{aborted, cancelled, failed, completed, compensated\}$, Validation is divided into the following several situations.
 1. If $TSS(a) = completed$ and no transaction relationship in the TF can make state of a change completed, is true, and ATS is invalid. Thus, there must be transaction relationship in the TF which can change into completed state of a, when $TSS(a) = completed$.

When $TSS(a) \in \{aborted, cancelled, compensated\}$, certificate process is the same as $TSS(a) = completed$, and there must be transaction relationship in the TF which can change into completed state of a.

2. If $TSS(a) = failed$, $failed \notin ATS(a)$, and $R(a)$ is true. That makes ATS be invalid. So $\neg \exists a \in WS, TSS(a) \notin ATS(a)$

25.5 Application of Transaction Model for Web Service Composition

Transaction model proposed in this paper is applied in online travel arrangement. Workflow of online travel arrangement is expressed in Fig 25.1. It includes the following component services: CRS Web service receives requirement of travel destinations and restaurants given by customer. HB Web service schedules restaurant. FB Web service books air. OP completes the online payment Web service functions. TDFE Web service completes ticket delivery through the FedEx. TDU service delivers ticket through the UPS.

ATS given by designer of process is shown in Table 25.1. By definition 5 CF is express as following:

$$CF_{seq} = \{ \langle CRS, HB \rangle, \langle CRS, FB \rangle, \langle HB, OP \rangle, \langle FB, OP \rangle, \langle OP, TDFE \rangle, \langle OP, TDU \rangle \}$$

$$CF_{par} = \{ \langle TDFE, TDU \rangle \}$$

$$CF_{par} = \{ \langle HB, FB \rangle \}$$

$$CF_{con} = \varnothing$$

According to rule 1 CTF is generated.

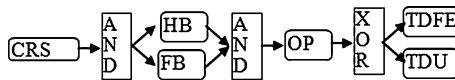


Fig. 25.1 Workgroup of online travel arrangements ATS given by designer of process is shown in Table 25.1

Table 25.1 ATS of online travel arrangements

CRS	HB	FB	OP	TDFE	TDU
Completed	Completed	Completed	Completed	Completed	Initial
Completed	Completed	Completed	Completed	Failed	Completed
Completed	Failed	Compensated	Aborted	Aborted	Initial
Completed	Compensated	Failed	Aborted	Aborted	Initial
Completed	Failed	Cancelled	Aborted	Aborted	Initial
Completed	Cancelled	Failed	Aborted	Aborted	Initial
Completed	Compensated	Compensated	Failed	Aborted	Initial

$$CTF_{alt} = \{ \langle TDFE, TDU \rangle \}$$

$$CTF_{act} = \{ \langle CRS, HB \rangle, \langle CRS, FB \rangle, \langle HB, OP \rangle, \langle FB, OP \rangle, \langle OP, TDFE \rangle \}$$

$$CTF_{can} = \{ \langle HB, FB \rangle, \langle FB, HB \rangle \}$$

According to rule 2 ATS is well-formed, if HB and FB must be compensated, and TDFE must be retried.

According to rule 3 TF is generated.

$$TF_{act} = \{ \langle CRS, HB \rangle, \langle CRS, FB \rangle, \langle HB, OP \rangle, \langle FB, OP \rangle, \langle OP, TDFE \rangle \}$$

$$TF_{can} = \langle HB, FB \rangle, \langle FB, HB \rangle$$

$$TF_{alt} = \{ \langle TDFE, TDU \rangle \}$$

25.6 Conclusions

Currently, the research for the Web services is still relatively weak, and Web service transactions cannot be used in a distributed environment. In addition, the reliability and consistency of enterprise application integration used Web services cannot be guaranteed. This paper focuses on solving these problems. Web service transaction model is proposed, which can meet the requirements of the reliability and consistency, and formal description of the transaction model is also given. The model takes the acceptable states for user as accuracy criteria, and the validity of the modeling approach is proved. Finally, online travel arrangements service composition as an example proves validity of the model.

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Chapter 26

Domain Authentication Protocol Based on Certificate Signcryption in Ipv6 Network

Longjun Zhang, Jianhe Zhang, Ang Xia, Tianqing Mo and Liyi Zhao

Abstract This paper proposes a signcryption-based authentication scheme which proves to be secure in a random oracle model. Then the paper designs an IPv6 cross-domain authentication protocol and analyzes its security and efficiency. The results show that, on the point of security, the protocol has the quality of Perfect Forward Secretly (PFS) and mutual entity authentication, and meets the demand of authentication security; on the point of efficiency, compared with other similar protocols, this protocol needs no computing of key encryption and decryption, avoids the restrictions of synchronous environments, and its computing cost and communication cost are both relatively small.

Keywords Ipv6 network · Certificate-based signcryption · Authentication

26.1 Introduction

With the enlarging network scale, more and more enterprises and organizations could have their own resources. The resources are protected from unauthorized user's access by the authentication service that organization's local authentication service facilities provide, which forms the relatively independent Autonomous System (AS). IPv6 network logically consists of many IPv6 supported Ass. Thus, request of shared resources access may not only come from local trusted AS, but probably from external trusted AS. So there is a problem with cross-domain

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authentication when external trusted user has access to resources of local trusted domain. The real environment has many similar applied scenes, for example, Correspondent Node (CN) and Mobile Node (MN) in IPv6 network may not be in the same trusted domain. To ensure security, it must have cross-domain authentication beforehand when CN communicates MN in different trusted domains.

The studies on cross-domain authentication mainly are Refs. [1–10]. By analysis, the proposed cross-domain authentication scheme in them is for four network environments: (1) The certificate-based authentication by net-users; (2) The identity-based authentication by all net-users; (3) The identity-based authentication by users in the same subnet, and the certificate-based authentication by users in different subnets; (4) The certificate-based authentication between users who use the certificate-based authentication and users who use the identity-based authentication.

The certificateless-based authentication appears in IPv6 network with the development of computer and network technology. Thus, it is a new problem how to authenticate and consult key between certificate-based users and certificateless-based users. This article at first introduces some knowledge about cross-domain authentication in IPv6. To solve this problem, the article creates abstractly a new cross-domain authentication model, and proposes a certificate-based signcryption scheme with provable security in the random oracle model. Upon that we design a signcryption-based cross-domain authentication protocol in IPv6 and make its evaluation.

26.2 IPv6 Signcryption-Based Cross-Domain Authentication Protocol

26.2.1 A Certificate-Based Signcryption Scheme

In this paper, we proposes a certificate-based signcryption scheme based on Boneh–Lynn–Shancham Signature [11]. CA implements IBE Scheme to produce certificate and reduces computing capacity and communication cost as we discussed below:

Let G_1 be a cyclic additive group generated by P of order q , G_2 be a cycle multiplicative group of order q , and it is discrete logarithm puzzle in G_1, G_2, E, D , which are secure symmetric encryption algorithm, $\hat{e}: G_1 \times G_1 \rightarrow G_2$ is bilinear map. Define three secure hash functions: $H_1: \{0, 1\}^n \times \{0, 1\}^\lambda \rightarrow G_1$, $H_2: G_1^2 \rightarrow \{0, 1\}^\lambda$, $H_3: \{0, 1\}^n \times G_1 \rightarrow G_1$ (n represents the length of user's identity, λ represents the length of key). CA chooses a random number $P, P_{pub}, H_1, H_2, H_3$ as the system primary key, second, computes the system public key: $P_{pub} = s \cdot P, s \in \mathbb{Z}_q^*$, and the opened parameters $\{G_1, G_2, q, \hat{e}, E, D\}$.

The user key generation: user U randomly chooses $x_U \in Z_q^*$ as private key, computes relatively public key $y_U = x_U \cdot P$. Assume $U = i$ and $U = j$ represent sender and receiver separately, their private/public keys are (x_i, y_i) , (x_j, y_j) .

The certificate generation: input system parameters, the primary keys of CA, the identity identifier ID_u of user and public key y_u , and compute $Q_u = H_3(ID_u || y_u)$, then output user's certificate $Cert_u = s \cdot Q_u$. The certificates of user i and user j are $Cert_i = s \cdot Q_i$, $Cert_j = s \cdot Q_j$.

Signcryption: in order to send message m to receiver j , sender does as follows: randomly choose $k \in \{0, 1\}^\lambda$, compute $h_1 = H_1(m, k)$ and $c = E_k(m || y_j)$; compute $Y = 1/(h_1 + Cert_i \cdot Q_j)$, $S = Y \cdot y_i$, $V = Y \cdot x_i \cdot y_j$; compute $h_2 = H_2(S, V)$, $U = k \oplus h_2$; send signcryption ciphertext to receiver. Unsigncryption: when receiving (U, c, S) , receiver does as follows: compute $h_2 = H_2(S, S \cdot x_j)$, $k = U \oplus h_2$; (2) compute $m || y_j = D_k(c)$, $h_1 = H_1(m, k)$; compute $Y = 1/(h_1 + Cert_j \cdot Q_i)$; verify whether the equation that $\hat{e}(P, S) = \hat{e}(P, y_i)^Y$ is established, if it is, then send message m to receiver, or output \perp .

The correctness proof: $S \cdot x_j = V$

$$Proof \quad S \cdot x_j = V = Y \cdot x_i \cdot y_j \cdot P = Y \cdot x_i \cdot y_j = V$$

$$Cert_i \cdot Q_j = Cert_j \cdot Q_i$$

$$Proof \quad Cert_i \cdot Q_j = s \cdot Q_i \cdot Q_j = Q_i \cdot s \cdot Q_j = Q_i \cdot Cert_j$$

$$\hat{e}(P, S) = \hat{e}(P, y_i)^Y$$

$$Proof \quad \hat{e}(P, S) = \hat{e}(P, Y \cdot y_i) = \hat{e}(P, y_i)^Y$$

26.2.2 The Security Proof of Scheme

26.2.2.1 Confidentiality

Let any polynomial time attacker $A_{\eta(\eta=1,2)}$ has the ciphertext $c_\mu = E_{k_\mu}(m_\mu || y_j)$ generated by No. μ session, $k_\mu = U \oplus h_2$, $h_2 = H_2(S, x_i \cdot y_j \cdot Y)$. For the attacker $A_{\eta(\eta=1,2)}$, it is impossible to achieve this session plaintext through computing because to compute h_2 having unsettled CDH problem. Thus, the proposed scheme in this paper is indistinguishable under adaptive chosen ciphertext attack. Generally, A_2 is better in computing plaintext m_μ than A_1 [12]. Therefore, we just need to prove that scheme adversary A_2 is indistinguishable under adaptive chosen ciphertext attack.

26.2.2.2 Unforgeability

If an adversary could make a forged signcryption scheme proposed in this paper, it can also make a forged signature scheme in Ref. [11]. However, Ref. [11] has already proved that the signature scheme is unforgeable. Thus our scheme is unforgeable under adaptive chosen ciphertext attack.

26.2.3 Ipv6 Certificate-Based Cross-Domain Authentication Protocol

To solve the authentication and key negotiation problem between certificate-based user and identity-based user, in view of cross-domain authentication model in Sect. 26.2 and certificate-based signcryption scheme in Sect. 26.1, with the study achievements in the previous chapters, a certificate-based trusted cross-domain authentication protocol is proposed in this chapter.

The authentication progress is:

- (1) With the certificateless-based algorithm, User A computes signcryption ciphertext $\sigma = SC_{CL_PKC}(m, s_{us_a}, P_{ASM_a})$, $m = (ID_a || ID_b || s || a)$, random number is $s \in Z_q^*$, $a = g^x$ ($x \in Z_q^*$), and sends σ to ASM_a.
- (2) ASM_a gets the message and makes the unsigncryption with the relevant algorithm. After realizing the authentication of User A, do the following steps:
 - Choose random number $k \in \{0, 1\}^{\lambda}$, and second, compute $h_1 = H_1(m, r)$, $c = E_k(m || y_{ASM_b})$;
 - Compute three equations which are $Y = 1/(h_1 + Cert_{ASM_a} \cdot Q_{ASM_b})$, $S = Y \cdot y_{ASM_a}$, $V = Y \cdot x_{ASM_a} \cdot y_{ASM_b}$;
 - Compute $h_2 = H_2(S, V)$, $U = k \oplus h_2$;
 - Send the signcryption ciphertext $\sigma = (U, c, S)$ to ASM_b.
- (3) ASM_b gets the message and does the following steps:
 - Compute $h_2 = H_2(S, x_{ASM_b} \cdot S)$, $U = k \oplus h_2$;
 - Compute $m || y_{ASM_b} = D_k(c)$, $h_1 = H_1(m, k)$, $Y = 1/(h_1 + Cert_{ASM_a} \cdot Q_{ASM_b})$;
 - At first prove the equation $\hat{e}(P, S) = \hat{e}(P, y_{ASM_a})^Y$, if does, accept this message. And second compute ciphertext $\sigma = SC_{CL_PKC}(m, s_{us_a}, P_{ASM_a})$ with identity-based signcryption algorithm, and send it to User B.
- (4) When User B gets this message and makes the unsigncryption with relevant algorithm. After realizing the authentication of User B, separate s and a from message m , and do the following steps:
 - Compute cipherkey $N = a \oplus s$;
 - Choose $y \in Z_q^*$ randomly, compute $R = a^y$, $b = g^y$;
 - Generate session key $K_1 = H(ID_a || ID_b || s || R)$ ($H : \{0, 1\}^* \rightarrow Z_q^*$);
 - Compute $E_N(ID_a || ID_b || R || b)$, and send it to User A.

User A gets this message and computes $N' = a \oplus s$, prove $N' = N$. If does, then compute the equation which is $(ID_a || ID_b || R || b) = D_N[E_N(ID_a || ID_b || R || b)]$, evaluate $R = b^x$. If does, User A finishes the authentication on User B, and generates the shared session key $K_1 = H(ID_a || ID_b || s || R)$. A Chooses $y \in Z_q^*$ randomly, computes $K' = E_{K_1}(z)$, generates new key $K_2 = H(K_1 || z)$, and sends $K' = E_{K_1}(z)$ to User B for key updating.

The certificateless-based signcryption authentication User A and the identity-based authentication User B realize the key negotiation and get session key K1 in the authentication. Otherwise, they will generate new session key K2 in the communication and complete key updating when communication ends.

26.3 Performance Analysis of Protocol

26.3.1 Protocol Security Analysis

26.3.1.1 The Mutual Authentication Between Entities

It is through authentication in domain that realizing the authentication between user and authentication proxy (using certificateless-based signcryption authentication in AS1, and identity-based signcryption authentication in AS2). Proxy ASM_a and ASM_b use the certificate-based signcryption authentication to realize their authentication. When proxy ASM_a finishes authentication on User A, it returns the authentication result to ASM_b. Because there is a trusted relationship between ASM_a and ASM_b, ASM_b gets the authentication and User B also realizes it. In the meantime, A makes authentication on B by proving the equation $R = b^x$ ($b^x = g^{x \cdot y}$). And because the communication between a and b is under encryption (ASM_a and ASM_b knowing a rare trusted), User A and User B realize the mutual authentication.

26.3.1.2 Key Negotiation

The communication key between User A and User B is produced by material a , b separately given by each user, random number s and both users' identities, all of which are sent under encryption. Thus, it is safe to compute a^y or b^x to get the communication key which is $K_1 = H(ID_a || ID_b || s || g^{x \cdot y})$. The attacker would efficiently solve the CDH problem if he gets $g^{x \cdot y}$. So no untrusted third-party could get K_1 except only User A and User B sharing it.

26.3.1.3 Perfect Forward Secretly (PFS)

In the key generation, random number z takes part in every time communication key generation and is sent under encryption. The user who has K_1 and z can get communication key. And it is not related between new and old keys when keys update. So that is PFS.

26.3.1.4 Known Key Security

The key $K_1 = H(ID_a || ID_b || s || b^x) = H(ID_a || ID_b || s || a^y)$ is independent because x, y, s are randomly chosen and sent with ciphertexts in network.

26.3.1.5 No Key Compromise Impersonation

When the long-term key of user is leaked, the attacker could only camouflage the user but not anyone else. For users in domain A, the private key is generated by user and KGC together, and even the attacker knew the private key, he just could not get system secret number, which is a DL problem, and could not deduce other users' private keys. For users in domain B, even the attacker knew the private key and identity of the user, he could not compute the system secret number either, which is a difficult math problem using the equation $s_u = P / (s + Q_U)$ to compute with known Q_U, s_u . So the protocol has the quality of No Key Compromise Impersonation (Non-KCI).

26.3.1.6 The Man-in-Middle Attack Defend

The attacker cannot forge message like $E_N(ID_a || ID_b || R || b)$ because of the encrypted s and a in the communication. Thus the protocol can defend the man-in-middle attack effectively.

26.3.2 Protocol Efficiency Analysis

This chapter analyzes the computing cost (Table 26.1) and communication cost of protocol (Table 26.2) and compares them with other protocols.

In Table 26.1, P_U is the key encryption and the decryption time of user, E_U is the symmetrical encryption and the decryption time of user, S_U is the signature and authentication time of user, E_x is the index computing time of user, P_A is the key encryption and the decryption time of cross-domain authentication proxy, E_A is the symmetrical encryption and the decryption time of cross-domain authentication proxy, S_A is the signature and the authentication time of cross-domain

Table 26.1 The computing cost

Protocols	P_U	E_U	S_U	E_X	P_A	E_A	S_A
Reference 5	2	0	1	2	4	0	4
3.2, reference 8	1	1	1	2	2	0	2
3.4, reference 8	1	1	1	2	2	0	2
Paper	0	2	1	2	0	2	2

Table 26.2 Communication cost of protocol

Protocols	C	C_{AB}	C_{ab}
Reference 5	14	6	0
3.2, reference 8	10	3	1
3.4, reference 8	5	1	2
Paper	5	1	2

authentication proxy. In Table 26.2, C is the total communication time of protocol, C_{AB} is the exchange time of cross-domain authentication proxy, C_{ab} is the exchange time between User A and User B.

From the above two lists we know: About protocol computing cost, the user only needs twice symmetric encryption and decryption computing, one time signature or signature proof computing and twice exponentiation computing; domain authentication just needs twice symmetric encryption and decryption computing and twice signature or signature proof computing. About protocol communication cost, the communication time is as same as the improved cross-domain authentication protocol proposed in Ref. [8], but the protocol proposed by this article is not limited by the network environment while the authentication protocol in Ref. [8] could only be used in synchronous communication network due to the timestamp brought in by the protocol. So the cross-domain authentication protocol proposed in chapter has better transplantability and reduces system costs.

26.4 Conclusion

This paper at first introduces some knowledge about IPv6 cross-domain authentication and creates a signcryption-based cross-domain trusted authentication model abstractly. And we put forward an IPv6 cross-domain authentication protocol and analyze its security and system costs. The results show that the protocol is secure, highly efficient, and transplanted easily for the authentication between certificateless-based user and identity-based user in IPv6 network.

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Chapter 27

A Non-Template Approach to Purify Web Pages Based on Word Density

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Abstract A news web page has lot of words, most of which exist in topic zones, and the rest in noise zones. According to this feature, we propose a novel approach to purify webpages. Without site template and based on word density, it can purify isomorphic pages, nonisomorphic pages, and pages not meeting XML specification. The test proves it as satisfactory and stable.

Keywords Web page purification · Information extraction · Character density

27.1 Introduction

Advertisement, non-related links and copyright in webpages, decreases the accuracies of Web applications, they are noisy content. Text description of news, readers' comments, and anything that we need in webpages, increases the

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accuracies of Web applications, they are topic content. A variety of approaches have been proposed to reduce noise and keep only topic content in webpages [1, 2]. Most of the past studies are based on website templates [3–6]. A template is a DOM tree structure that has eliminated noisy nodes, and only works within a set of webpages. These studies have the obvious shortcomings: a set of webpages has a template and it only corresponds to a set of webpages, the template does not work in some special circumstances [7], and when the sampling number of pages in the site is not significant, the error rate of the analysis is high [7]. Other studies are based on multisite heterogeneous webpages without template, but they are algorithmic complexity, low efficiency, or low precision. These studies, such as the approach based on focused topic [8] and VIPS [9–12] algorithm proposed by Cai et al., make full use of page layout features and some heuristic rules to divide the page at the semantic level. The main limitation of this approach is that performing visual rendering and segmentation of webpages is resource intensive [13]. We thus propose a novel approach based on statistics on words account, which does not need any template and works well with pages that do not meet the XML specification [14].

27.2 A Non Template Approach to Reduce Noise in Webpages Based on Word Density

In the paper by Zhang et al. [1], according to the function, the HTML tags can be divided into two categories: one is used to plan the layout of the webpage, known as the Container Tag. These tags visually divided the webpage into several content blocks; Common container tags include `<body>`, `<table>`, `<tr>`, `<td>`, ``, `<div>`, and `<form>`; the other one is used to describe a segment contained in the webpage, known as the Description Tag, these tags have no use of the layout of the webpage but just a picture or a hyperlink; Common description tags include `<a>`, ``, and ``. The description tags can be further divided into two categories:

Style Tag. These tags regulate the content elements of webpages, such as text, tables, and images; they are used to change the style of the content elements. Commonly used tags as `<style>`, `<script>`, ``, `<center>`, `<p>`, ``, and special tags, mainly converted from office documents, as `<o:p>`, `<u1:p>`, `<st1:csdate>`. The `` changes the text size, color, et al. surrounded by it.

Element Tag. These tags can be seen in visual elements, parts of them are visual elements. Commonly used tags as `<a>`, `<object>`, ``. The `` represents a picture.

Our approach is divided into two steps:

Extract the source code from a webpage, remove all style tags and comments in the source code, and get the source code without style tags which we call as Non-Style page(NSP). And the source code of it we call as the Source Code of Non-Style page(SCNSP).

A page's SCNSP is divided into several parts; each of them has the same number of characters. Find the part with the largest number of words and redivide the part. At last we find the highest word density part which we call the high word density source code of non-style page (HSCNSP). Extracting all tags in the HSCNSP, searching the SCNSP for corresponding start and end tags, we get a part of extended source code surrounding by all the tags we have got. We call the extended source code as the source code for topic content (SCTC). It is the source code of the purified page.

27.2.1 Remove Style Tags from the Source Code of a WebPage

Although the words concentrate on the visual rendering of a webpage, they may be dispersed in the source code. Kinds of HTML tags separate the words. This always happens, especially to webpages converted from office documents. Most of these tags are Style Tags; they are useless and will trouble further Web applications. For the sake of the webpage purification effect and not troubling follow-up Web applications, we can in advance remove all style tags and comments, and get the source code consisting of words, container tags, and element tags. The webpage purification approach work is based on this kind of source code.

We can remove style tags and comments by the following algorithm:

Algorithms 1 remove style tags and comments

Input: SCP: the source code of a webpage

Output: the source code without style tags and comments

1. //the regular expression
2. SCP = Regex.Replace (SCP, @ "[\s\S]*<body.*?>", "", RegexOptions.IgnoreCase);
3. SCP = Regex.Replace (SCP, @ "</body>[\s\S]*", "", RegexOptions.IgnoreCase);
4. SCP = Regex.Replace (SCP, @ "<script.*?>.*/script>", "", RegexOptions.IgnoreCase | RegexOptions.Singleline);
5. SCP = Regex.Replace (SCP, @ "<style.*?>.*/style>", "", RegexOptions.IgnoreCase | RegexOptions.Singleline);
6. SCP = Regex.Replace (SCP, @ "<\/? (?:(FONT|SPAN|PIBR|CENTER| O\:*|U1 \:*|ST1\:*)[^>]*>", "", RegexOptions.IgnoreCase);
7. SCP = Regex.Replace (SCP, @ "<![^>]*?>", "", RegexOptions.IgnoreCase);
8. Return SCP;

27.2.2 Searching Algorithm for the Highest Word Density Pieces of the Source Code

Proceeding with the analysis from the source code of a non-style webpage, we find the relationship between words and HTML tags: words of a webpage exist between or in tags, and are separated by the tags that make scattered text zones.

Because of fewer tags in the topic content zone, the zone has a greater number and higher density of words. There is a part of the SCNSP from a webpage in Fig. 27.1. We use several rectangular boxes to divide the source code into several small pieces, each piece has the same number of characters. We find the pieces have different number of words, and the one from the topic content zone has the greatest number.

Definition 1 The SCNSP S is divided into v pieces in accordance with the same number of characters. Each piece is marked as S_i , $1 \leq i \leq v$. We get the following formula:

$$C(S_i) = \frac{\sum_{j=1}^{i-1} \text{sgn}(\text{len}(S_i) - \text{len}(S_j)) + \sum_{j=i+1}^v \text{sgn}(\text{len}(S_i) - \text{len}(S_j))}{v - 1} \quad (27.1)$$

Formula: $\text{len}(S_i)$ is Algorithm 2 which is described below, $\text{sgn}()$ is a sign function. When $C(S_i) = 1$, $\text{len}(S_i)$ is greatest, and $(\text{len}(S_i) - \text{len}(S_j)) > 0$, $1 \leq j \leq v, j \neq i$; S_i has the greatest number of words in the array $(S_1, S_2, S_3, \dots, S_v)$. When none of $(C(S_1), C(S_2), C(S_3), \dots, C(S_v))$ equals 1, S has the highest density of words, and it cannot be divided.

Algorithm 2 $\text{len}(S)$: Calculate the number of words in the SCNSP S

Input: S : the SCNSP of a webpage

Output: the number of words in S

1. //the regular expression
2. $S = \text{Regex.Replace}(S, @"<[^>]*>", "", \text{RegexOptions.IgnoreCase})$;
3. $\text{string}[] \text{tempArray} = \text{strText.Split}(\text{new char}[] \{ ' ', ',', '.', ':', ';', '?' \})$;
4. $\text{return tempArray.Length}$;

Fig. 27.1 Divide the SCNSP into several pieces



The idea of the algorithm: The SCNSP S as an input parameter. We remove all HTML tags by using a regular expression “<[^>]*>”. Then we get a text string. The number of the words in the text string is what we need. For Chinese webpages, we replace the third line of code with “byte[] byts = System.Text.Encoding.GetEncoding(“gb2312”).GetBytes(S);”, and the fourth line of code with “return byts.Length—S.Length;”.

Algorithm 3 WordDensity(S): Search the SCNSP for one piece with the highest density words.

Input: S : the SCNSP of a webpage

Output: the piece of SCNSP with the highest density words

1. if ($T < \max T$){//when recursion $\max T$ times, no more recursive computing
2. for (int $i = 1$; $i \leq 5$; $i++$){//assignment for each piece of SCNSP
3. String $S_i = S.Substring(S.Length/v * (i - 1), S.Length/v * i)$;
4. }
5. for (int $i = 1$; $i \leq 5$; $i++$){//traverse each piece of the SCNSP
6. if $\left(\frac{\sum_{j=1}^{i-1} \text{sgn}(\text{len}(S_j) - \text{len}(S_i)) + \sum_{j=i+1}^v \text{sgn}(\text{len}(S_j) - \text{len}(S_i))}{v-1} == 1 \right) \{$
7. $T++$;//recursion times plus 1
8. WordDensity(S_i);//Further search for the higher density word piece of S_i when S_i is the higher density word piece of S .
9. }
10. }
11. }
12. return S_i ;//we get the highest density word piece of the SCNSP

The idea of the algorithm: The SCNSP S as an input parameter is initialized as the SCNSP of a full webpage. In accordance with the same number of characters, we divide S into v pieces. Traversing ($S_1, S_2, S_3 \dots S_v$), when $C(S_i) = 1$ ($1 \leq i \leq v$), we believe that S_i has a higher density of words than the others. The SCNSP S_i as an input parameter, we proceed with another recursive calculation. In a recursive calculation, when each $C(S_i) \neq 1$ ($1 \leq i \leq v$), we believe that the S has the highest density of words and cannot be divided, which we call as the highest word density for Source Code of Non-Style Page, HSCNSP. These are two integer thresholds and an integer variable: v , $\max T$, and T . T initialized as 0, when one more recursive calculation happens, T increased by 1. In order to avoid recursive calculation too many times leading to lose too much content for the HSCNSP, we have a threshold $\max T$, which stops the calculation when recursion the $\max T$ times. And the HSCNSP, no matter whether it is the highest word density piece of the SCNSP, is supposed as the highest word density piece. The threshold v is the number of pieces we divide the SCNSP into.

The HSCNSP cannot be expressed as a format-completed webpage, and may be as just one part of the topic content. We have to enrich it.

We know each container tag is composed of two parts: a start tag and an end tag, such as `<div>` and `<table>` are start tags, the corresponding end tags are `</div>` and `</table>`. The source code between two parts of a container tag can be expressed as a format-completed webpage.

Through Algorithm 3, we get the HSCNSP of a webpage. From the location of the HSCNSP, we search the SCNSP forward for the latest end container tag and backward for the latest start container tag. Then we get an extended HSCNSP surrounded by the two start and end tags. Extracting all the unpaired start or end container tags, from the location of the extended HSCNSP, we search forward and backward for all corresponding end and start container tags in the SCNSP. Then we get a further extended HSCNSP. This is the SCTC. The page expressed by SCTC is the purified webpage.

27.3 Empirical Evaluations

Algorithms are written in C# language. The webpages come from several Chinese online news providers. The text is processed by .Net Class System.Text.Encoding, encoded in GB2312. In Algorithm 3, the threshold $v = 5$ and $\max T = 3$. We have 15,000 webpages from five news website, and 3,000 from each. In order to reflect the nontemplate approach for webpage purification and to have the advantage, we disorder these pages and mix them. After purification, we classify the purified pages in accordance with the site they belong to, and evaluate the effect from the following two data. The experimental result is shown in Table 27.1.

The purification for these pages is not very satisfactory, but the topic content is basically preserved, yet containing a small amount of noisy content.

When the Topic Content Node has a small amount of text, it will be mistaken as a noisy node, and a noisy node with more text will be mistaken as the Topic Content Node. When the Topic Content Node has a great amount of text, this approach works well. Appropriate to adjust the two thresholds v and $\max T$ will has little effect on the experimental result.

Table 27.1 The result of purification experiment

Source website	Number of pages	Proportion of properly purification (%)	Proportion of basically purification (%)
Sina news	3,000	79	18
Netease news	3,000	82	12
Sohu news	3,000	83	12
Pacific news	3,000	65	23
CSDN	3,000	69	25

27.4 Conclusions

We present an approach for reducing noise in webpages. Based on the features that the topic content node has a greater number of words than the other nodes in a webpage and these words are concentrated, this approach works well. It can be used for the purification of mix-site pages. Comparing with other technologies based on the DOM tree, our approach has the advantage of less time consuming. And there is a highlight that our approach can work well with pages that do not meet the XML specification. But when the Topic Content has a small amount of words, the purification effect is not ideal. In future work, we will improve the approach so that it has greater applicability.

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Chapter 28

Study of Web Data-Mining Technology in the Electronic Commerce Application

Kebin Huang and Zheng Zeng

Abstract The article introduces the Web excavation technology that uses a Web log framework and database data mining, and it analyzes the methods of the Waikato environment for knowledge analysis (WEKA) mining tool to a simulation e-commerce sites in the process of data mining and its key techniques, discusses the Web data mining for e-commerce sites, the importance finally points out the development trend of Web mining and the existing defects of mining tool, the paper proposes developing intelligent, and popularization of the reality of mining tool and necessity [1, 2].

Keywords Electronic commerce · Data mining · WEKA · Web data mining

28.1 Introduction

Web data mining is a kind of semi-structured mining system, it is based on database general affairs, handling data, has strict structure and relatively high accuracy, more suitable for Internet multiple levels, and there are certain structures, and there are lack of logic structure between sites, in the face of Internet environment that can be used widely.

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In the modern society where electronic commerce has become an important new business model, it can directly influence the customer acquisition with fast and accurate information and is decided to enterprise the survival and development space. Therefore, data mining work becomes the core of the customer relationship management, widely used in customer segmentation, customer churning, customer value analysis, developing marketing strategy, customer relationship management and application in financial, medical degree, entertainment, and in different fields [3].

28.2 Web Use Mining

Web use mining also called as web log mining, through the users Web access in the server when left visit record for mining, to get the users information. Mainly mining mode is divided into two classes [4]: one is the KDD through which technical analysis visit record to learn the user's access mode and intention and improve the structure of the organization as a site basis; Two is a particular user preferences and characteristic analysis, for different users provide personalized service.

The user through webpages on a visit with the server, the server will produce some log files, such as server log book, the error log, and cookie log, which records user page access information, including the IP address of the user, the user name, access time and the commonly used website, and other information. Through the records and the completion of the background information, browse user information, Internet information mining of their own. Web use mining generally scores according to pretreatment, mode, and pattern analysis found on that three stages.

28.2.1 Data Pretreatment

The format of Web log file is not easy for data mining directly, it needs these data pretreatment, forming a transaction database again after data mining algorithm to the converted data mining. It Usually includes data cleaning, user identification, conversation recognition, and path added.

Data cleaning is to wipe off the target file types. The user identification is considered with different IP address of the users. Conversation recognition according to time interval or page links for processing. The path to the user use added refers to "back" functions, leading to the page no records or missing data added. Data to inquire as an example, the site is usually to customers with cookie data collecting. First need to record from the database cookie derived, then the data cleaning, according to a web page document to unless suffix of other records, and then based on the IP address in user identification, at the same time, a conversation recognition and path added.

28.2.2 Pattern Found

Pattern Found is using various methods to find the hidden patterns and rules. At present, we often use artificial intelligence, data mining, and statistical theory, sequence mode, classification, clustering, pattern recognition method, as long as the mining technology has path analysis technology, the association rules technology, sequence mode technology, classification technology, clustering technique, etc.

28.2.3 Mode Analysis

Mode analysis process is to analyze the mode analysis, and find out the useful, users interested mode, delete these useless mode, and use the tools to express to people the form that people can understand. The current research and application of the mode analysis technology mainly includes: visualization technology, online analysis (OLAP) technology, knowledge inquiries and so on. With “diapers and beer” story as an example, according to the association rules, the businessman beer and diapers can be put together, but in actual sales, probably it will lead sales are down, this needs to learn the knowledge inquires according to consumer psychology, as well as other factors, to achieve the purpose of the final to increase sales.

28.3 The Application of Web Data Mining in E-Commerce Sites

Web data mining is widely used in each big shopping website, compared with the past by simple cookie, market investigation, collect user information, and then used the traditional software for the management, and now the Web site all use data mining tools. Waikato environment for knowledge analysis (WEKA) is a free commercialization of JAVA Environment based on open source of machine learning (machine learning) and data mining (data mining) software, set data pretreatment, pattern found, mode Analysis at an organic whole. Below we establish a simulated e-commerce sites small database, and to WEKA software for example is introduced the digging.

28.3.1 Preparatory Work Before Data Mining

Preparatory Work mainly includes: WEKA software installation, debugging WEKA running environment, installation database operation environment, export, or create web database, using web log file and establish conversion formats.

28.3.2 With WEKA Software to Excavate

As the research needs, we can simulate a bank edition piece of electronic commerce web log files, and convert to WEKA to identify the files. According to web use mining steps, it is further divided into the following three steps for mining analysis:

28.3.2.1 For the Data Pretreatment

According to the established web log file, to bank data item of data cleaning, namely to delete the data mining task useless attribute items, such as ID, Save_acct, Current_acct, etc.

28.3.2.2 The Model-Decision Tree

For the process of data mining to customers, mining software can create model, and the model is analyzed, with the relevant icon to express.

In WEKA software, we use C4.5 decision tree algorithm to bank-data set up classification model, and to obtain the corresponding icon. The method is: use “Explorer” open training set “bank. arff”, switch to “Classify TAB”, select “trees” of the “J48”, and click “Choose” right of the text box, pop-up Windows for the algorithm set various parameters, we keep default parameters.

In WEKA software of rectangular diagram in the mining, the Numbers on the diagonal matrix, the bigger the prediction that the better. In the generation of decision tree, can be directly extract customer information, and judgment.

28.3.2.3 Model Assessment

According to the model to import data forecast, in practice to forecast data set and training data set with each attribute set of requirements must be consistent.

For a particular data, and may, according to web log file establish related model, can directly from the model according to the data to predict the future applications. When a new e-commerce sites launched a product or need some kind

of sales promotion product, can according to user information with different model and the algorithm, which target customers, and differential marketing.

28.4 Web Data Mining for E-Commerce Sites of Significance

Data mining for the application of e-commerce sites is very important, has become the e-commerce application of one of the essential tools. Mainly reflects in:

1. Let the electronic commerce marketing environment be more accurate according to its model to the classification of the choice for customers, locking the marketing personnel, truly accurate marketing.
2. Better mining potential customers, subdivision customers, make customer relationship management. Through the data mining, data was very well, the classification of the data by artificial classification of quantitative analysis, according to marketing strategy, can adopt different for different customer marketing solutions, so that no doubt increased website customers, improve the site traffic.
3. Better to implement the differential marketing.

Through the data mining, the artificial intelligence developing marketing strategy, and other market research way in, according to the results of data mining formulated strategies to better achieve the differentiation. Different websites based on data mining may obtain the customer the most visible, the most valuable information, and can be specified on a business trip of the alienation of marketing plan and market schemes.

Web data mining effectively improve the traditional sales model will market, customers, competitors, three key elements of the data collection and separate not very correct characteristics, it sets the three elements of a body to carry on the analysis, the market, the analysis of data fusion competitors to customer data, based on different customer produce different scheme, better for the customer relationship management, effectively realized the differential marketing. At the same time, through the data mining, the website can better optimization web pages, and strengthen the interaction between with other site, on the other hand the increase your website traffic.

28.5 Conclusion

Web mining is a new great development prospects in the field of research, the technology is a wide range of applications at home and abroad. Along with the continuous rise, C2C B2C, the application in the future development, the website shopkeeper directly through to mining software online data mining may have to become a trend.

The current mining tools need special server for the establishment of database, in the data on Web much data when data pretreatment problem, the algorithm is universal, the complexity of the model, the term of the popularity, etc. are restricting mining tool popularize. Develop a general intelligent and mining tool to make data mining application in real life, to realize with the customers as the center of the differential marketing has the very realistic significance.

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Part IV
Information Technology and Applications

Chapter 29

A Study on Construction of the Flood Emergency Program System

Yu Rong Yu, Hua Xiao and Wei-chen Hao

Abstract With the expansion of population, development of economy and acceleration of urbanization, flood disasters have more and more effect, especially on cities. Flood disasters have mainly influenced the planning and development of people's lives. Solving the flood disaster problem has been the urgent matter of many countries, in which one of the basis is to construct the flood disaster emergency program system. This paper mainly discuss three aspects of flood disaster emergency problems: the situation of flood disaster in China, the flood emergency program system design, and the improvement and operation of integrated decision making system.

Keywords Flood · Disaster · Emergency · Program system

29.1 The Situation of Flood Disaster in China

With economic development, the economic losses caused by the devastating floods continue to increase. Relevant materials show that the synthetic loss per unit area of China floods has increased from 21.9 million Yuan/km² in the 1950s to 1.212

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million Yuan/km² in the 1990s. It is worth being pointed out that the synthetic loss per unit area of the flood in those developed areas is much higher than the national average. For example, among the economic loss caused by the flooding of Taihu Lake region in 1991, the loss of township enterprises accounted for 80 %, and this proportion was higher in 1998 and 2010.

Floods have great destructiveness and universality. On one hand, floods result in heavy casualties and spread of diseases in large-scale which endangers the health of the people; on the other hand, floods destruct houses, railways, bridges, water control works, resulting in huge loss of property. Flood disasters also damage industry, agriculture, transportation, etc., causing huge indirect economic loss; and damage land resources and ecological environment and seriously affect comprehensive, coordinated, and sustainable development.

Flood disaster consists of comprehensive factors in many aspects, mainly including natural and human causes. Rainstorm is the most significant natural cause which results in floods in several river basins; abrupt heavy rains lead runoff to flow into rivers and lakes, water level increases suddenly if the flood in upper reaches releases, and this causes flood disasters. Anthropogenic activity is also an important factor affecting floods. On the one hand, the irrational production and behavior of humans will exacerbate the occurrence and hazard of flood disasters; on the other hand, the imperfections of the prevention system and the backwardness of disaster prevention technique will bring great difficulties in flood control, thereby increasing the economic loss due to floods.

A large area of barren hills and wasteland is reclaimed, forests are generally overexploited, and forest resources continue to decline; the confusion and influence cut is increasingly fierce; soil erosion is serious, one party controls multidestruction, the damage is greater than the control; people construct without authorization, and randomly dump solid waste and garbage, and encroach on flood walkways, largely ruining rivers, and sand excavation becomes out of control in rural areas. The ecological environment of major river basins is still worse; the unreasonable production and living behavior no doubt causes a serious imbalance in the ecosystem's input and output, increasing the chances and dangers of disasters [1].

The construction and improvement of the flood disaster control system is the main favorable measure and mean. A lot of work has been done every year in China for prevention and control of flood disaster monitoring and forecasting, but the system is still not perfect. In China, there are seven departments in charge of disasters and over 510 million observation stations. Over 1 million people take part in the system. At present, 95 % of the counties (cities) in the Yangtze River area have established the flood control and drought relief agencies; the commander is served by a deputy chief of the county (city), the number of actual staff is very small. At present, the standards of water conservancy projects against floods are generally low, they can only generally resist the small flood in a large number of small and medium-sized rivers, and the medium flood will be flooded and bring damage. The scope of disaster service is small and it is of low quality and cannot guarantee the continuity of the work of flood control, we lack systematic mastery

over the dynamics of flood disasters, and it is unable for us to carry out a comprehensive prevention and control. Together with the severe destruction of hydrological facilities and the relatively backward hydrological forecasting and flood warning system, the data of irrigation and water conservancy before and after the flood are difficult to accurately reflect and connect, and all of these bring many unfavorable effects to flood prevention [2].

29.2 The Flood Emergency Program System Design

Flood disaster information involves multisource remote sensing data, vector data, DEM data, and other data types. It has a very large amount of data, so the data management of flood disaster assistance decision support system needs to be established and database to be configured. To develop the database management, subsystem module can achieve the basic operation of the data, such as data warehousing store, browse, query, retrieve, etc., in order to achieve a unified, efficient management of the spatial data and provide an effective solution for spatial data organization and management.

According to the data sources and business requirements, we can design several databases; the realization of spatial database management module includes the following aspects: (1) the main interface of the database management system adopts the menu-driven way to realize structure. (2) Flood database management system mainly includes data warehouse storing, editing, browsing, data query, and other operations.

After the flood inevitably occurs, the post-disaster emergency relief is very important; how to make the greatest degree of defense in the shortest possible time is a key measure of flood control system. In this paper we are talking about the “Preparedness averts peril”. The flood is very destructive and very often there are momentary outbreaks of flood; however, in a scientific, secure, and strict control system, we can fully set a sufficient number of emergency program reserve models. When the disaster is a gradual process, we can use the results of analysis subsystem and monitoring system for the response of the model, and call out the corresponding model, thereby taking action as “acting according to actual circumstances”, and there will be adequate response time for us to do a good job of disaster defense. In emergency program system design, the main job is to design emergency program models. There are some correlations between the models in a flood disaster and there may be a variety of programs; we can choose the best option, or combine the use of several programs. We can take one program as the first program and take the others as auxiliary programs. The establishment of an emergency program model also results from the consolidation of several factors. In an emergency, we should minimize flood losses for personal safety; the protection of human life is the primary task of flood control, next comes the maintenance of farmland and other properties; after all of these have been done well, the step to

consider the sum of the inputs of human, material, and financial resources can be considered, which the program requires.

Emergency alarm mechanism comprises the emergency report mechanism, the internal emergency alarm mechanism, the external emergency alarm mechanism, and reporting. Its form is from bottom to top and from inside to outside; it forms an ordered network emergency alarm mechanism. (1) Emergency report mechanism, after accessing the highlighted features of dangerous source through the hazard identification system, report to the person-in-charge of the on-site emergency headquarters (work area). First, the person should immediately report to the emergency headquarters and quickly activate emergency plans. (2) Internal emergency alarm mechanism, after the start of the emergency plan, the on-site emergency headquarters should sound the reaction alert. Through telephones and cell phones the on-site emergency headquarters should notify the related staff and all the staff at the scene about the accident to enter into the emergency response status. The emergency response organization should get into the emergency plan and emergency plan implementation state. (3) External emergency alarm mechanism, which starts at the same time that the internal alarm mechanism starts, immediately start the external emergency alarm mechanism according to the deployment of the emergency headquarters, and alarm the project department in the adjacent work area, the surrounding built-up external emergency response collaboration system, and the social and public relief agencies [3].

29.3 The Improvement and Operation of Integrated Decision-Making System

The final operation of the system is shown in Fig. 29.1. Generally speaking, the system makes full use of multiplatform satellite remote sensing data, supported by geographic information system and satellite network communication technology, establishes the environment and flood disaster monitoring, disaster simulation, disaster assessment and mitigation, disaster relief auxiliary decision support systems, and puts them into operation to provide services, this mainly includes the following steps. (1) Environmental monitoring. Provide the environment state data whenever needed, use the latest remote sensing information to dynamically monitor the situation of vegetation cover, changes in water, land degradation, and provide the analysis report of environmental conditions' developing trend. (2) Flood disaster monitoring and loss assessment. Real-timely monitor floods and make rapid assessment of disaster losses. (3) Flood disaster simulation and disaster mitigation and relief measures. Make use of computer simulation technology to do simulation display of floods of areas with high frequency of floods, forecast the trend of development of the disaster that may occur under different conditions, provide computing program of disaster prevention, mitigation, emergency relief measures, and disaster recovery. (4) The operation of the system. Establish the

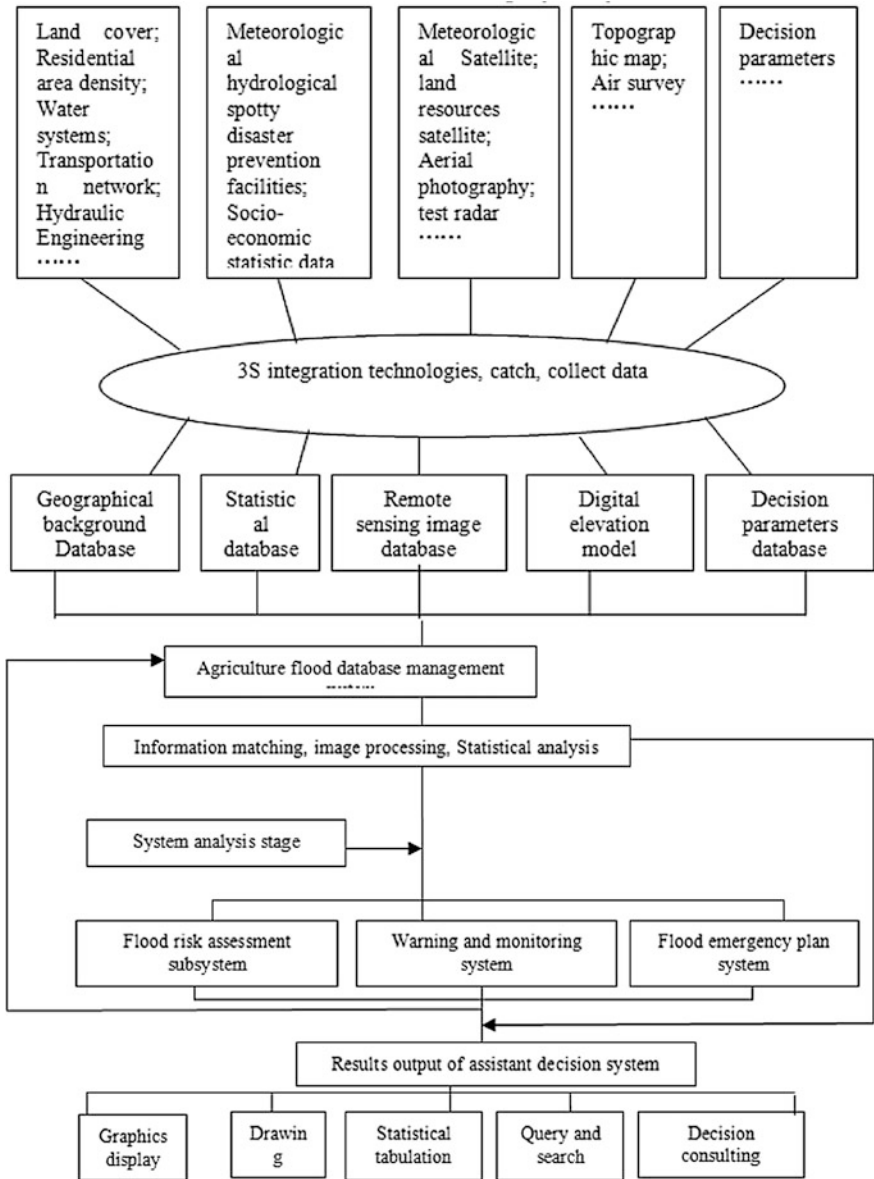


Fig. 29.1 The improvement and operation of integrated decision-making system

operating service system which can achieve the above objectives and is with stable performance and easy to use and scalable, the operation of the system consists of four modules: (1) Satellite data receiving and pretreatment. Making use of remote sensing techniques (including the NOAA satellite images, TM photo, and synthetic aperture radar images, if necessary, supplemented by airborne remote sensing

photos) to receive and preprocess the satellite data. (2) The human–computer interaction interpretation of floods. Finally, form the extraction of area of the affected range and automatic generation of area data. (3) The loss assessment of flood disaster. It includes the compound analysis of ground land types, the automatic generation of various types of land inundation data. (4) The edition and network transmission of floods' inundation data and graph reports.

29.4 Conclusions

Prevention is always, no matter what kind the disaster is, the most important thing in the construction of agricultural flood disaster assistant decision system. To make flood prevention play its role and to minimize the risk and the loss is actually the maximization of system functions. Here, we would like to stress that only through the unity of these three aspects can we achieve the above optimal preventive effect, i.e., the information is collected comprehensively and accurately, the decision making system runs steadily and safely, and the human and materials flow effectively. If the statistical information is not adequate enough and timely and precise, the entire system operation will be nonsense because of the distortion of information. The integrity and security of the system operation is the most important part which should be considered in the construction of decision making system. The system includes massive databases, analysis subsystems, early warning mechanism and emergency mechanism, and so on. Its speed and safety and science of running and responding is directly related to the decision-making results. If its network gets attacked such as hacker attack and nonnetwork physical attacks in the process of running, the whole system will lapse into a state of congealment. The flow of persons and materials is the terminal part of executing the entire decision-making system, because natural disaster is always more or less inevitable. When we act according to the situation in flood control, the requirement for the efficient flow of persons and materials is very high; an efficient decision-making system must be matched with an efficient terminal part. In this way, the decision can be ensured to be executed and implemented very well. The above three aspects are not separated; they are interrelated and are mutually conditional. If these three areas are effectively unified, then we can ensure that the prevention decision-making system runs well and then ensure the optimal preventive function of the system [4].

Hi-tech modern information technology is a sharp blade in the process of civilization in the new era with its dynamic, unbounded delimitation and extension. It is combined with agricultural flood disaster prevention to establish the data sharing and multilayered business collaboration unified agricultural space decision support system which has great effectiveness. The development of 3S integration technology and intelligent systems and programming techniques provides long-term power and guarantee for the development of the agricultural flood spatial decision support system, so we should pay more attention to the timely update of

the technology applications and the innovation theory in agricultural decision support system. The technology-centralized agricultural disaster decision-making system can minimize the risk of flood hazard to reach the purpose of flood prevention and flood control.

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Chapter 30

Study of Collaborative Learning Based on Blackboard e-Education Platform

Mei Zhang, Jianjie Du, Xiangfei Guo and Xiaoli Huang

Abstract Collaborative learning in network environment is the product of the combination of collaborative learning and networking technologies. It aims to create a pleasant teaching environment, and to guide student's communication, collaboration, and common progress. In this study, an exploration was made on Blackboard platform-based collaborative learning. Collaborative learning model and evaluation system were designed and applied to public class medical information retrieval teaching. Functional modules' use of Blackboard e-education platform was investigated, and 200 students were randomly selected to make a questionnaire survey about network collaborative learning. The results showed collaborative learning model achieved good teaching results. Group pages, discussion board, and communication region were function areas in Blackboard e-education platform most commonly used.

Keywords Blackboard e-education platform · Collaborative learning model · Questionnaire survey · Interaction analysis

30.1 Introduction

With the rapid development of modern teaching techniques and the deepening of information technology in education, one of the most widely used educational software, Blackboard e-education platform (hereinafter referred to as BB platform), is selected as a carrier of information construction by many of the

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world-renowned institutions and universities. Meanwhile, exploration of effective teaching methods and strategies to make network teaching platform and network programs to play the biggest role in teaching practice in the university, is of widespread concern.

30.1.1 Web-Based Collaborative Learning

Web-based collaborative learning is a new kind of collaborative learning built on the basis of modern electronic information and communication technology [1]. Compared with other instructional media and environment, collaborative learning in the network environment has certain advantages in scenario creation, resource providing, communication, and interaction [2]. Web-based collaborative learning includes four basic elements: the collaborative group, mentor teachers, teaching resources, and learning platform and tools [3].

30.1.2 Blackboard e-Education Platform

BB platform developed by the U.S. Blackboard Inc comprises four independent functional modules, namely course content, online communication, assessments, and system management [4]. With this powerful network learning platform, teachers can manage courses, produce teaching content, arrange learning task and homework in order to complete the teaching objectives better; while students can easily join online learning, learn collaboration and communication, submit homework, and give online examination, so as to achieve the goal of education reform and personnel training.

30.2 Construction of Collaborative Learning Model

According to the requirements of collaborative learning and the features of BB platform, we designed a collaborative learning model based on BB platform and applied it to medical information retrieval teaching. This learning model comprises four parts, tasks arrangement, group collaboration, achievement exchange, and evaluation system.

30.2.1 Tasks Arrangement

Teachers analyze the teaching objectives and priorities, based on students' learning characteristics to determine the collaborative learning task, and select appropriate teaching strategies. After that students should be grouped. If the team

members have a close and friendly relationship, it would contribute to the formation of mutual dependencies. At the same time, teachers must also take into account the complementarity of the various capacities of students [5]. Thus, the grouping strategy was free association based, taking into account students' abilities and gender differences. Five to six students would be in each group which was conducive to improve learning outcomes [6].

The "team management" tool of "User Management" in BB platform could be used to group students. Many functions, such as group file exchange, group discussion board, group virtual classroom, and the group e-mail would be available to each group.

30.2.2 Group Collaboration

In the group collaboration process, teachers designed appropriate teaching and learning activities based on collaborative learning tasks. Students should have collaborative learning together to complete the proposed tasks in accordance with the activity arrangements designed by teacher [7]. Communication tools in BB platform, such as notification, chat rooms, virtual classroom, forums, and e-mail, could be used to achieve the communication between teachers and students, or communication among students.

Teachers had to supervise and guide the entire process of students' learning. In addition to viewing the history of chat rooms, virtual classrooms, and the forum, the BB platform course Statistics function can also be used to get detailed statistics of each student in the learning process. Teachers should be on students' collaborative learning guidance, via e-mail, replying to the posts, messages, etc.

30.2.3 Achievement Exchange

In order to achieve the teaching objectives, every student must separately complete the teacher assigned learning tasks, and upload their homeworks. The homeworks of the members should be compared and analyzed in the team, after the modification, final team homework would be uploading. Finally, the teams should use PPT courseware to exchange their learning achievements in the classroom [8]. All team members need to share the results of their learning with other students, and listen to the opinions of students and teachers, to make it better until the final results. At the same time, the students should seriously study the learning outcomes of other groups, and give a fair evaluation.

In the achievement exchange process, the "virtual classroom" tool of BB platform could be used to upload PPT, online browsing and text chat which improved the timeliness of the exchange.

30.2.4 Evaluation System

Appropriate learning evaluation system was designed on the basis of objectives, tasks, and processes of learning activities. In addition to the evaluation of teachers, also need to refer to the individual self-evaluation, the group's self-evaluation and mutual evaluation [9]. BB platform has detailed records of students' learning time, access to course content, participation in discussion, etc. [10]. Teachers can easily make a fair, scientific, and accurate evaluation on the students according to the data presented by the BB platform. Collaborative skills score, individual score, and final examination score together constitute the final results of students.

Collaborative skills score was based on the situation of students' discussion in BB platform and classroom. The team members' individual score was calculated in accordance with the following formulas [11]:

$$\text{(Individual self-evaluation and mutual evaluation score)} * \text{Team score} = \text{Individual score}$$

$\frac{\text{Average score of the individual's self-evaluation and mutual evaluation}}{\text{Average score of all members self-evaluation and mutual evaluation within the group}} = \text{Individual self-evaluation and mutual evaluation score.}$

$\frac{\text{Average score of other teams assessment and teacher's assessment}}{\text{Team score}} = \text{Team score.}$

For example, one team of five members got 87 points for team score. The letters A, B, C, D, and E were used instead of the five students. Evaluation results were listed in Table 30.1.

The statistical data in Table 30.1 show that although the team score is 87 points, but the final score of each member in the team is not the same. The difference between the highest score and the lowest score was 4.6 points. This is to some extent, to ensure fair and accurate score.

30.3 Questionnaire and Data Statistical Analysis

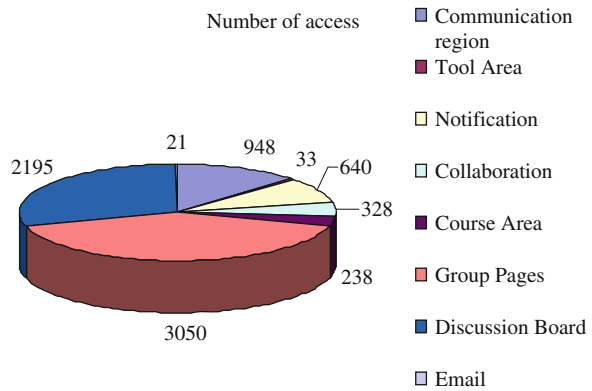
At the end of the semester, by sample survey method, 200 students were randomly selected to make the questionnaire in order to learn the effect of network collaborative learning and the problem encountered in the learning process. Meanwhile, by using the statistical functions of BB platform, large amounts of data were analyzed to get information of learning time, number of access, discussion, etc.

The survey results showed that compared to traditional teaching, fewer opportunities for students are present to participate in online collaborative learning. Most students hold a positive attitude on collaborative learning based on Blackboard e-education platform. Within the scope of the investigation, 82 % of the students thought the collaborative learning model can better facilitate their learning. More than half of the students expressed that they were willing to use BB platform to assist learning and satisfied with the assisted learning features of BB

Table 30.1 Evaluation results of the team members

Evaluator	A	B	C	D	E	Average score	Individual self-assessment & peer assessment score	Individual score
A	83	79	84	80	79	$405/5 = 81$	$81/82.96 = 0.976$	$0.976 \times 87 = 84.9$
B	80	82	87	85	81	$415/5 = 83$	$83/82.96 = 1.0004$	$1.0004 \times 87 = 87.0$
C	86	85	84	87	85	$427/5 = 85.4$	$85.4/82.96 = 1.029$	$1.029 \times 87 = 89.5$
D	81	84	86	82	80	$413/5 = 82.6$	$82.6/82.96 = 0.995$	$0.995 \times 87 = 86.6$
E	83	85	81	83	82	$414/5 = 82.8$	$82.8/82.96 = 0.998$	$0.998 \times 87 = 86.8$
A + B + C + D + E						$414.8/5 = 82.96$		

Fig. 30.1 The number of access of BB platform function areas



platform. 93 % of the students thought teacher’s guidance was also needed in network collaborative learning. 83 % of the students expressed that they were willing to exchange their views with other students, but 22 % of the students pointed out that their learning outcomes had been copied in collaborative learning process. This means some students did not have active thinking in collaborative learning process. Group Pages, Discussion Board, and Communication Region were function areas in BB platform most commonly used by students in their collaborative learning (Fig. 30.1).

30.4 Conclusion

Teaching practice in medical information retrieval course with group collaborative learning model achieved good teaching results. This teaching model based on modern network information platform not only enriched the form of classroom teaching but also provided a new platform for independent learning of students. Compared to traditional teaching, collaborative learning based on BB platform has obvious advantages, as follows: First, group discussions, consultation, and mutual cooperation can help to strengthen the analytical capacity of learners on specific issues, and effectively promote the development of independent learning and collaborative learning ability [12] and develop students’ team awareness and communication interpersonal skills. Meanwhile, the division of labor is conducive to students’ individual strengths, confidence increase, and a sense of accomplishment [13]. Second, the group discussion can be an active classroom atmosphere, increasing students’ interest and self-learning ability. Third, the production of PPT courseware and using network tools to search online information can broaden students’ knowledge, help them be familiar with modern network technology.

There are some problems to be resolved, although the collaborative learning based on BB platform has many advantages. First, teachers will face greater

challenges, they must learn to use a variety of network tools and have heavier workload. Second, for students, individual members do not actively participate in the discussion and collaborative learning activities; they cannot complete the learning task by their own, but copy other students' learning outcomes. Some students fear of hardship and cannot always maintain a positive and serious attitude in the learning process. These problems need to be overcome in teaching process.

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Chapter 31

Research on Ideological and Political Education in Universities Based on SWOT Analysis Technology

Binghui Liang

Abstract In recent years, due to some factors, major events happened in China and the nonpeace international environment. Governments at all levels have increased the intensity of management in ideological and political education, and take advantage of the country's current major event in the development of mining and analysis research. They take all kinds of effective measures to promote the improvement in quality of ideology and politics. This paper first introduces the present situation of Chinese universities students' ideological and political education, then analyzes the necessity and importance of Chinese universities students' ideological and political education from China's country nature. Then, based on the SWOT analysis technology, the qualitative and quantitative analysis research has been done on the ideological and political quality of Chinese university students. Finally, the results show internal factors of score of 0.65 points and external factors of score of 0.35 points. Thus, we can assume the conclusion that the key to Chinese people's own ideological and political quality education is to form a correct world outlook on life and values in the process of promoting universities students' ideological and political quality of education.

Keywords Universities students · SWOT technology · Qualitative analysis · Quantitative analysis ideological and political system

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31.1 Introduction

Currently, the major responsibility of ideological and political education is to guide people to establish a correct outlook on life, society, and values [1]. However, as a global network of information resources sharing platform, all cultures, all kinds of ideas, the formation of contending with the phenomenon, including part of the cultural and ideological nature may not be suitable for China's basic national conditions, and not suitable for the contemporary socialist social people's outlook on life in the formation of social concepts and values. Western developed countries deliberately use advanced IT to advocate for the socialist country's political and economic inadequacies, rumor-mongering propaganda the bourgeoisie in order to grasp and use advanced science and technology, and vigorously promote the political, cultural, and social values of the bourgeoisie, strongly defamation and false charges against the socialist political, economic and cultural systems to oppose the promotion of a harmonious socialist society, respected system of money worship, individualism, and hedonism [2]. With the passage of time, cause would be a socialist country people's psychological distorted views which cannot establish the correct outlook on life, society and values, so that the socialist countries, causing broken the hearts of beautiful ideals and beliefs and understanding the real-life distorted popularity of the ideological and political education and promotion, cannot effectively improve the level of ideological and political quality of the people [3]. Based on the SWOT analysis, this paper makes a qualitative and quantitative analysis of China's ideological and political quality of education, detailed and comprehensive analysis to increase the advantage of the ideological and political education, weaknesses, opportunities and threats, and other factors, can be drawn, the impact of ideological and political quality internal factor score is 0.65 points, and the external factor score is 0.35 points.

31.2 The Present Situation Analysis on Chinese Universities Students' Ideological and Political Education

Reform and opening up of the socialist modernization construction opened up a broader space, especially China science and technology education and continuous development of the cause, for students in the ideological and political aspects of healthy development has provided more favorable conditions. Chinese contemporary universities students' living in the great period of reforming and opening; they love the party, love the motherland, love the people, love socialism, uphold the party's theory and policy, lofty ideal, the courage to self-reliance, full spirit of exploration, willing to accept new things, to adhere to the path of socialism with Chinese characteristics, implementation builds comparatively well-off society in the round and the grand goal of full of confidence. Chinese universities students' ideological and political status of the mainstream are positive, healthy, and

upward [4]. However, in the development of the socialist market economy and opening up under the conditions, the idea culture surges mutually in the environment, students' ideological activities of the independence, selectivity, variability, diversity increases apparently, and subject to various ideological and cultural influences increased significantly.

31.3 The Importance of Ideological and Political Education

31.3.1 National Nature of China's Decides the Ideological and Political Education System

The main purpose of the ideological and political education is to improve the universal ideological and political improvement of the quality; the ideological and political qualities include the following aspects: the most important belongs to the cultural qualities and physical and mental qualities to improve, because as long as a person has a good cultural quality and healthy physical and mental qualities, in order to make some contribution to society, and cultural qualities and physical and mental qualities are the basis of guarantee, equivalent to consolidate the fundamental role; followed by the professional quality, on the basis of the cultural qualities and physical and mental qualities, and a certain professional quality, just as a technology to create wealth and value; Finally, the quality of innovation, innovation is the soul of a nation, a nation of the spirit of innovation, cannot stand in the ranks of a great nation, only the quality of innovation in order to new blood, new power and soul of a nation, as is shown in Fig. 31.1 [5].

Fig. 31.1 Contents of the ideological and political quality



31.3.2 *The Necessity of Ideological and Political Education*

The effect investigation of ideological and political education of responsibility is to guide students to establish correct outlook on life and social values. In today's society as a global network of information resources sharing platform, a variety of cultures, ideas, formed the phenomenon of contention of a hundred schools of thought, which includes a part of culture and thought; in essence, they may not be suitable for China's basic national conditions, and not suitable for Contemporary Universities Students' outlook on life, social values, and values formation; in addition, with the western developed countries with advanced information technology to the temptation of deliberate disinformation propaganda universities, only the bourgeoisie to master and use advanced science and technology, advance energetically bourgeois political, cultural and social values, to slander and framed by a socialist political, economic and cultural system, against promoting socialism harmonious society, money worship, praise individualism, and hedonism system. With the passage of time, in the course of time, will the students' psychological cause distorted views, so that students can correctly establish outlook on life, social values and the values, resulting in their heart broken and the ideal and faith of distorted understanding of real life. In the state of Ideological and political education, on the basis, first of all to promote ideological and political education of universities students', universities students' are the future hope of the motherland, the motherland of the builders and creators must ensure the right positive political thought. Figure 31.2 reflects the Chinese universities students' Ideological and political education on Universities Students' political consciousness influence.

31.4 SWOT Analysis of the Ideological and Political Education

31.4.1 *The Establishment of SWOT Matrix*

China is a socialist country which belongs to the large developing countries. In order to ensure and increase the long-term stability, the long-term efficiency of

Fig. 31.2 The investigation of the effect on universities students of ideological and political education

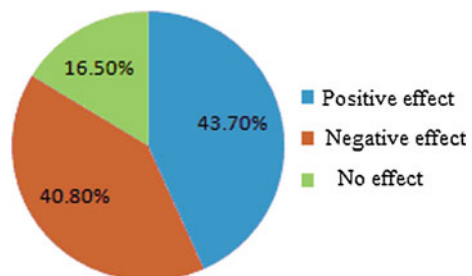


Table 31.1 SWOT analysis matrix of the ideological and political education

Internal strengths (strength)	External weakness (weakness)
S1. Countries of socialism with Chinese characteristics	W1. Capitalist countries of the sugar-coated bullets of temptation and impact
S2. Influence of developing countries, third world, and the international status of	W2. Some party members' ideological corruption, the advanced nature of Party members
S3. The essence of the long history and culture of Chinese civilization	W3. Foreign economic, political crowding
S4. The guiding ideology of the Marxist ideological	W4. The international situation, temporary instability, and unstable
S5. Mao Zedong thought, Deng Xiaoping theory and the important thought of three	W5. Due to economic factors, the quality of their own cultural level is not high
<i>External opportunities (opportunity)</i>	<i>External threats (threat)</i>
O1. Countries further ideological and political education system	T1. Ideological and political education system is imperfect
O2. Countries adhere to the expansion of economic development policy	T2. Ideological and political education is not complete
O3. State has increased the political construction and investment	T3. Foreign capitalist ideologies
O4. International and domestic political contacts and close ties	T4. Our geographical constraints, most of the region is difficult to accept advanced ideas
O5. Advancing with the ideology of Marxism and Mao Zedong thought, Deng Xiaoping theory and the important thought of three represents and sustainable development strategies	T5. The vestiges of feudalism thinking

China's economic and political growth must be based on China's national conditions: to make greater efforts to improve the current situation of China's ideological and political level, to promote comprehensively improve China's comprehensive ideological and political quality play a socialist country advantages, weaknesses, seize the development trends of the international economy at the same time, and seize the opportunity [6]. This thesis is based on the SWOT analysis method, the implementation of China's ideological and political education for qualitative and quantitative analysis is to establish the following method of combining analysis and research, Table 31.1 shows the SWOT analysis matrix.

31.4.2 Determine the Weights of the Various Indicators

After the establishment of China's ideological and political education of the SWOT matrix, in order to more effectively demonstrate the various factors, the promotion of China's ideological and political education must be analyzed from a quantitative point of view. To this end, invite the experts in the field of ideological and political importance of scoring, while 2, 4, 6, 8, and 0 represent different

degrees of influence, can be expressed as: “unimportant”; 4 is expressed as “less important”, expressed as the “General”, expressed as “more important” as “important”, the expert score, we use the theory to analyze, you can use the formula for each indicator, 0 the calculated standard deviation of S_j , M_j and opinions of the arithmetic mean of the coordination degree V_j [7]. We can use the formulas (31.1), (31.2), and (31.3) to calculate each indicator [8].

$$S_j = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (X_{ij} - M_j)^2} \quad (31.1)$$

$$M_j = \frac{1}{n} \sum_{i=1}^n X_{ij} \quad (31.2)$$

$$V_j = \frac{S_j}{M_j} \quad (31.3)$$

The significance of each equation is: X_{ij} expert importance score of the j index value. Under normal circumstances, when $M_j \geq 6$ and $V_j \leq 0.5$, the indicator of the filter was left, that is, taking into account the impact factors. The various factors of the above indicators with the importance of scoring and classification, were given a score to determine the weight of each indicator of the impact of ideological and political education to promote. Carrying out the ideological and political education indicators pair wise comparisons, after the scoring of a number of experts, all of the above indicators to meet the requirements are taken into account, which is the affect of raising the level of ideological and political quality of education, which can be applied to the analysis of the paper. General Saaty proposed a rate of 1–9 scales.

Through the input analysis and expert-level analysis software yaahp 4.0.1 scoring results, the largest eigenvalue by the software, you can get the weight of every ideological and political education indicators. Meanwhile, the use of formula (31.4) can be used to calculate and analyze the SWOT analysis matrix factor weights [9].

$$X = \sum_{i=1}^n (O_i \times W_i) + \sum_{i=1}^n (T_i \times W_i) \quad (31.4)$$

31.4.3 The Computational Results Analysis

Combining various factors affecting the index weight and expert scoring, we can get all kinds of factors in the evaluation of form, which are as shown in Table 31.2.

Table 31.2 Internal factors assessment matrix of ideological and political education

Internal factors	Weight	Assessment value	Overall assessment value
<i>Strengths (S)</i>			
S1. Countries of socialism with Chinese characteristics	0.1039	4.83	0.50
S2. Influence of developing countries, Third World, the international status of	0.0829	4.76	0.39
S3. The essence of the long history and culture of Chinese civilization	0.0467	4.00	0.19
S4. The guiding ideology of the Marxist ideological	0.0829	4.67	0.39
S5. Mao Zedong Thought, Deng Xiaoping Theory and the important thought of Three	0.0584	4.17	0.24
Total	0.5		
<i>Weaknesses (W)</i>			
W1. Capitalist countries of the sugar-coated bullets of temptation and impact	0.0473	-2.33	-0.11
W2. Some party members' ideological corruption, the advanced nature of Party members	0.0522	-2.83	-0.15
W3. Foreign economic, political crowding	0.0438	-2.17	-0.10
W4. The international situation, temporary instability, unstable	0.0905	-4.00	-0.36
W5. Due to economic factors, the quality of their own cultural level is not high	0.0741	-3.17	-0.23
Total	0.5		

From the above analysis, we can see that the impact of higher school ideological and political education is the main factor by: S1, S2, S4, W1, W2, W4; O3; O1, T2, T3, T5, according to the above table, when they reflect to a coordinate axis, we can get the ideological and political education system. We should chose SO to ideological and political education system selection and promotion.

We must vigorously improve universities students' scientific, cultural, and health quality, at the same time, we need to work hard to improve universities students' Ideological and political quality, guiding universities students to establish correct ideal and belief, enhanced political discernment, effectively preventing, and resisting hostile forces' Ideological penetration [10].

31.5 Conclusion

Ideological and political education is related to a country and a national political stability and security affects a country life and death, as the world's largest socialist countries, we must not compromise to capitalism, will always adhere to the Marxist guiding ideology, Mao Zedong thought, Deng Xiaoping theory and the important thought of three represents and the strategy of sustainable development,

and to intensify the ideological and political education in the investment, to ensure that socialist country people enjoy the results of the socialist and to form the correct outlook on life, society, and value.

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Chapter 32

Entrepreneurship Differences Between Chinese and Foreign Country Students Based on Logistic Model

Tao Xiong and Jianfeng Cui

Abstract Facing with severe employment pressure and students' own wills, some of the students chose to make their own businesses; it can be regarded as a viable means of employment. However, our students also have big problems not only from their own funding, experience, and limited capacity but also from lacking of supporting. How to solve these problems so that they can be avoided and overcome are the core problems we should pay close attention to. Foreign venture started earlier, and it is relatively mature and successful. This book wrote from the comparative perspective, analyses the difference between a Chinese University student and a foreign student in starting an enterprise in order to find out the difference between a domestic and an international university student. This kind of comparative analysis benefit our country's university students and make them take lessons from others experiences of start an enterprise, and the use of statistical models can help us to analyze and improve the university students entrepreneurship policy environment in order to realize the successful venture of our country's university student. Moreover, this kind of comparative analysis effectively solves the employment pressure and makes our country's students to realize their life goals.

Keywords University students · Entrepreneurship · Differences · Comparative analysis · Logistic model

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32.1 Introduction

At present stage, the employment situation is relatively grim; the University Students' innovative undertaking has also become a viable employment way [1]. At present, University gives a certain policy for students who want to start their own enterprise, but it still has many problems, such as lack of funds, poor operation, poor management, and other conditions lead to the loss of venture. Entrepreneurship itself is a hard work, not only to pay the money but also the energy, and even have to face a lot of puzzled eyes. How to sustain and have a stable development of entrepreneurship by fully using their own advantages under the country and the capital policy support is the problem that people should pay close attention to [2]. This book will analyze our students and foreign students by using the relevant data to make the quantitative descriptive statistics in order to find out the differences between domestic and foreign students. Then, find out the existing inadequacy in our country university students' innovative undertaking, and make up it by making full use of the resource optimization configuration, and learning experience, in order to achieve success in business.

32.2 The Situation of Chinese and Foreign University Students' Starting an Enterprise at Present Stage

Chinese University students' innovative undertaking at present is mainly in a relatively small size, relatively low technological content, and the pioneering consciousness is not very strong [3]. Due to lack of power, without good pioneering policy environment and cultural atmosphere, and insufficient support, the entrepreneurial success rate is not high. Although there are still about 65 % percentage of university students hoping to make their own business under employment pressure, but only less than 1 % students actually realize to start their own business. But in the foreign nations, student enterprise ratio has reached 25–35 %. Apparently in the Chinese entrepreneurial environment, the entrepreneurial success ratio is very low. The entrepreneurial success ratio of the international students can reach 20 %, but the situation of our country is not very hopeful. Although university student success ratio in Zhejiang province is the highest, the proportion is only 4 %. Guangdong province accounted for only 1 % proportion [4].

The entrepreneurial education in foreign countries started very early; pioneering consciousness infiltrated and influenced the college students. At the same time, foreign entrepreneurial education's curriculum is relatively reasonable, rich, and colorful. The interest of the class is also relatively high, and the rich resources of experienced teachers can give students practical knowledge, and they are also able to carry out an effective combination of theory and practice for the purpose of using. However, domestic entrepreneurial education is in a fledgling state, at present still in the examination-oriented education with teaching and the

employment disconnected; so it cannot make theory learning to be applied widely effective in practice. China's university students generally lack entrepreneurial awareness, even if they have pioneering consciousness and the current state and universities have a certain entrepreneurial support policy and funding. The enterprise itself is a long-lasting, time-consuming, labor-intensive, expensive stage, so this support is not enough. In such a competitive society, it also cannot allow students to involve in business all the time. Without enough money and effort, it is unable to achieve success in business.

32.3 Analysis on the Entrepreneurship Differences Between Chinese Students and Foreign Countries' Students

According to the results of research in Fig. 32.1, the university students' entrepreneurial desire is not very strong, normal accounted for the largest proportion, reaching 47.1 %, the second is more than normal who perform a little interesting in enterprise reaching 20.5 %, in the third row which is not very willing to participate in enterprise accounted for 14.3 % ratio, and students willing to participate in enterprise ratio is 9.6 %, which is less than 10 % [5]. Relatively speaking, with some enterprise willing university students accounted for only 30.1 %, which did not reach even half of the proportion, fully show that the students' pioneering consciousness is not strong, without enough motivation, and confidence to do business.

Figure 32.2 shows that the university student's innovative undertaking resistance factors are insufficient funds, limited capacity, lack of employee, no high technical content, weak policy knowledge, and lack of market information. In these factors, lack of funds is the main resistance, which reached the proportion of 29.1 and 21.5 % of the students think their own limited capacity lead to the inability to do pioneering work successfully, which is the second largest resistance. The third resistance is the market information, which is insufficient and accounted for 19 % of the proportions. The next is followed by the lack of high technical content which accounts for the proportion of 11.6 %. Relative to the lack of

Fig. 32.1 Analysis on the university students for the entrepreneurial desire

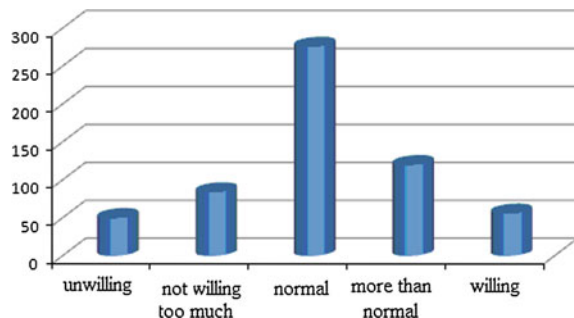


Fig. 32.2 University student’s innovative undertaking resistance factors

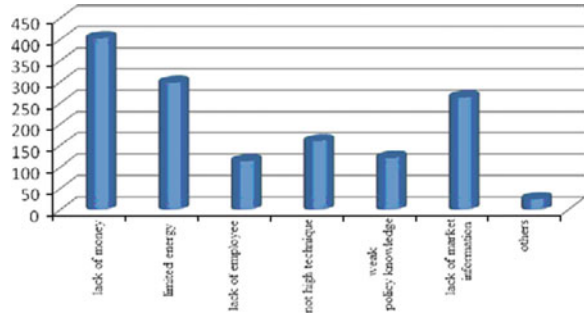
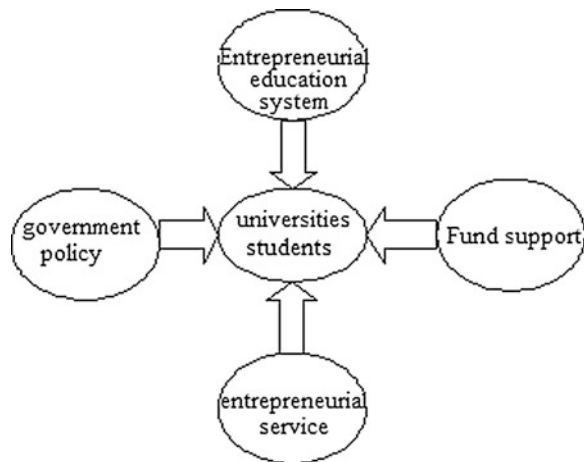


Fig. 32.3 Chinese university students’ entrepreneurial support system



employee and weak policy, although their proportion is not total, it accounts for a proportion of 16.8 %; so, we should pay enough attention toward that too.

Domestic students, in addition to their own limited capacity deficiency, mainly lack enough external support which is limited due to the less attention of the society and State [6]. As shown in Fig. 32.3, the domestic support system consists of entrepreneurial education, government policy, financial support, and business service platform, but there is a great lack of support and strength when compared to foreign students, who have a high percentage of hoping to start an enterprise and their entrepreneurial success rate is also very high. It is indicating that the foreign students are not only by themselves, but also by the external environmental conditions are able to meet the business needs.

Starting an enterprise in foreign is mainly divided into four stages: the first stage is before an adult, mainly for primary education, cultivating the students’ independence, and also establishing the positive enterprising consciousness. The second stage is after entering university acquiring the main teaching and enterprise practice; the major part of this is to cultivate the student’s management skills,

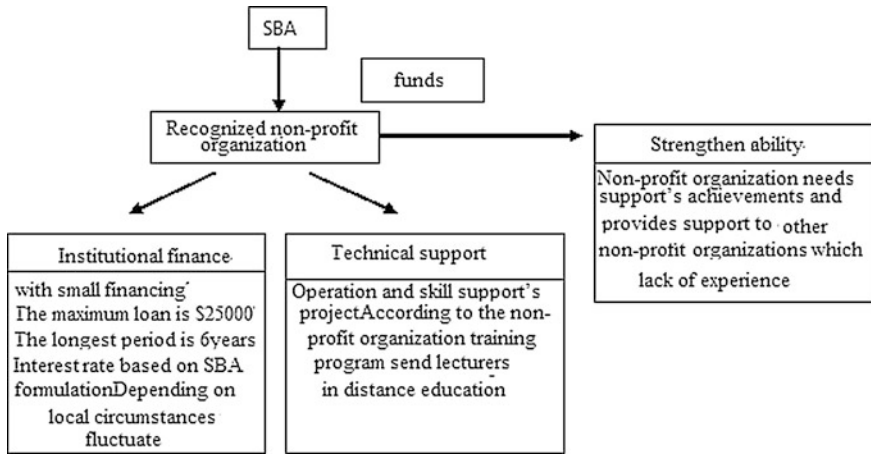


Fig. 32.4 The small and medium-sized enterprise support system in America

to form venture wishes and ideas. Then after that is the third stage, which allows usage of own funds to carry out business and also business education, and at the same time provides small loans and technical support. Then the last stage is the business expanding stage, financing, guarantee, and so on. Each stage has a relative support groups. As shown in Fig. 32.4, the business support system is very perfect, and it adopts a “school, government, folk” multiparty support system on financing, technology support, and capacity-building support.

32.4 The Evaluation of Students’ Entrepreneurship Abilities Based on the Logistic Model

Evaluation research on university student’s innovative undertaking is through the logistic model to establish a regression model, analysis of university students’ innovative undertaking resistance factors influence to successful venture, which can guide the society to make better efforts in these aspects, and serve the students better, and the most important is to create a better enterprise environment and atmosphere.

First, the definite and dependent variables of the distribution are X, Y . P is the probability of event which is generated under the following conditions [7]:

$$P(y = 1/x_1, x_2 \dots x_n) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 x_1 + \dots + \beta_n x_n)}} \tag{32.1}$$

β shows when the variable changes, the probability of event ratio does not have the logarithmic ratio.

In regression models, the need to obtain data for the following formula [8]:

Table 32.1 Evaluation and analysis entrepreneurial support system on university students venture based on the logistic model

<i>X</i> (<i>X</i> business support system)	<i>Y</i> (Students venture evaluation)		
	Degree of significance	Regression coefficient	Exponential value
The entrepreneurship education system	0.449	-0.067	-0.657
Financial support	0.038	0.198	2.229
Policy support	0.056	0.183	2.035
Innovation service platform	0.171	-0.132	-1.416

$$y_i = \beta_0 + \beta_1 x_i + \varepsilon_i \quad i = 1, 2, \dots, n \tag{32.2}$$

And get the corresponding value $\hat{\beta}_0, \hat{\beta}_1$ which is the estimation of β_0, β_1 , and determine the regression equation [9]:

$$\hat{y}_i = \hat{\beta}_0 + \hat{\beta}_1 x_i \tag{32.3}$$

At last $\sum_{i=1}^n |y_i - \hat{y}_i|$ or $\sum_{i=1}^n (y_i - \hat{y}_i)^2$ which needs to achieve the minimum with the residual value.

From Table 32.1, we can see that the largest significant value is entrepreneurial education system, with 0.449 in the support system. The second is the business service platform about 0.171, then the policy support, and the last is the financing support. But for the regression model, the entrepreneurial education system and the innovation service platform’s regression coefficient are negative, while the policy support and financial support are positive. The policy support and financial support as well as the entrepreneurship education system and service platform have significant influence to university students, but the entrepreneurial education system and platform needs to be used correctly, to fully give off its positive benefit without causing negative effect.

32.5 Conclusion

Chinese university students and foreign students are not only in the students’ own ability level, but in the government’s policy support, financing institution support, entrepreneurial education, and in the entrepreneurial service platform. There is a big gap, so these factors cause wide attention of society. At the same time, we need to effectively use the entrepreneurial education and entrepreneurial services platform, and should not act in a diametrically opposite way to cause negative effect. The society from all levels should strengthen the university students’ innovative undertaking attention and give them support, and also actively try to build pioneering culture atmosphere in order to make university students’ get into the entrepreneurial team, constantly find themselves, and continually show themselves. It also solves the employment problem, creating greater value for the community.

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Chapter 33

Teacher Abilities Evaluation Based on Gray Theory

Yong Liu

Abstract The young people are flowers in the future of China, cultivating good healthy, positive, and comprehensive talent to meet the needs of social development. In order to study the affect of teachers' Abilities students' learning in the teaching process, this chapter makes the analysis through questionnaire survey to the school teachers, students, and parents, on the basis of which screens to determine evaluation index of teachers' Abilities, by determining the dimension weight of teachers Abilities, quantitative analysis for the teachers' Abilities, thus using the gray level theory construct perfect evaluation system for teachers, to promote the teachers of school in the teaching process to make better use of their advantages for school teaching and improve teaching quality.

Keywords Teachers' abilities · Gray theory · Dimension weight · Evaluation system

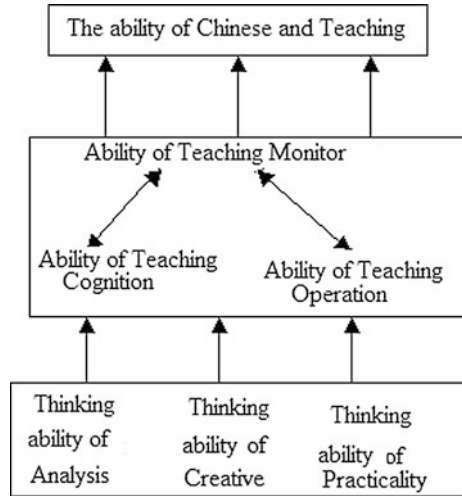
33.1 Introduction

With the promotion of reform and opening-up, economics in China is rapidly developing; at the same time China and the developed countries of the world are increasingly having frequent exchanges in recent years [1]. But with the development of society, China put forward the teaching model of quality education, while the tendency of education has slowly moved from “exam-oriented education” to

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Fig. 33.1 Relationship diagram of teaching Abilities



“quality education [2]. As development and promotion of the trend, obviously, teacher’s role has undergone subtle changes, before teaching simply the knowledge, teaching students how to deal with knowledge in each course exam, how to sum up effective knowledge, and conduct examination techniques. Now, teachers pay more attention to the teaching practice, how to lead students to think independently. Quality education is reformed in many aspects and it is boldly innovated in the quality of teaching courses, curriculum evaluation management and teaching effect evaluation, and other aspects, but also put forward new test and requirements for teachers. Teachers should change their idea, mainly cultivate students’ autonomous learning abilities and the abilities to create [3].

This paper carries analysis through the questionnaire survey from teachers in the school, students, and parents, on the basis of which screens to determine evaluation index of teachers Abilities, by determining dimension weight of the teachers Abilities, quantitative analysis, and study for the teachers’ Abilities, thus using the gray theory for teachers’ Abilities to construct perfect evaluation system.

33.2 The Importance of Teachers’ Abilities Evaluation to School Teaching

Figure 33.1 is the teaching Abilities diagram of quality education, reflecting the importance of teachers’ Abilities in the process of quality education [4]. Through the questionnaire survey, in the process of quality education, teachers should attach great importance to their level of knowledge and improve teaching practice to raise the level of students’ Abilities of innovation training. Thus, in the process of the quality education of school teaching, teachers should act as an organizer and

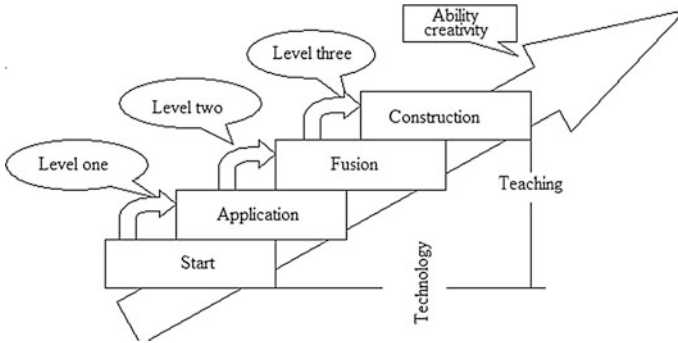


Fig. 33.2 Innovation flow chart of students' Abilities under the quality teaching

instructor, thus have the Abilities to develop students' Abilities of innovation. Specific is shown in Fig. 33.2 [5].

33.3 Model Establishment of Gray Theory

It is a subject of Applied Mathematics of studying the uncertain phenomena about part information which is clear or unclear, expression form of gray system prediction model is mainly differential equations, which reveal the continuous process of the effect for college students' ideological and political quality of surfing the Internet by mobile phone. This chapter uses the DPS software for analysis of gray forecast model GM (1, 1) [6].

Generating through the data sequence (33.1), accumulated, it obtains (33.2).

$$X(0) = \{x(0)(1), x(0)(2), \dots, x(0)(N)\} \tag{33.1}$$

$$X(1) = \{x(1)(1), x(1)(2), \dots, x(1)(N)\} \tag{33.2}$$

In equation,

$$X(1)(t) = \sum_{k=1}^t x^{(0)}(k) \tag{33.3}$$

To construct accumulated matrix B and constant vector Y_N , i.e.,

$$B = \begin{bmatrix} -\frac{1}{2}(X^{(1)}(1) + X^{(1)}(2)) & \cdots & 1 \\ \vdots & \ddots & \vdots \\ -\frac{1}{2}(X^{(1)}(N-1) + X^{(1)}(N)) & \cdots & 1 \end{bmatrix} \tag{33.4}$$

$$Y_N = [x^{(0)}(2), x^{(0)}(3), \dots, x^{(0)}(N)]^T \tag{33.5}$$

To use the method of least squares to solve gray parameters

$$\hat{a} = \begin{bmatrix} a \\ u \end{bmatrix} = (B^T B)^{-1} B^T Y_N \quad (33.6)$$

To put gray parameters into time function

$$\hat{X}^{(1)}(t+1) = \left[X^{(0)}(1) - \frac{u}{a} \right] e^{-at} \quad (33.7)$$

Reduction after derivation to $\hat{X}^{(1)}$

$$\hat{X}^{(1)}(t+1) = -a \left[X^{(0)}(1) - \frac{u}{a} \right] e^{-at} \quad (33.8)$$

To calculate the difference $\varepsilon^{(0)}(t)$ between $X^{(0)}(t)$ and $X^{(0)}(1)$

$$\varepsilon^{(0)}(t) = X^{(0)}(t) - \hat{X}^{(0)}(1) \quad (33.9)$$

33.4 Evaluation System of Teachers' Abilities

33.4.1 The Index Determination of Teachers' Abilities Evaluation

Teachers' Abilities evaluation is in accordance with a certain standard of value, describing activities of teachers' education and teaching and its related factors, and makes the corresponding value judgment. At present, giving the summative evaluation of teachers, whether the teachers master teaching Abilities or not are evaluation condition by the evaluation results, which is still the most important purpose of evaluation. The identification and differentiation function of teachers' evaluation is an indispensable link in education management, which guides teachers constantly to explore ways to improve teaching efficiency and quality through the feedback of the evaluation result, and gradually narrow the gap between the targets. Evaluation under the quality education should become the important means for teachers to improve work and progress quality. Figure 33.3 is the index system of Abilities evaluation for the teachers (Table 33.1).

The Abilities of teachers mainly refer to the activity of quality education and is the essential psychological characteristics of character in order to achieve the goal of teaching, which mainly refer to theoretical knowledge and practical skills in the education field. The main faculty includes Abilities of classroom teaching, cultivating students' innovation, and language expression for communication of the student or parent and some other aspects and so on. See Table 33.2 [7].

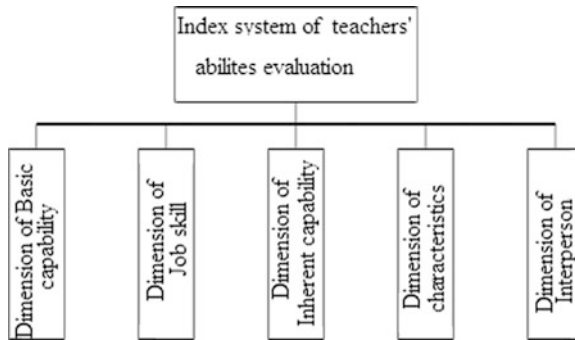


Fig. 33.3 Index system of teachers' Abilities evaluation

Table 33.1 Evaluation index of teachers' abilities

Index	Index description
B1	Knowing content of teaching activities and prepare the lessons carefully
B2	Choose the proper methods of teaching
B3	Abilities of integrating curriculum knowledge
B4	The overall control capacity on the teaching activities
B5	Design abilities of education activity
B6	The abilities to respond to emergencies
B7	With their aptitude, capacity of individual education in accordance
B8	Abilities of teaching reflection
B9	Broad knowledge and solid professional knowledge
B10	Win the trust of everyone
B11	Create a free, relaxed, healthy, and rich environment of life and activities
B12	To pay special attention to students in disadvantage
B13	Pay attention to the response students, and listen to the idea of students
B14	Objective, comprehensive evaluation of students
B15	Encourage students to actively explore
B16	Make the different developments according to the difference of students
B17	Be capable of transposition thinking
B18	Good at modestly consulting to colleagues
B19	Ready to help other teachers
B20	Share information resources with colleagues
B21	Correctly dealing with the relationship between colleagues
B22	Good at contacting with parent
B23	The capacity of creating activities environment according to the students' physical and mental characteristics
B24	Capabilities of integrating community resources

Table 33.2 Results of dimension

Capacity dimension	Index
Dimension one	Prepare lessons elaborately, teach students after understanding knowledge Study the suitable teaching mode With the overall capacity of the course Pay attention to coordination and plan in advance in the work Has a profound professional knowledge Have the abilities to innovate To create a good atmosphere in the classroom
Dimension two	According to the students' response to adjust teaching mentality and behavior Students can have a positive effect Pay attention to students' physical and mental health Advice, guide students who have problems in thought, psychology Good at discovering the merits of students Properly handle the relationship between teachers and students To enable students to develop their potentials

33.4.2 The Establishment of Capacity Dimension

According to evaluation index of teachers Abilities above, it can determine the capacity dimension of the different indicators. The indexes above can be divided into five dimensions, respectively standing for dimension one, two, three, four, and five. Details are shown in Table 33.2.

33.5 System Construction of Teachers Abilities Evaluation Based on the Gray Theory

By determining the dimension and indexes of teachers Abilities, calculating the corresponding weight ratio, it can make gray theory model of the teachers Abilities evaluation more scientific and reasonable. Through the application of gray theory model, the corresponding weights set is $A = \{A1, A2, a3...An\}$, in which the weights of a_i ($i = 1, 2, 3...M$) indicate the important degree in the index system, generally given by experts.

The evaluation matrix of single factor is [8]:

$$R = \begin{bmatrix} -\frac{1}{2}(X^{(1)}(1) + X^{(1)}(2)) & \cdots & 1 \\ \vdots & \ddots & \vdots \\ -\frac{1}{2}(X^{(1)}(N-1) + X^{(1)}(N)) & \cdots & 1 \end{bmatrix} \tag{33.10}$$

Comprehensive evaluation of the subgoal by type (1) is [9]:

$$\begin{aligned}
 B_{i-1} &= A_i B_i = (ai1, ai2, \dots, aim) \begin{bmatrix} -\frac{1}{2}(X^{(1)}(1) + X^{(1)}(2)) & \dots & 1 \\ \vdots & \ddots & \vdots \\ -\frac{1}{2}(X^{(1)}(N-1) + X^{(1)}(N)) & \dots & 1 \end{bmatrix} \\
 &= bi1, bi2, \dots, bin
 \end{aligned}
 \tag{33.11}$$

B is the set of gray comprehensive evaluation; bi ($I = 1, 2, 3, \dots, N$) is the index of gray comprehensive evaluation, namely evaluation index. Membership function is the foundation of fuzzy control application; properly constructed membership function is the key to use fuzzy control. Take the maximal evaluation index bj as the results of evaluation [10]:

$$V = \{vj/vi \rightarrow bj \max\}
 \tag{33.12}$$

According to the weight of each index given by the expert, we can obtain the matrix of membership degree.

33.6 Conclusion

Quality education is that mainly propose certain requirements to teacher, not only meet the students' theoretical knowledge in the school teaching. What is more important is to cultivate the students' spirit of innovation, knowledge learning, and Abilities of practice, pay attention to the harmonious and healthy development to students in the process of education, respect the students' individualization of learning, not erase the creativity of students. Based on the construction of teacher evaluation system, it can provide effective reference in the process of quality education. Teachers are organizers by guiding students to innovate and must possess professional knowledge and interpersonal skills.

Acknowledgments This chapter belongs to the static achievements of two foundation projects. One is the ideological and political issue of 2011 Party construction in Huaihai Institute of Technology with the name Research on the performance evaluation and accountability mechanisms of political instructors' position from the perspective of constructing the harmonious campus and the Project number DS2011051. And the other is the key project of Education creativity in Huaihai Institute of Technology with the name Research on The Strategy Research on the necessity and approach of improving the accomplishment of teachers in constructing the harmonious campus and the Project number S2009030.

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Chapter 34

Human Resource Management Strategy in Corporate Social Responsibility

Hui Yu

Abstract Corporate social responsibility (CSR) is the necessary part of an enterprise as its primary task. A long-lasting enterprise needs to do it. Therefore, there is an organic combination between the creation of the social responsibility sense and the human resource management (HRM) strategy. With the HRM strategy, every employee will firmly create the social responsibility sense. As long as the enterprise does it consistently, the employees will invariably unify social responsibility with the enterprise's profit and their personal interests to realize the mutual overall success.

Keywords Human resource management • Strategy • CSR

34.1 Introduction

With social and scientific advancement, corporate social responsibility (CSR) is a hot topic in the eyes of all in all walks of life [1, 2]. There are terrible events such as the Chinese toxic baby milk crisis, ZiJin copper ore-polluted water linking crisis in the mining industry, BP Global's Deepwater Horizon explosion and oil spill in the Mississippi Canyon, and so on [3]. The focus on CSR seems to be a smash hit.

To hold social responsibility and protect the interests of employees is the inevitable requirement of enterprises. How to resolve the contradiction between increased cost of holding social responsibility and getting more profit for enterprises? This problem must be solved urgently [4, 5]. To formulate the

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corresponding Human Resource management (HRM) strategy from the perspective of corporate social responsibility and promote the level of HRM is the key point to solve the problem [6].

So far, the global study on CSR and HRM shows the CSR impact on the HRM and the concrete shifts for the HRM to hold the CSR [7, 8]; however, there are rare studies on what strategy of HRM is made by an enterprise to realize the combination between CSR and enterprise profit.

What are the special requirements in modern society that each enterprise can hold the social responsibility? This chapter points out the social responsibility of enterprises, and on the basis of those theories, analyzes the relations between CSR and HRM. It is claimed that the HRM strategy, the construction “corporate social responsibility” includes three parts: The rebuilding of modern human resources consciousness, strengthen corporate social responsibility consciousness, and innovation of management.

34.2 Corporate Social Responsibility

Although there are numerous expectations and explanations from different countries and enterprises about CSR, the core of this concept is the transmission of one firm from just interests’ pursuit to enterprise’s citizen obligations, such as ER awareness, environmental protection, and so on. The concrete performances are the appropriate requests of the related profit groups:

For shareholder, it protects the profit, and increases the rate of the capital investment return.

For employees, it fulfills the appropriate interest needs of each employee as a social person, and provides a safe and healthy working environment, fair and honorable pay, and training opportunities to promote their ability of employment.

For customers, it supplies products or service at low price and high quality to raise the convenience.

For communities, it actively participates in activities, and has the responsibilities of creating employment opportunities and environmental protections.

For government, it pays tax on regulations, and also participates in charities raised by the government.

For the partners, it uses the mutually beneficial principle for the behavior to aim at corporate development.

For the competitive rivals, it insists on the equal competitive rule, and not in illicit ways to take advantage of the competition.

34.3 The Relationship Between the CSR and HRM

Close relationship between the CSR and HRM must exist in an enterprise. It results from the social responsibility held by one firm that may or may not rely on the concrete movement from the routine job under special circumstances. Therefore, there are only HRM activities for the managements and employees to transmit, communicate, and raise the social responsibility sense in one enterprise, and moreover, those activities must emphasize the social responsibility behaviors. The cultivation of the strong social responsibility culture in one enterprise can fulfill the business management in practice, and the employees and managements can grow as active citizens in public.

However, forming the dense social responsibility sense and actively helping the management and employees undertake citizen behavior, the demanding factor for them is actually the attitude of one enterprise towards the principle, policy, and practice of their own employees. Here, if this attitude is not with total social responsibility, how can the employees believe their boss to hold the social responsibility? Therefore, whatever enterprises hold as social responsibility, the first step is to go through the social responsibility principle in the practice of the HRM.

34.4 The HRM Strategy Based on the CSR

34.4.1 Rebuild the Modern Human Resource Sense

34.4.1.1 The Sense that Human Resource is the First Resource that Needs Building

The realization of modern enterprise HRM could build harmonious relationship between the employer and the employee is a proven fact. In addition, it could be a way to increase the enterprise cohesion. Furthermore, the good relationship could create the workers' responsibility in the development of their enterprise. For lowering the management cost to the optimum, raise the work efficiency and quality; the employees' satisfaction rate should be increased and the shifting rate should be reduced. On the contrary, if the traditional personnel management still stays in one enterprise, that is, the relationship between the employees and the employers is just regarded as a hiring relationship with the contract—the simple exchanging relation is “the payment equals to the work load”. As a result, the employees take a passive attitude towards their work, or worse, the relationship between them turns tense. These lead to changing jobs frequently and hence a dangerous phenomenon of waste and conscious destruction. Finally, the cost of enterprise management fairly rises. Therefore, the modern HRM must be undertaken, that is, in their depth to motivate effectively, and at most to increase the satisfaction rate of the employees for developing their potential, so that they

become the dynamics of the enterprise development and creation. All in all, the enterprise will be the victors of the day in the furious marketing competition.

34.4.1.2 The Change of the Simple Sense of Low Cost into the Human Resource “Capital”

The modern human resource capital theory states that Human Resource capital is the capital form for the Human Resource developing investment to bring the increase in feature value. In the past, the low cost of Human Resource was the apple eye of the majority of enterprises. Many enterprises considered their employees as workers, “the capital”, so that, the boss just reduced the payment and welfare, and some even made the lowest standard of payment worse than that the authority did, let alone the training investment and promotion of employees. By contrast, if employees are considered as all talented who develop their potential utmost with systematic training, promotion, management, and inspiration, in future, those employees will become the dynamics of the enterprise development and creation and valuable capital as well.

34.4.2 Reinforce CSR Awareness

The level of the CSR practice is limited by the authority and the social responsibility sense from the enterprise management. The authority decides the level of the practice according to the policymaker, that is, can it or can't it; the sense is used to decide the managements' attitude toward the social responsibility, that is, to think it or not to think it. Therefore, the HRM should increase the social responsibility sense of the enterprise management, especially the high regulators; also, they must turn the social responsibility sense into practical strategy and behavior. The awareness of the importance should be pointed out to develop the situation of the enterprise HRM. For the enterprises themselves, they should be aware of the modern HRM as the vital part of the social responsibility. There is a direct relationship between the situation of the enterprise HRM and the level of the CSR practice. However, this practice is also an important solution to promote self-image and competitiveness.

Nowadays, with the rapid development of globalization there is a change in the competitive advantages. The global business has already declared social responsibility as one of the advantages. Here, the well-recognized standards are changed into limited ones. Next to the traditional cost, quality, supply date, flexibility as the basic and normal standard, social responsibility becomes one of the limitations. Moreover, the consumer's social responsibility sense becomes strong; they think selfish enterprises are unwilling to hold their social responsibility. For every consumer, not only the price, quality, and safety of one product counts, but also the production methods and the location of the factory matter.

Obviously, for enterprise, the cost of the HRM will be increased with having social responsibility, raising the welfare of employees, enhancing the labor protection, and developing the condition of working and living. On the other hand, those strategies will be used to highly increase the enterprise Human Resource capital. At the same time, the quit rate and the producing accident will be reduced, with the increasing employees' identity of the enterprise, the working energy, and activeness. As a result, the produce rate will be raised to get more marketing garment and economic returns for the aim of promotion of competitiveness.

34.4.3 Bring New Ideas of the Management Mode

34.4.3.1 To Speed up the Pace at Which the HRM Meets the Multinational Corporation

So far, the frontier of the global business is for multicorporations. They create the advanced managing ideas, and guide the revolution of the HRM in many nations. In foreign economists' opinion, Western industrialization is derived from technology in 30 % and from management in 70 %, especially the HRM. It is a huge driving force of the enterprise development. Now that HRM is very crucial, the enterprise needs to pay attention to the psycho-contract with the employment to develop a mechanism of performance, scientific and reasonable payment, and well-being welfare. The enterprise also needs to help the employees design their careers appropriately to improve the status of the HRM for fulfillment of the CSR.

34.4.3.2 Set Up a Mechanism of the Enterprise Human Resource Crisis Management

The regulators should keep track of the international standard of CSR and policy development in time to handle the trends of the social responsibility movement for the reference of the HRM policy design. They also need to evaluate and predict the needs of the payment, welfare, working environment, and so on regularly, in order to find out the distance between the situation of the Human Resource social responsibility fulfillment and the employees' needs. Understanding the possibility of the cause and crisis, the enterprise could build up a proposal of the solution to the crisis to promote the level of the HRM. In the end, there will be an advantage for the enterprise to constantly develop and fulfill the CSR.

34.4.3.3 Formulate the CSR Target

The enterprise melts the target system into the employees' basic social responsibility by zooming into a working target for related department and regulators. The HRM

department should bring the related Human Resource basic social responsibility into the management flow-sheet, then divide into each HRM post and elemental task, and take over the fulfillment earnestly. For example, there will not be any discriminations of gender, location, faith, or nationality during the recruitment, training, employment, examination, and promotion, and there no force to do extra work. The Human Resource regulators also organize the process of the CSR fulfillment. For instance, for cultivation of every ranks of management's social responsibility sense, the regulators should stimulate the employees with education, regulator regime, profession standard, and encouragement measures; there will be a stage of unblocked communication for the understanding employees' suggestion on the CSR fulfillment and the difficulties in the process. Therefore, they can coordinate with each inner department; engage the relationship between the enterprise and related-profit parts; like the evaluation of the economic responsibility, the HRM could assess the situation of the fulfillment of the CSR target; within the enterprise's economic power, there must be a biggest investment in the social responsibility fulfillment.

34.4.3.4 Set Up the Audit Regime in the Inner Social Responsibility

The investment of the social responsibility is labor and property for the social responsibility fulfillment in an enterprise, such as, managing pollution, improving welfare, providing satisfactory product and consuming environment, and involving charity. Those could be shown by the financial index. However, the cost of social responsibility contains not only the investment, but also the expenditure from the organization or individual. That is, it is not shown in the index. It is partially made up of the environment pollution, the depletion of the natural resources, the cultivation of the social Human Resource, the land use, and other costs. The social responsibility efficiency results from the improving enterprise image with the CSR fulfillment, the attraction toward the talents, long-term interest, loyalty to the consumers, and remission of the government's pressure. If the HRM regularly throws into the CSR fulfillment and audits the cost and efficiency, (1) the enterprise management could sum up the experience to motivate the scientific usage of the resources; (2) the enterprise will get clear the visible or invisible, so-far or long-term efficiency. The contrast between the pay and the gain among the related profiteers will improve the passion of the enterprise to devote to the social responsibility continuously; even the regulators will increase their social responsibility sense.

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Chapter 35

Study of Online Bank in E-Commerce Environment

Li Huang

Abstract This article combines the technical assistance with relevant financial system and proposes that only a sound Internet banking security system with integration, innovation tapping their own business and services, developing and improving the online banking, specific regulations and building network trust system, can be a set of mechanism for security system being created and make a breakthrough on the subjective or the objective bottlenecks in the development of the e-business environment for the Internet banking.

Keywords E-commerce environment · Development of Internet bank · Bottleneck · Countermeasure

35.1 The Development of Internet Bank in E-Commerce Environment

Since October 1995, the world's first Internet Bank—Security First Network Bank (SFNB) opened its “virtual door” [1] with nearly 4,000 customers depositing US\$ 9,000,000 across all 50 states in America. Almost half of U.S. households adopt financial services provided by online banking and the profits have already taken accounts for over 50 % in total profit of the banking industry. With the development of national economy in China, the Internet information technology, financial informationization construction, the extent of electronization, networking

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and intellectualization for banking system as well as the Internet banking all have rapid development. Since 1997, China Merchants Bank's "One Card" began to provide domestic online services which drew the curtain for the national network banking, more and more banks followed suits and opened banks on the Internet. Now more than 200 branches of 20 banks own website and homepage among which there are over 50 branches carrying out the substantive Internet banking business. And the Internet banking has covered the major big and medium cities all over the country and the number of customers is far more than that of phone banking and mobile banking, and also the volume of business has increased rapidly.

Though the business scales of our network banking is increasing, the total amount of business volumes still lags behind that of the traditional commercial banks. And the financial network has not been fully realized as to the development of e-commerce. The reason is the bottlenecks like technical measures, legislative protection, and the credit systems, etc. which influence the development of the online banking.

35.2 Bottlenecks in the Development of Network Banks in E-Commerce Environment

35.2.1 Problems of the Network Bank Security Caused by Technical Risks

The technical risk and safety loophole of the network banking may first come from the computer network information security of the banks [2]. The risks not only come from the uncertain factors such as host of the computer system, the damaged disks, and so on, but also from the external network like network attacks, virus interference, etc. If the bank computer is attacked by virus, the host system of the bank will lose data. If the data transmission system is broken, the information about the Internet banking users will be revealed and thus endanger the fund safety of the users. Next are the customer identification and verification issues including user authentication, digital signature authentication, and the security calls of the users' personal information, and so on. Since there is no related certification system for bank customers currently and therefore cannot guarantee a safe and effective use of their online banking account and can easily lead to account embezzlement and money stolen, etc. Third is the aspect of the Internet banking operation system. If there are defects in the Internet banking operating system settings, it would be vulnerable to hackers or on being damaged. Finally, there are problems on the bank's internal management and the operation problems caused by business personnel.

35.2.2 Lack of Product Innovation and the Simplicity Problems of Virtual Services

The products of our Internet banking and online financial transactions are basically on-line copy and a simple “move” from traditional counter services, [3] most banks take the Internet as another sales mode or sales channel, and some banks even regard the online banking as a distribution channel for the low value products. They function in three ways: inquiries, transfers, and payments into the mainstream services of the Internet banking, and the product lack attraction to the customers. In addition, most banks ignore the innovation potential of both the online financial products and services that lack the banking products designed specific to the features of Internet.

Furthermore, as the Internet banking services possess simplicity and virtuality, our online virtual bank services lack humanity compared to that of the developed countries.

35.2.3 Lag in Legislation and the Challenges of Financial Supervision Networking for Online Banking

At present, many aspects of financial laws and regulations are not clear and complete in China’s network. In many cases, there are no relevant policies to regulate the online banking until the behavior of the network bank has violated the rights of consumers. Compared with developed countries, China’s financial legislation is lagging behind [5]. As early as 90 years in the twentieth century, the United States has enacted the “Digital Signature Law”, “Uniform Electronic Transactions Act”, and other laws to figure out the legitimacy of the electronic signature and electronic payment, Whereas in China, the People’s Bank of China did not promulgate “the Interim Measures for the Administration of On-line Bank Business” until July 9, 2001.

The risk of banking networks increased, so in addition to the protection of legislation, it also need appropriate financial regulation [4]. The Internet banking supervision must involve the issuance of electronic money management, financial certification management, electronic currency tool management, secure electronic transaction management, supervision and management of the electronic currency operation, especially the national financial CA system. But at the same time many boundaries are blurred by the bank networking development, so the jurisdiction of such online transactions, online transactions legal compliance issues, online business standards, which related to bank security and efficiency, important development issues, making the financial regulation faced with the Internet revolution.

35.2.4 E-Commerce Credit Crisis Restrained the Development of Internet Banking

At the present stage, China's current development of social credit system is lagging behind. People lack the awareness of integrity and have not formed the consumption habits with integrity. The dishonest phenomenon in economic activity is serious at the moment and Internet banking is entirely based on open Internet, virtual banking services means, online transactions —both sides of the payment do not meet and the authenticity of the transaction is hard to examine and verify, so most of the individual or corporate customers of e-commerce adopt a wait-and-see attitude. Many customers do not want to take the credit settlement of electronic transactions and are more willing to take cash transactions, barter, and other original ways.

35.3 Countermeasures in the Development of Network Banks in E-Commerce Environment

35.3.1 Improve the Internet Banking Security System and Guard Against Operational Risks

The security of the Internet banking is the lifeblood of the online banking business. Along with the increasingly mature e-commerce, there is a need to pay close attention to technical risk management for the Internet banking business. We must comprehensively use the protective equipment and detection tools to improve network security and the defense capability of key equipment to form a complete, dynamic security circle and establish a sound Internet banking system through risk analysis, implementation strategy, system implementation, vulnerability detection, and real-time response which are the fundamental measures to prevent and reduce risk of the technology and improve the network security performance. On the other hand, the relevant network banking business technology should be specified by industry standards, including the developing of the necessary network access standard that allows users who adopt different information technology to join banking activities in the Internet which can provide the technical support for the security of Internet banking. In the meantime, establish a risk compensation mechanism to eliminate the concerns of Internet banking customers and win their trust, and create favorable conditions for sustained and healthy development.

To prevent and reduce the bank's internal operational risk and the potential safety problems, we should improve the bank's internal control system, establish a scientific operation specification, and make strict internal control mechanism. Perform technical training against risks for staff; supervise the operation implementation of the risk management system; assess and take appropriate measures

for the operational risk of Internet banking; make use of insurance to offset those “low-frequency, high-hazard” operational risks; monitor all banking business in real time, do network scanning, and use the audit records to check the business operators and computer system administrators.

35.3.2 Make Innovation on Online Banking Products and Develop Virtual Services

To develop new products and services, the differentiated Internet banking products should be designed from the customer point of view. Today the Internet banking products is in growing homogenization, product differentiation, on the one hand depends on the degree of simplicity and depth of services provided, which requires banks to design online banking products that are easier for users to understand and accept [6]. For example, electronic network system can be developed based on the electronic acceptance, electronic letter of credit, guarantees, and other electronic security services. Business intelligence services can also be used to jump out of simple innovative way like business technologies plus business. We can also learn from some foreign online banking to build the Internet banking an online financial business “business collector” (also called “screen collector”). This can let customers download online financial information about the website of such banks, insurance companies and stock brokers companies, and other institutions by only a single website. Customers can choose diversified financial products from different financial institutions according to their own needs. Another aspect of product differentiation shows the multichannel integration technology with full-time client manager and a two-way communication platform established with customers. In addition to electronic bulletin board (BBS), online answers and other commonly used means of communication, the Internet banking should use the interactive video network technology to chat online by clicking the button and to realize real-time and two-way communication when there are special needs by customers, thus provide customers with personalized service on a fluent communication platform. If the customers have problems in the online banking operation, it can easily go to the customer service specialists in call center or through direct dialogue between web conferencing and other methods to solve problems encountered by the customers.

35.3.3 Accelerate the Development and Improve the Network of Specialized Banking Laws and Regulations, Strengthen Supervision of Financial Networks

The current priority of the Internet banking in China is to familiarize themselves with and master the relevant international standards and norms of network security. To draw lessons from the developed countries, modify and improve the frame

of the existing financial legislation, and develop appropriate laws and regulations [5]. The policies and regulations should be developed as soon as possible on the aspects of online information security, network bank electronic payment, and so on, and meanwhile proceed to develop a standardized Internet banking. Next, according to the current problems existing in the Internet banking, we should develop binding legal norms and the online behavior of the system; standardize the behavior of the participants in the online banking transactions activities; at the same time, develop appropriate laws to impose sanctions on computer crime, computer leaks, and theft of commercial and financial secrets; enhance the network's fight against vandals punishment to protect the security of online transactions and confidentiality; punish the person who makes crime in network banks and provide the security of online banking safety guarantee from the legal system.

On account of the network innovation on banking industry, the financial regulation should also be creative and own new system, new laws, new regulations, and new tools to deal with the innovation of the current online banking and strengthen supervision and enhance the efficiency of supervision. First, we must strengthen the market access and exit regulation for the network bank business. If the financial institutions want to offer online banking services, they must implement the regulations in "Interim Measures for Internet Banking". Second, improve the existing financial regulatory measures, adjust, supplement and construct a financial regulation measures, and operation systems that comply with the survival and development of online banking from the aspects of legal compliance of the business operations, capital adequacy, asset quality, liquidity, profitability, management, and internal controls. Finally, the transnational flow of Internet banking funds is increasing at large; we can strengthen our financial management institutions and foreign financial supervisory authorities in information sharing, cross-border exchange of law enforcement assistance, and experience in areas such as communication and cooperation, and actively seek the best way to network monitoring. When the time is ripe, we can establish a flexible joint online banking supervision system with other countries or regions.

35.3.4 Strengthen the Social Credit System and Promote Online Banking Credit Mechanism

On the one hand, the bank's information disclosure system of the network should be strengthened and improve the management level of the Internet banking operators. On the other hand, the public awareness of financial networks should be strengthened and enhance the degree of trust of online banking. Actively and safely guide the consumers to use electric credit payment and lay a good foundation for a credit society. Finally, we should actively explore the basis of the new credit system; establish a sound social credit management system and legal system, and then create a good credit environment.

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Chapter 36

Study of the Function of University Library Based on Serving Society

Xiaoqin Guo

Abstract The university library is the distribution center of public resources; it should contribute to the society, benefiting all citizens. However, the management of institutional barriers, lack of library management, lack of information resources, information sharing barriers, and other reasons, resulting in library cannot really play to their capabilities to serve the society.

Keywords University library · Resource sharing · Serving society · Literature

36.1 Introduction

At present, the literature guarantee rate of Chinese public libraries is below 50 % in China, while the situation is the same to coverage, and 400,000 people have a public library on average, which has greatly influenced the promotion of diathesis of the whole civil and limited the development of Chinese cultural and education. By contrast, the quantity of Chinese current university libraries is relatively ample, which is more than 600 million [1]. If we can reply on the rich collection resources of universities and give full play to the role of literature resources, the contradiction between supply and demand will be effectively relieved without doubt. Therefore, it is the duty of the university library to give an appropriate opening to social with a premise that it has satisfied the demand of teachers and students.

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36.2 The Significance of the University Library's Service for Society

First of all, it is helpful for the promotion of local economy and cultural level. The reform of higher education has greatly promoted the localism of colleges and universities, which is based on the tenet that to base on and serve local place. Research subjects involving localism and the research projects issued by local government have gradually become the key of universities' teaching and scientific research, which requires that university libraries can provide related information and intelligence and use their advantages of human resources and information to serve the construction of local economy and cultural.

Second, it is helpful for the construction of the sharing model for the whole society. As a social and nonprofit cultural facility for the whole society and the citizen, the library has the distinct sociality and education function. The library is not only the supplement for information transmission and professional education but also the collection and distribution center for human culture and the important place for the school education assistant organizations and social education. To open the library the society has become one of the most important features of modern libraries.

Finally, it is helpful for the development of the university library itself. The high school library has rich books, newspapers, magazines, and information and that is the most attractive factor for social readers. At the same time, the university library has a large number of talented teams with high quality and reasonable knowledge structure, specialty structure, and age structure, so it has the ability of high level service work. The openness has proposed more complex requirements for the library's management and service, which will promote the development of the university library itself.

36.3 Difficulties of the University Library's Service for Society

Although, to the open the university library for society to serve ordinary citizens has been recognized, there are still many problems when implementing that.

First of all, there are still some obstacles for management system obstacle. Chinese library management system is still divided into public, universities, scientific research, trade unions and so on according to administrative subordination relations with lengthways leadership, and every system is independent to deal with affairs, which makes them in a closed and semi-closed state. If the university library is open to the whole society and provide needed intelligence information to all social fields timely and accurately to become an organic whole with the society, resources will be fully used both inside and outside school and the

closed loop between regions and departments will be broken through so that the university library will also generate new vitality. For a long time the university library implement a closed service mainly for the school staff and students, and the readers' quantity is limited, what's more, the utilization ratio of books is low. As the library is closed within the departments systems, so the literature which originally belongs to the country gradually belonged to departments. There is one thing that we cannot ignore that is when we are reveling in the incomparable collection of books, we have to face the fact that library resources are wasted enormously, which means that library resources loss its value due to the bondage of the management system [2].

Second, books management personnel are insufficient. The main key of the university library is to serve the school teachers, students, and scientific research personnel. If you want it to provide society service, personnel are obviously insufficient. The main performance is as following, one is shortage of the staffing. The staffing of the university library belongs to the institution, which is according to number of teachers and students and the collection of books. Therefore, it can only satisfy the needs of school readers, if serving society, the personnel are obviously insufficient. Second, the library lacks high quality talents which can offer profound information to the society. The library which has talents know both knowledge of library intelligence and professional technology and has rich business experience and expertise, however, [3, 4] they excel in providing information for readers in the school and rarely participate in economic information market activity, so they do not fully understand social economic activities, as a result it is difficult for them to provide information service to society.

Third, literature information resource is deficient. In recent years, though quantity and quality of the college library has achieved certain scale, the literature information resources that university library masters still has great gap for the demand from point, face, and timeliness of society. And usable specialized databases are limited by shortage of funds and human resource. Information resources cannot cover all areas of economic activities. Therefore, the capacity to provide all kinds of different levels of information service are limited [5, 6].

Finally, there are some obstacles in information resource sharing. As the university library's information service scope is mainly in school, it lacks communication with social enterprises and other units, in which there are obvious obstacles existing in communication.

36.4 The Principle for College Library to Serve Society

The university library should keep to the following basic principles when providing the service to society.

36.4.1 Do Things According to Its Abilities

It has been already common in western developed countries to open the university library to the society, but they all ensure that their teachers and students' need it as the primary condition. In China running conditions of most colleges have huge gap with foreign libraries, the literature material purchase funds, staffing and reading room seats, computer reservation, public toilet, and other infrastructures are all according to the number of the college teachers and students, which is difficult to meet the needs of readers in and around schools. If we ignore the fact, both teachers and students will feel dissatisfied. The daily work of the Library staff should also mainly focus on education and research services, only when they have spare energy after serving the main objects, can the university library develop external service projects. So our university libraries should be adhering to the principle to serve school teachers and students first, which is not only the priority of it but also the prerequisite to strive for the support of teachers and students of universities.

36.4.2 It Should Follow the Principle Step-by-Step

There is no doubt that to open the university library to the society has a positive effect, but we should open the library step-by-step. After increasing enrollment for many years, now the number of student has increased dramatically in universities all over China . There is great shortage of teaching resources, the phenomenon that it is for students to find a seat in study lounges and reading room is very common. If we ignore the Ignore status and open the library blindly, the contradiction of the scarcity of education resources is aggravating. Therefore, at present, the college library should be open to the society step-by-step. And the university library also needs to comb its resources in detail. If it has ripe conditions, we can open it first or we need to postpone the open [7, 8]. Of course we can open the library partly or wholly according to its ripeness of conditions. The college should formulate feasible openness schedule step-by-step, and never ignore its own circumstances to follow up blindly.

36.4.3 It Should Follow the Principle of Being Flexible

The high school library can try to seek the best balance between different needs and characteristics of readers in and around schools according to its actual situation, making full use of time to offer a wide range of service. For example it can serve school readers at ordinary times and receive social readers at weekend and on a national holiday or set a special day for other readers. During the

3 months summer and winter holiday, the library can be open to social readers while it can stop opening in final exam stage. The information service of the university library has its own characteristics, and broadens the service scope according to its respective features and advantages. Besides the low level borrowing services, the library can develop deep information service, such as expert introduction service, intelligence tracking service, technology inquiring service, literature searching service, research service, information agency services, information retrieval service, reference service, patent information service, special services, and so on. After approved by the department of industry and commerce, some libraries which have conditions can establish information development center to change passive service to active service and closing service to open service. Libraries can investigate development trend of social economy, science and technology, and master ordinary citizens' needs hotspot in order to develop deep information service such as prepare abstract indexed, collect business information, information retrieval, market research and consult patent documents, relying on the university library document resources they can also provide copy, typing, copying literature material, and other services according to needs of social readers.

36.4.4 It Should have a Reasonable Charge

The university library's service is controlled by limitation of library card, borrowing number, and borrowing date so that it will not influence teachers and students' learning and research. Now university libraries have commonly purchased WANFANG doctors and masters' dissertation database, CNKI, and so on, which forms an online electronic resources system to provide 24 h service. The university library should make full use of digital information resources and network equipment superiority and personnel advantages to provide online service for the society, such as internet information consultation, document delivery and document copy, and so on. The benefit of online service is that it will not occupy students' physical space and has no limitation on the number of copies, and people can accept service no matter at home or in the outside. Of course, to provide these services will increase the loss of books and materials and the management cost, so it is necessary to have a reasonable charge, which can adjust and control readers flow because plenty of social readers will clog information passage [8, 9]. However, university libraries should not only see immediate economic benefits, they should try to promote image and status through being open to the society. The library should grasp discretion in practice. On one hand we should eliminate irregular fees; on the other hand, the library can have a reasonable charge according to the actual conditions with the permit of schools.

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Chapter 37

Role of Information Systems in Supply Chain Management

Hemin Da

Abstract The Institute for Supply Chain Management has defined supply management as “the identification, acquisition, access, positioning and management of resources an organization needs or potentially needs in the attainment of its strategic objectives”. The purpose of this chapter is to explore and evaluate the various approaches that can be taken to facilitate the management of supply chains.

Keywords Supply chain · Management · Information · It · SCM

37.1 Introduction

37.1.1 Terminological Background

The Institute for Supply Chain Management has defined supply management as “the identification, acquisition, access, positioning and management of resources an organization needs or potentially needs in the attainment of its strategic objectives” [1, 2]. The essence is a shift of focus away from business units such as warehouses or factories to a more holistic view of a supply chain [3–5]. For a given company this might include parts suppliers, manufacturers, transport, logistics, and retailers.

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37.1.2 Origins of SCM

SCM has its origins in organizational extension theory first proposed by Mallen in 1963. Mallen's theory was developed within the context of marketing and advocated the extension of an organization to include all the members of the distribution channel.

37.2 Body: Why Use SCM

Supply chain management as a concept has been evolved to address a number of issues that effect modern companies as follows [6, 7]. The number of suppliers that companies use has tended to increase greatly, for example Sun Microsystems has three factories of its own but uses its supply base to increase its productivity by a factor of hundred. Sourcing from such a large supplier base allows a company to choose the best value components available from the world market giving added value to the customer; the downside is the obvious extra management burden that comes as a result.

Economic factors such as global recessions and increased global competition have forced companies to focus not just on their product but also on streamlining every process across the value chain from the component suppliers to the end vendor.

As supply chains grow in size and complexity it can become apparent that there are dependencies between companies in the supply chain. For instance a smaller size supplier may maintain a line purely to service a larger company. When this happens it makes sense to share information between the companies and may even to go as far as integrating systems for mutual benefit.

37.3 IT Approaches to SCM

In the 1970s procurement professionals played a key role in cutting costs to help companies compete during the energy crisis, in the 1980s procurement had to again find ways to cut costs to fight against the competitive advantage of high quality and low priced Japanese products. From the mid-1990s to present, procurement professionals are combining best practices with technology to streamline processes, control costs, achieve operational efficiency, and deploy strategic procurement initiatives across the enterprise.

37.3.1 Data Storage

Step one when looking at any company would be to examine how it stores its information. Many companies will still be using antiquated databases of different types or may even still be reliant on paper records. Centralizing the companies' data into a modern relational or object-orientated database would immediately reduce the amount of redundant or duplicated data. This approach would allow the departments ability to use data from other departments to reconcile their own data, highlighting errors that would otherwise have not been apparent [8–10].

While this is probably the most important factor for any company, it is often most difficult to make changes in due to the extremely high initial costs and disruption incurred. However, without a well-structured database a company will find its ability to make progress in other areas hampered.

37.3.2 Operational Processes

In this area procurement, factory/warehouse management and logistics are grouped together. These areas can all be greatly assisted by modern improvements in communications and software. A great deal of time and money is wasted by companies still relying on the use of the telephone, fax, or post to communicate between these departments and with external sources. Once a company has rationalized its data storage it becomes possible to automate many inter-departmental processes. It need not stop there either, systems are available to transfer information between various trading partners; systems such as these are known as inter-organizational information systems (IOIS).

The virtual corporate integration that results when such systems are adopted can lead to a reduction in what has been termed as supply chain uncertainty. All companies within the IOIS will have a great awareness of the state of play at any given time resulting in increased operational efficiency. The company that has access to this information is also going to offer value added services to its customer such as order tracking.

New approaches to manufacturing become possible such as Just-in-Time (JiT) and Build-to-Order (BTO). A large company is now able to react to a change request from a customer, giving more added values.

37.3.3 Inventory

Carrying unsold inventory costs U.S. businesses about \$332 billion per year.

As can be seen from the above statistic there is huge scope for clawing back lost potential revenue in this area. If, for example, at the end of a supply chain,

company A is supplying vendor B; it is quite possible that both companies might keep a reserve surplus stock or worse still, they may both run out of stock. The solution here, as I hinted at earlier, is to share information between the companies or even to integrate systems. This has been implemented in a number of different ways; we shall examine Vendor Managed Inventory (VMI) and Continuous Replenishment Program (CRP).

With VMI: Company A is able to access B's inventory records and when they fall below a level, set by B, send more stock and raise the appropriate purchase orders.

With CRP: Data from the whole of the supply chain is analyzed with the goal being that when an item is purchased from the vendor (B) a message travels back through the supply chain requesting the production of a new replacement item. So far this would seem to be similar in effect with VMI; CRP however, makes use of the extra data it has, to make a prediction of the likely sales on a given day and sets the recommended level of stock. This is known as demand forecasting. Depending on the complexity of the implementation CRP may be able to take into account general trends, seasonal trends, or other known patterns specific to a given product.

37.3.4 Potential Pitfalls

The obvious major drawback when thinking of redesigning a supply chain is cost. A very large company without these systems faces a fairly stark choice: invest millions in restructuring or watch market share slip away to those competitors willing to spend and give their customers better service.

There are off-the-shelf customizable solutions available from companies such as SAP and PeopleSoft which are often referred to as Enterprise Resource Planning applications. Large companies are often tempted by these systems as a comparatively cheap alternative to having a bespoke system built from scratch. As usual there is a sting in the tail with SAP consultants being among the most costly in the market and the various modules that make up these applications often needing 'tweaking' to bring them into line with business changes.

As with any major development project a company undertakes, there will be a resistance from the employees to change, especially those who have served for a long period and are used to doing the job in a particular way. A full impact analysis is always advised before embarking on any major project.

Implementing a JiT or BTO system is very desirable for a producer but will not be nearly so attractive to the suppliers. A supplier will be quite happy to deliver 10,000 widgets a month to the producer but will be much less amenable to being asked to supply variable amounts on a weekly or even daily basis. For a producer to implement such a system, it will generally require the producer to be in a powerful bargaining position with many competing suppliers.

37.3.5 Alternatives to SCM

Underneath the bonnet most SCM software that has been written in the past 20 years uses a technology called Electronic Data Interchange to implement the communications required between processes, departments, and companies. With the advent of the internet and the dominance of TCP/IP transport, new powerful concepts are beginning to emerge. Companies have been understandably reluctant to use what is essentially for a public network to transmit their sensitive data but the introduction of 128-bit encryption is able to offer at least as much security as EDI over a phone line.

Business to Business Integration (B2Bi) is the name given to the standards for inter-company communications over the Internet. These are open standards and they all revolve around the use of extensible mark-up language, better known as XML. This user-definable mark-up language can be used to describe interfaces to services that a company wishes to offer. The success or failure of B2Bi largely depend on the uptake of the various proposed standards such as Web Services Description Language (WSDL)—for defining services—and Universal Description, Discovery and Integration—which is like a yellow pages services for customers to look for available services.

A few leading B2Bi solutions include: IBM MQ Series Integrator; Extricity; BEA Link; web Methods B2B Enterprise; NEON Business Integration Servers; Vitria Business Ware; and Microsoft BizTalk Server.

37.4 Conclusion

It has been suggested that SCM will provide a sustainable competitive advantage to those organizations implementing it. Whether or not an advantage in business can ever be sustainable, for eternity is doubtful; in the field of SCM when a new technological advance is always just round the corner it is highly unlikely. Successful supply chain management strategies do, however, enable organizations to reduce costs while simultaneously improving service and product quality. The realization of these benefits can provide a significant competitive advantage over other organizations. In order to gain this advantage, it is important to implement a comprehensive supply chain management initiative that includes technological, organizational, and attitudinal changes.

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Chapter 38

On the Online Financial Services in the Digital Age

Shuanghong Liu

Abstract The online financial services mean that the financial companies make use of the Internet and other technical means to provide all kinds of adaptable, highly value-added financial products for the purpose of continuously improving the consumer satisfaction for the services of financial companies, with a virtual, direct and risk and other features. In recent years, along with the increasing popularity of the Internet, the online financial services entered the daily lives of people. This article focuses on the digital age to start a network of the financial services. Therefore, it has a certain practical significance.

Keywords Digital age · Online financial services · Problems · Strategy

38.1 Introduction

In the twenty-first century, science and technology has achieved a highly rapid development. In this digital age, the Internet is changing the riotous and complicated world with an imperceptibly gradual step, and simultaneously exerts an in-depth and extensive influence on the politics, economies, cultures, and lives of human beings in general [1–3]. Besides, the Internet began to penetrate into the financial sector since the day of its emergence in the world. With the supports from the network technology and the electronic technology, all the financial markets all over the world have transformed into a huge and intangible capital network [4]. This can give a full expression that the networking of finance has changed into one of the most important

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symbols for the increasingly developed financial industry [5]. Under such a situation or background, the online financial services rise in response to the proper time and conditions. In this paper, a discussion is conducted primarily on the online financial services in the digital age, with the purpose of providing some useful strategies for the development of the online financial services in digital age [6].

38.2 The Features of the Online Financial Services

Online financial services mean that the financial companies take advances of the Internet and other kinds of technical means to provide all kinds of strongly adaptable and highly value-added financial products for the purpose of continuously improving consumer satisfaction for the services of financial companies. Specifically speaking, the online financial services are with the several features as shown in the following [7].

38.2.1 Virtuality

Generally speaking, the online financial institutions in the digital age are usually embodied in only one uniform resource locator (URL) and all of the transactions between banks and customers are conducted through the Internet. In this process, there are no actual paper currencies as well as the metallic currencies in existence. All of the online financial services are completed in Internet. This makes an enhancement to the speed and quality of the financial services to some extent.

38.2.2 Directness

The Internet promotes the relationship between the financial institutions and the customers to be much more direct, and makes the two sides unlimited by time and space. In the mean time, the Internet creates a good condition for the international flow of capitals. Also, the savings and investments become more effective. And the savings among different countries are no longer limited in the domestic market, but can search for new opportunities all over the world.

38.2.3 Risk

The increasing popularity of the digital market and the electronic currency gives rise to a great number of problems for the economic control of the central

government and participants in the economic activities. Therefore, it is imperative for the modern people to deeply deliberate how to face up with the problems such as the dysfunctions of the network system and the bankruptcies of the electronic currency issuers.

38.3 Problems in the Online Financial Services

There are a series of problems although the online financial services in China achieve a stable development. As the growing speed of Chinese economy becomes very rapid, the financial credit mechanism attains a gradual improvement, and the financial development level is upgraded progressively. These problems can be specifically concluded from the following four aspects.

38.3.1 Inaccurate Orientation on the Targeted Consumer Groups

As is known to all, the customers of the different banks should be different. In other words, there are either professional online financial services or comprehensive network financial services. However, seen from the current situation, it can be learnt that the needs of the customers are not taken by all kinds of the financial institutions into account during the course of providing the service activities. Specifically speaking, they seem to take things all in a lump without any discrimination, so that the services they provide are not the things the consumers need really. Therefore, if such a situation continues, the old customers cannot be kept.

38.3.2 Relatively Shortage of the Online Financial Information Resources

According to the relevant statistics, the online databases of the financial information services in China increase by 80 % annually. The increasing number of the databases has reached to nearly 130,000. This statistics suggests that the online database receives extensive recognition from people all over the world; there are more and more people to take full advantage of the online databases for the information retrieval, making it served for their own life and work. However, seen from another different perspective, it can be known that the financial stock information databases in China take up only 1.5 % of the total online databases of the world. This can sufficiently prove that the number of online financial information resources in China is quite low at present, and also the service information which is offered by multiple financial websites are same and are not enough in breadth and depth.

38.3.3 Great Difficulty of Searching the Online Financial Information

At present, there are a fairly large number of financial websites to respond to the information requests by using search engines. However, the search engines have a great number of problems in both the recall and precision rates at the present time. Therefore, the service information through the retrieval of the search engines is not the things that are needed by the users really. Under such a situation, it is necessary for the financial enterprises to make the most of the expert systems, semantics webs, and other information technologies, so as to improve the information retrieval mechanism and continuously increase the effectiveness and values of the financial information.

38.3.4 Insufficiently Improved Online Financial Management Strategies

Seen from the current situation, it can be known that a fairly great number of the financial institutional resources are being allocated again in China; the insurance, online banking and security websites have been established in Internet; and also a series of information platforms such as the information consultant websites, online transaction payment platforms, and financial products. However, generally speaking, these financial institutions have not entered the marginal benefit increasing stage yet, and therefore have not played the low-cost competitive advantages, making the management strategies of the online finance far from being well improved and unable to acquire the maximum economic benefits.

38.4 How to Promote the Online Financial Services in the Digital Age

With the purpose of receiving a sustainable development, it is necessary for the online financial services in the digital age to strengthen the personalized services and take the satisfaction of the needs of the consumers as the starting point and ultimate target. Hence, the services can be clearly oriented at the markets and can achieve an enhancement.

38.4.1 Clearly Locating the Target Consumers

With the purpose of strengthening the online financial services, it is necessary to clearly locate the target consumers, and take their actual needs as the orientations

of developing the online financial service activities. Subsequently, it is necessary to be close to and know the customers further and learn how to think with them together. Ultimately, the effective interaction methods and communication models can be sought. Besides, the consumer orientation is always deemed as the starting point as well as the destination for the transmission of the online financial services. Therefore, it is highly necessary for us to advocate “what do the consumers want” but not to seek “what kind of consumers do we need”. Only in such a way, the degree of satisfaction of the consumers can be increased ultimately.

38.4.2 Necessary to Implement the In-depth and Specialization of Financial Services and Change the Current Situation that the Online Financial Information Resources is in Shortage

After the target customer groups are located very clearly, it is rather imperative for the users to positively change the current situation that the online financial information resources is in relative shortage and also put forward much more and higher requirements on the information industry. Hence, the information industry can be promoted from a large number to explore the resources which are needed by the customers and also can give a reflection to the laws of the financial activities and thus the consumers can be helped to make a correction strategy on investment. For this reason, it is highly necessary for the financial institutions to collect the financial information as much as possible within the quickest speed, and then carry out in-depth integration and researches on them, so as to prevent the information from being repetitive and ineffective.

38.4.3 Making the Online Financial Services Intelligent and Resolving the Problem that the Online Financial Information is Difficult to be sought

First of all, it is highly necessary to intelligently realize the consistence between the needs of the consumers and the financial information resources. For this reason, it is highly necessary for the financial institutions to improve the financial websites, and provide the “accurate information searching” for the consumers by means of the intelligent information retrieval. Second, it is also necessary for the financial institutions to intelligently realize the initiative promotions of the financial information. In other words, the networking systems can be driven to automatically realize the rapid retrieval searching results of the multiple database

pools in accordance with a certain keyword provided by the users. In the mean time, all searching results can be compared, and are provided for the consumers after sequencing. Such a way can make an enhancement to the effectiveness and values of the financial information, and also make the online financial services intelligent.

38.4.4 Improving the Management Strategies and Reducing the Costs to Attract the Customers

During the course of providing the online financial services, it is rather necessary for the financial institutions to make use of the cost strategies to retain the consumers, for the purpose of reducing the costs to attract the customers. For example, the persons who settle accounts with the electronic currencies can be given with some simple gifts; a discount price can be adopted to satisfy the buying psychological needs of the consumers, and simultaneously the effects of the “famous brands and distinguished personages” and the “upper society” can be utilized to offset the expensive prices, making the consumers think the paid costs are actually not so high, actually exceed the actual values and even ignore the costs only for the sake of the best-quality services. However, in order to implement such a cost strategy, it is necessary for the financial institutions to timely know the cost values well which the consumer groups are willing to pay to satisfy their needs. In such a way, the precisely targeted services can be adopted ultimately.

38.4.5 Making an Adjustment to the Service Direction Based on Response Behaviors of Consumers

In Internet, the consumers often only click the financial information and only take a glance at it. For this reason, it is necessary for financial institutions to establish a long-term and good communication with the consumers. It is necessary not only to provide the online financial services for the consumers and also to attach importance to the circulation of the financial services in itself. After the quality services are provided for the consumers, it is also necessary to carry out a powerful and effective communication with them, because the recipients of the financial information will make some response behaviors such as the satisfaction. Therefore, it is necessary for the financial institutions to make timely measurements and statistics on these responses, and input them into the databases, and finally make a great number of adjustments to the services in accordance with the information. At last, a win-win situation can be accomplished for the financial institutions and the related customers.

38.5 Conclusion

Generally speaking, if the capital market in China is desired to attain a sustainable development, it is necessary to have the corresponding online financial services as the foundation. Besides, accelerating the quick development of the online financial services and establishing a powerful financial service platform are the necessary needs of improving Chinese capital market and participating in the globalization of economies of all countries. As the networking technology receives an increasingly rapid improvement, the online financial service in the digital age will certainly develop toward the personalization, intelligence, and professionalization. This is a fairly important tendency, which can be predicted by the modern people. In the mean time, it can add an important strength which can never be neglected for China in the process of entering the international market, and also promote the capital market in China to have a much brighter and splendid tomorrow.

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Chapter 39

Study on Independent Innovation Scheme of Electronic Information Industry

Qing Li Zhang

Abstract Electronic information technology industry is one of the most important industries in the national economic system. It not only help to GDP and export but also greatly improve the state science and technology competition. In the current overcome of the influence of monetary and economic crisis, the industry is playing a very important role in the transition of the operation mode of the industry and the industrial structure, An appropriate key areas of the company is necessary, for decision makers put forward the policy to the manager of the company to enhance the achievement of business management to achieve goals.

Keywords AHP · DEA · Electronic information industry

39.1 Introduction

In 2008, main business income is in the electronic information industry in our number reach 5.17477 trillion yuan, and the growth rate of 16 %, compared with 2007 [1]. Many companies in this industry were selected for the company in Shanghai or Shenzhen list stock market. Now many of the other companies are to enter the market (IO). But it is very difficult, because there are many more listed companies in the same industry. In those listed companies have some industry “nets things” concept and some with “30” concept [2]. Therefore, we should simplify choose such companies for their operational effectiveness evaluation.

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The concept of the “Internet” was put forward as early as the 1999 shooting. It was simply defined as: all through the Internet connection or similar information technology RFID realize the intelligent identification and management of sensor. “The world summit on the information society at the Tunis in 2005, international telecommunication union (ITU) submitted an annual report is called” the Internet of things [3]. In the United States, President barrack Obama took office in early 2009, he actively responded, including those smart infrastructure, “the Internet of things”, when he took the round table meeting and business leaders. He proposed “new energy” and “Internet options” as the two big weapons to revive the economy [4].

39.2 Principles A Applications of AHP

39.2.1 Brief Introduction to AHP

The Analytic Hierarchy Process (AHP) was developed by Saaty in the 1970s [5]. The key principle of AHP is to establish priorities among the elements of the indicator hierarchy by making a series of judgments based on pairwise comparisons of the elements. Then synthesize these judgments to yield a set of overall priorities (weights) for the hierarchy through a set of numerical computations [6].

39.2.2 Steps of AHP Approach

Structure the hierarchy from the top through the intermediate layers to the lowest layer [7].

Construct a set of pairwise comparison matrices for each of the lower levels with one matrix for each element in the level immediately above by using the relative scale measurement.

$$C_B = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{bmatrix}$$

C_B is a judgment matrix of elements C_1, C_2, \dots, C_i to the upper layer B.

Hierarchical synthesis is now used to weight the eigenvectors by the weights of the criteria and the sum is taken over all weighted eigenvector entries corresponding to those in the next lower level of the hierarchy [8].

First calculate $M_i = \prod_{j=1}^N a_{ij}$ ($i, j = 1, 2, 3, \dots, n$)

Then calculate $W_i = \sqrt[n]{M_i}$

Vector $\bar{W} = (\bar{W}_1, \bar{W}_2, \dots, \bar{W}_n)$, normalize it, then

$$W_i = \frac{\bar{W}_i}{\sum_{i=1}^n \bar{W}_i} \quad (39.1)$$

The largest relative eigenvalue of C_B is λ_{\max}

$$\lambda_{\max} = \sum_{i=1}^n \frac{(AW)_i}{nW_i} \quad (39.2)$$

Having made all the pairwise comparisons, the consistency is determined by using the eigenvalue, λ_{\max} , to calculate the consistency index.

$$CI = \frac{\lambda_{\max} - n}{n - 1} \quad (39.3)$$

Look up the table to get random index RI. Calculate consistency rate,

$$CR = \frac{CI}{RI} \quad (39.4)$$

The CR is acceptable, if it does not exceed 0.10. Otherwise, the judgment matrix is inconsistent. To obtain a consistent matrix, judgments should be reviewed and improved.

39.3 Brief Introduction to DEA

Data Envelopment Analysis (DEA) was invented first by three operational researchers Charnes A, Cooper WW, Rhodes E in 1978. DEA is a post ate analysis, based on the past performance cross-sectional view of several organizational units in a given period. Decision Making Units (DMUs) are measured by their multiple inputs and outputs in DEA model, then classified into two groups, comparative efficient and inefficient, in Pareto sense. The feature of this method is that when evaluating DMU, the best weight that is propitious to the DMUj is selected by means of mathematical programming. That means no anthropogenic factor could affect the evaluation result.

The CCR model is the first model of DEA, also called as C^2R in some literature. Since the conditions of CCR model includes keeping economic scale unchanged, but in empirical economy the scale could not be constant always, so in 1984, Banker, Chares, and Cooper proposed a variable returns to scale (VRS) model, also called as BCC model.

BCC model is shown as Eq. (39.5).

$$\begin{aligned}
 \min & [\delta - \varepsilon(e_1^T s^- + e_2^T s^+)] = V_D(\varepsilon) \\
 \text{s.t.} & \sum_{j=1}^n x_j \lambda_j + s^- = \delta x_0 \\
 & \sum_{j=1}^n y_j \lambda_j - s^+ = y_0 \\
 & \sum_{j=1}^n \lambda_j = 1 \\
 & \lambda_j \geq 0, j = 1, 2, \dots, n \\
 & s^- \geq 0, s^+ \geq 0
 \end{aligned} \tag{39.5}$$

In Eq. (39.5), θ refers to input ratio variable; ε refers to non-Archimedes infinitesimal variable, which is usually valued 10^{-6} ; $e_1^T = (1, 1, \dots, 1) \in E_m$, $e_2^T = (1, 1, \dots, 1) \in E_s$, $s^- = (s_1^-, s_2^-, \dots, s_m^-)$ is the slack variable vector correspondent with inputs; $s^+ = (s_1^+, s_2^+, \dots, s_s^+)$ is the residual variable vector correspondent with outputs.

39.4 Listed Companies Efficiency Evaluation Calculation and Results Analysis

39.4.1 Selecting Input and Output Indicators by Using AHP

The four listed companies mentioned in part I of DMUs prepared by selected input indicators are: I_1 —Total Assets; I_2 —Total Indebtedness; I_3 —Running Expenses; I_4 —Asset-liabilit Ratio; I_5 —Revenue from Main Operation.

Prepared selected output indicators are: O_1 —Operating Profit; O_2 —Earnings Per Share; O_3 —Net Profit; O_4 —Return on Equity; O_5 —Total Profit.

Then invite specialists to score the above input and output indicators respectively to make pairwise comparisons, establishing judgment matrixes A and B as shown in Tables 39.1 and 39.2.

According to above calculation results, the weights of the indicators, we select three input indicators I_3, I_1, I_2 , and three output indicators O_3, O_5, O_2

That is, the input indicators: X_1 —Running Expenses (10,000 Yuan); X_2 —Total Assets (10,000 Yuan); X_3 —Total Indebtedness (10,000 Yuan). The output indicators: Y_1 —Net Profit (10,000 Yuan); Y_2 —Total Profit (10,000 Yuan); Y_3 —Earnings per Share (Yuan).

Table 39.1 Pairwise judgment matrix a

Input	I ₁	I ₂	I ₃	I ₄	I ₅	w
I ₁	1	2	1/3	5	4	0.235
I ₂	1/2	1	1/4	3	2	0.312
I ₃	3	4	1	9	6	0.512
I ₄	1/5	1/3	1/9	1	1/2	0.046
I ₅	1/4	2	1/6	2	1	0.0769

CR = 0.013 < 0.1. The matrix is consistent

Table 39.2 Pairwise judgment matrix b

Output	O ₁	O ₂	O ₃	O ₄	O ₅	w
O ₁	1	1/3	1/6	2	1/4	0.069
O ₂	3	1	1/4	4	1/3	0.142
O ₃	6	4	1	8	2	0.465
O ₄	1/2	1/4	1/8	1	1/5	0.045
O ₅	4	3	1/2	5	1	0.279

CR = 0.029 < 0.1. The matrix is consistent

Table 39.3 Input output indicators and DEA calculation results

	Input			Output			Efficiency evaluation			
	X ₁	X ₂	X ₃	Y ₁	Y ₂	Y ₃	crste	vrste	Scale	rs
GHGF	5667.43	137257.38	77543.88	1094.79	2142.86	0.0421	0.290	0.964	0.300	irs
XDL	5360.55	149035.35	61881.47	6260.93	8369.53	0.1400	1.000	1.000	1.000	-
DXHP	5728.05	90983.05	20548.19	4169.90	3336.08	0.1781	1.000	1.000	1.000	-
DTDX	15513.63	337490.40	274739.18	3895.78	9586.96	0.0887	0.506	1.000	0.506	drs

39.4.2 Efficiency Evaluation Calculation Using DEA

Collect concern data of the four companies up to September 2009 from Hong Kong and Macao Information Company and then use software DEAP2.1. We then calculate efficiency results as shown in Table 39.3.

39.5 Conclusion

Since data released publicly listed company, so we chose four list companies to evaluate DEA efficiency. Due to the limit in length this paper presents a model in the discussing these issues in the relevant academic fields, but does not show a full mathematical calculation and perfect result.

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Chapter 40

Network Moral Education for Higher Vocational College Students

Xiao-Ling Huang

Abstract With the popularity of the network in higher vocational colleges, network moral education has been an important composite part in the morality education for higher vocational colleges. This paper will make analysis on the irregularity of network morality for higher vocational colleges. In addition, it will explore on the reason why the students in higher vocational colleges would have the irregularity of network morality. Proceeding to the next step, this paper has put forward few methods so as to strengthen the network morality education of students in higher vocational colleges.

Keywords Higher vocational college students · Network morality · Education

40.1 Introduction

With the rapid popularity of network in higher vocational colleges, students in higher vocational colleges have been one of the main groups for the network. Network has played a key role in the ideological concepts, the value orientation, the methods of thinking, and the behavioral modes as well as the personal psychology, and so on. The network has produced a profound influence on the above aspects. Under these circumstances, the network morality education problem of the students in higher vocational colleges has been an urgent problem that cries for the solution.

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40.2 The Network Morality Disorder Problem is Serious for Higher Vocational College Students

“The so-called network morality disorder refers to the weakening and failure of the social morality adjustment effect. The weakening and failure of the social morality adjustment effect is caused by the loss and the imperfection of the basic morality standards in the social networking . In addition, the so-called network morality disorder will produce the confusion and disorder on the level of the entire network social behaviors”. As for the disorder of the network morality for students in higher vocational colleges, the main manifestations are shown as the followings [1]:

40.2.1 Network Words and Behaviors are at Will and Undisciplined

In the first place, as for the topics and the content of the chatting of the students in higher vocational colleges, a great amount of the students do talk about a great deal of things that are unhealthy. Their topics and content have penetrated into a great amount of unhealthy things. In addition to the unhealthy topics and content, the words said and the behaviors of the students in higher vocational colleges are at will and without following to the disciplines [2]. In the second place, a lot of students in higher vocational colleges do pass their eyes over the pornographic website as well as the websites involving a great deal of violence. According to the investigation of the relevant experts, there are about 20 thousand pieces of pornographic photos entering into the internet every day. As for the noneducational information that is flowing on the internet, 70 % of them are related to violence. As for the violence information, a certain amount of them are embodied through the network games. One for the main objectives for 40.9 % of the university students is to play games [3]. In the third place, their studies could be affected due to the fact they have spent a great deal of time on the network. According to the statistics, there are 237 students in East China University of Science and Technology who have discontinued their schooling, and made their academic probation as well as transferring to another school. Among the 237 students , there are 80 % of them indulging in computer entertainment, network chatting as well as network games. Their excessive indulgence result in their bad performance in the university [4].

40.2.2 Network Values are Obscuring and Concept of Legal System is Indifferent

The openness of network has offered convenience to make use of the internet so as to penetrate into the expression of one’s political views for the western countries.

The penetration of the opinions on public affairs has affected the stability of the society [5]. In addition to these, the openness of the network has made it convenient to express words and behaviors that are able to affect the ideological health of the students in higher vocational colleges. As the students in higher vocational colleges do not have a wide vision as well as there are great limitations on their social experiences, they are very likely to be “Occidentalized”. They would gradually give away the original sense of worth as well as their value orientations that are optimistic and upward. In real life, they tend to show egocentrism and the vague value target in the aspects of sense of worth for they mimic slavishly but often with an absurd result and pursue sightlessly [6].

40.2.3 Internet Plagiarism and Plagiarizing a Work Created by Others

The network has offered rich resources. It has realized the information shared all over the world. The network by any means has brought convenience to the life and study for the university students. In addition to these conveniences, the network plagiarism problems occur [5]. In the contemporary society, the students in higher vocational colleges do purchase the essays and plagiarize the essays on the network. The plagiarism problem is becoming more and more serious. Some of the students in higher vocational colleges download the entire passage related to the topic on the network in order to complete the assignment arranged by the teachers. Some of them get their things done just by simple copy and paste method.

40.2.4 Indulgence into Love on the Network

The network has changed the living habits. Among them, the relatively outstanding one is the love online. Although the love online behaviors have little possibility to develop into the love in the reality world because of the meetings in the real world, love online behaviors do exist among the university students. There are approximately two-third of the university students having a meeting with the other party. What is worse, some of the university students have had the so-called “one night stand” with their friends on the network.

40.3 The Reasons for the Network Morality Disorder of Higher Vocational College Students

40.3.1 The Reason Lies in the High Concealment and Unreality of the Network

There are high degree of concealment and unreality of the network. McDonald, the principle for the American Association of Moral Education, once said, “The dangers of the unreality of the network lie in that it captures your attention with a method and a way that are full of deception as well as with the charm. It has discriminated against the other life awareness, feelings, sufferings and fun without any of your attention and awareness. It makes use of the desires and behaviours of communication between all human beings. Moreover, it has constructed her youth that is complicated and confusing and in its unfading flowers” [6]. The existence of every human being on the network is unreal. As for the students of higher vocational colleges who are immature psychologically, who are inexperienced in their social life, and who have relatively bad morality discrimination ability, the network without any doubt has great temptations.

40.3.2 The Important Root Lies in the Psychological Characteristics of Higher Vocational College Students

At the age when students join in higher vocational colleges their sex physiology has fully matured. However, the moral integrity has not yet developed in a mature way. The age stage of the students in higher vocational colleges is equipped with this characteristic. The social press has once made a metaphor between the young men born in the 1980s and 1990s as the strawberries. The appearances are in bright and cheery colors. However, they fail to bear any pressure. As there are a great deal of pressure in living and learning in real life for the students in higher vocational colleges, it is much easier for them to keep far away from the real society. Their keeping away from the real world is to get indulged in the virtual network society with the desire to get rid of the pressures existed in the real world.

40.3.3 One Factor for the Disorder is the Delay of Social, School, and Family Network Morality Education

The existing legal system, moral standards in our country has not yet been perfect. It apparently lags behind the actual situation of the network development.

As for the higher vocational colleges, its network morality education to the students has seriously lagged behind the network technology knowledge education. Most of the parents learn little about the network. They either adopt the methods such as “forbidden” and “blocking up” the network behaviors of their children, or take a liberal attitude toward their children. Therefore, the network morality disorder of the students in higher vocational colleges is inevitable.

40.4 Several Methods to Strengthen the Network Morality Education of the Higher Vocational College Students

40.4.1 Strengthen the Network Laws and Regulations and Morality Publicity, Standard the Network Behaviors

Strengthen the network laws and regulations and the publicity of morality for the students in higher vocational colleges. Since the year 1994, our country has formulated the followings laws and regulations in succession: “The People’s Republic of China Information System Safety Protection Regulations”, “The People’s Republic of China Computer Information Network International Networking Management Interim Regulations” and so on. The formulation and implementation of these network laws and regulations has played an active role in the security and promotion of the healthy development of the network in our country. In November, 2001, such relevant units as the central committee of the communist young league and the culture ministry have announced collectively the “National Teenager Networking civilization Conventions”. They have brought out the networking morality requirements of “five dos and five don’ts”. Practice has shown that only by strengthening the publicity of networking laws and regulations and morality for the students in higher vocational colleges can the perfect networking morality awareness be formed and the networking behaviors are regulated.

40.4.2 Concentrate Network Management and Monitoring Efforts, Purify Networking Environment

The inclusiveness and concealment of the network enables the influential power of a single individual to be enlarged without limitations. Words and behaviors that are unhealthy and illegal spread without restraint on the network. The porn and violence information is even filled with the networking space. Focusing on these problems, each relevant functional department of the government should strengthen the assistance and coordination. It should concentrate the management of the internet bars. In addition, it should intensify the forces to investigate and

treat these bars. Each functional department in the government should be determined to forbid any bars that violate the laws and regulations. It should do regular check to those bars that are equipped with the business license. Whenever any problems are found out, they should be corrected without delay.

40.4.3 The Key to Network Morality Education is the Improvement of Self-Education Ability of Higher Vocational College Students

Students in higher vocational colleges should learn to hold their own. They should scrupulously abide by the networking morality requirements and underscore that citizens should be equipped with. They should consciously strengthen the networking social morality and self-discipline and use the network in a correct manner. Moreover, they should cultivate the spirit of integrity maintenance.

Cultivate networking social morality awareness and improve networking social morality qualities.

Network acts as an important composite part and extension for the realistic world. It has given a great deal of freedom space for the citizens. However, this kind of freedom should not break through the underscores of morality and laws. The students in higher vocational college are the group who are equipped with relatively high culture qualities. They should build good image abiding by the networking social morality and continuously improve the networking social morality qualities.

Start from yourself and cultivate the networking discipline spirit.

The network has such features as unreality and concealment of behavioral subject. It is not beneficial to play the monitoring efforts of the social public opinions, making the morality standard to have apparent lower effect of external restrictions.

40.4.4 School Should Strengthen the Networking Morality Education and Treat It as a Part of the School Morality Education

Strengthen the networking morality education and build network moral concepts.

School should improve the network morality and law qualities by opening lectures on special topics, organizing activities, enlarging network publicity, etc.

Renew network educational concepts and improve efficiency of networking education.

Facing the challenges of network press the, educators should renew ideas and make role change rapidly.

Build school green website and account the website field.

School websites is not only the educational methods for educators, but also an important platform for educational activities. Therefore, higher vocational colleges should strengthen green website construction.

40.4.5 Transfer the Educational Methods of Parents and Adapt to the Needs of the Networking Times

The traditional educational methods should be changed to avoid the bad influences. Families should meet at times and accept new values and concepts in the networking environment.

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Part V
Information Security
and Network Protection

Chapter 41

Improvement of Chopchop Attack

Qingbing Ji, Lijun Zhang and Fei Yu

Abstract Wired equivalent privacy (WEP) is a security protocol in the IEEE 802.11 wireless standard. At present, three attacks are frequently exploited: chopchop attack, Korek attack, and PTW attack. The first can decrypt a packet, while the latter two could recover user's key from known plaintext/ciphertext pairs. We propose more efficient combinational mode of these attacks, and also improve chopchop attack. Our chopchop version does not need to recover the integrity check value (ICV), which reduces 32 data frames forgery. Counting in case of data payload with average length 1,156 bytes, our combinational mode "chopchop + PTW" saves 1,141 bytes plaintext recovery, improving efficiency by 98 %. Furthermore, the mode "chopchop + Korek + PTW" saves 1,154 bytes plaintext recovery, receiving 99 % efficiency improvement. Meanwhile, our attack modes greatly reduce the risk of being detected. So it is more suitable for the real environment, especially when there is no client or low data communication.

Keywords WEP · Chopchop attack · Korek attack · PTW attack · Combinational mode

41.1 Introduction

Wired equivalent privacy (WEP) is specified as the encryption protocol in the IEEE 802.11 wireless standard [1]. This protocol is widely applied in wireless local area networks of real life, and its security has been intensively studied.

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Borisov, Goldberg, and Wagner [2] first investigated the WEP protocol in 2001, and disclosed some severe flaws in its data protection for integrity and confidentiality. In the same year, Fluhrer, Mantin, and Shamir [3] proposed FMS attack, which can recover user's root key due to the improper use of underlying stream cipher RC4. Later, researchers found more attack methods, such as chopchop attack [4], Korek attack [5]; Klein attack [6], and PTW attack [7]. Every attack has its own advantages. FMS and Korek are attacks work in a passive way (just eavesdrop) which require to collect a large amount of data frame packets. Chopchop, Klein, and PTW attacks are active (forge and broadcast the data packets actively), so they need much less packets. In a real attack scenario, a passive attack may not succeed because of the low data communication. Hence, the chopchop and PTW attacks are applied much more presently. It is known that WEP has been replaced by Wi-Fi Protected Access protocol (WPA) in the successor standard IEEE 802.11i. However, WEP is still used and some vendors still ship devices which can only connect to totally open or WEP protecting networks. This is mainly out of cost consideration. The popular attacks (such as chopchop, PTW) need to broadcast the forged ARP data packets in the network, while nowadays most intrusion detection systems can find these active attackers promptly. Hence, it is meaningful to improve the attack efficiency and reduce the risk of being detected, which is exactly our motivation.

The rest of this paper is organized as follows: Sect. 2 reviews the chopchop attack and Sun's improvement [8]. In Sect. 3, we suggest that chopchop should combine with other popular attack methods. This could be a solution to the problem that data packets are insufficient for these attacks when there is only low data communication available. In Sect. 4, we give an improvement to enhance chopchop attack efficiency massively and reduce the risk of being detected, which makes this attack more suitable for real applications. We end this paper with some conclusions in Sect. 5.

41.2 Review of Chopchop Attack

In WEP, every client shares a root key Rk with the Access Point (AP). When a client is prepared to send a data M , it first computes the 32 bits Integrity Check Value (ICV) of M by using the CRC32 algorithm; then chooses a 24 bits Initialization Vector (IV) and inputs the concatenation $K = IV||Rk$ to the RC4 to generate the key stream $X = RC4(K)$ for encrypting plaintext $M||ICV$, i.e., the ciphertext $C = (M||ICV)X$; finally broadcasts the data $IV||C$. Upon getting $IV||C$, the AP uses the key K to recover $M||ICV = CX$, and enforces integrity checking for it. If the checking is correct, the ciphertext message is relayed back to the network by AP. Otherwise, it is silently discarded.

Exploiting this property and the CRC32 algorithm, Korek presented the remarkable chopchop attack [4] on NetStumbler forum. This attack can decrypt a WEP frame without knowing the key. Here we review the attack briefly.

We remind the reader that every 0, 1 sequence in WEP is also regarded as a polynomial over the binary field F_2 . For example, 100111101 is equivalent to $x^8 + x^5 + x^4 + x^3 + x^2 + 1$.

Suppose that the AP received the encrypted data, $C = (M||ICV)X$, whose polynomial is $C(x) = \sum_{k=0}^{N-1} c_k x^k$, where N is the bit length of C , and $c_k \in \{0, 1\}$, $k = 0, 1, \dots, N-1$.

Let $M' = M||ICV$, since, we have $C(x) = M'(x) + X(x)$. According to the CRC32 algorithm, $ICV(x) = x^{32}M(x) \bmod R_{CRC}(x)$, so that

$$M'(x) = 0 \bmod R_{CRC}(x) \quad (41.1)$$

Where $R_{CRC}(x) = x^{32} + x^{26} + x^{23} + x^{22} + x^{16} + x^{12} + x^{11} + x^{10} + x^8 + x^7 + x^5 + x^4 + x^2 + x + 1$ is the irreducible generator polynomial of CRC32 in $F_2[x]$.

Write $M'(x)$ as

$$M'(x) = x^8 M_1(x) + Y_1(x) \quad (41.2)$$

where $M_1(x) = \sum_{k=0}^{N-9} c_{k+8} x^k$ and $Y_1(x) = \sum_{k=0}^7 c_k x^k$, which means Y_1 is the last byte of M' .

Since $F_2[x]/(R_{CRC}(x))$ is a finite field (recall $R_{CRC}(x)$ is irreducible), x^8 is invertible in this field, and $(x^8)^{-1} = x^{31} + x^{29} + x^{27} + x^{24} + x^{23} + x^{22} + x^{20} + x^{17} + x^{16} + x^{15} + x^{14} + x^{13} + x^{10} + x^9 + x^7 + x^5 + x^2 + x$. Multiply $(x^8)^{-1}$ to the both sides of Eq. (41.2),

$$(x^8)^{-1} M'(x) = M_1(x) + (x^8)^{-1} Y_1(x) \quad (41.3)$$

So that

$$M_1(x) + (x^8)^{-1} Y_1(x) = 0 \bmod R_{CRC}(x) \quad (41.4)$$

Recall that $C(x) = M'(x) + X(x)$, we have $C(x) = x^8 M_1(x) + Y_1(x) + x^8 X_1(x) + X_0(x)$, where $X_1(x)$ and $X_0(x)$ denote the first $N-8$ bits and rightmost byte of the key stream X , respectively. Write $C(x)$ in the form $C(x) = x^8(M_1(x) + X_1(x)) + (Y_1(x) + X_0(x))$,

Now we look at the one byte chopped version $C_1(x)$ of $C(x)$, that is $C_1(x) = M_1(x) + X_1(x)$. Since $C_1(x) + (x^8)^{-1} Y_1(x) = M_1(x) + X_1(x) + (x^8)^{-1} Y_1(x) = (M_1(x) + (x^8)^{-1} Y_1(x)) + X_1(x)$,

Let $C''(x) = C_1(x) + (x^8)^{-1} Y_1(x)$ and

$$M''(x) = M_1(x) + (x^8)^{-1} Y_1(x) \quad (41.5)$$

Then $C''(x) = M''(x) + X_1(x)$

An attacker can send $IV||C''$ to the AP and the AP will decrypt C'' to get M'' then check its integrity. We know that the checking for M'' is successful if and only if

$$M''(x) = 0 \text{ mod } R_{CRC}(x) \quad (41.6)$$

From Eqs. (41.4) and (41.5), we see that C'' is determined by C_1 and Y_1 and when Y_1 is exactly the last byte of $M||ICV$, the Eq. (41.6) holds. However, as an attacker, he just intercepted C_1 without knowing Y_1 . So he will guess every possible value of Y_1 and send the corresponding data $IV||C''$. According to WEP protocol, if Y_1 is right, then the AP will transmit $IV||C''$ back to the network. So if the attacker intercepts this value, he will know the guess is right and the last byte of $M||ICV$ is recovered. The total possible values of Y_1 are 256, and in average, the attacker will need 128 queries. Iteratively, the attacker can recover all the plaintext bytes.

Sun and Hu [8] improved the chopchop attack; the idea is to recover plaintext bit by bit. Since one bit is either 0 or 1, the attacker will always guess every bit to be 0, and if he intercepts his forged ciphertext again, then the guess is right, otherwise the true bit value is 1. This means an attacker can recover a bit just by sending a packet one time, so 1 byte plaintext recovery will only need eight queries, which improves the efficiency by 16 times.

Now we present the detailed steps of the general chopchop attack.

Step 1: An attacker intercepted a WEP data frame $IV||C$.

Step 2: Chop the last i bits of $C = (M||IV)X$, and we denote this new ciphertext by C_i .

Step 3: Guess the last i bits of $M' = M||ICV = CX$ to be Y_i randomly, compute $Y'_i = (x^i)^{-1}Y_i \text{ mod } R_{CRC}(x)$, and send back the frame $IV||(C_iY'_i)$ to the AP.

Step 4: Monitor the network, if detect the frame $IV||(C_iY'_i)$, then the guess is right. Otherwise go to step 3.

In the original chopchop attack, i equal 8. The guess is byte by byte, while the improvement of Sun takes i to be 1. Therefore in step 3, the attacker will always guess the Y_i to be 0, and rely on the monitor result to determine whether it is right. This improvement recovers 1 byte with 8 queries, while the original version needs 128 queries which is slower by 16 times.

41.3 Combinational Attack Modes

For WEP protocol, Tews proposed the PTW attack, which can recover 104 bit (or longer) user's key in 1 min and requires much less data frames. It is so remarkable that almost all the practical cracking softwares on the Internet are based on this method.

However, any attack is not "perfect" (compared to FMS and Korek attacks, PTW requires more bytes of key stream, the first 15 or 31 bytes). In order to acquire these key stream bytes, an attacker usually uses the active ARP injection method. But the more injections are detected by the intrusion detection systems into the network easier. Hence in a real attack scenario, how to reduce injections is

a research topic of the PTW attack. Tews’s “chopchop + PTW” combinational attack mode [9] may be good advice for solving this problem.

In addition, unlike the PTW attack requiring the first 15 or 31 key stream bytes, the Korek attack only needs the first 2 bytes, which are much easier to supply. So Tews and Beck [10] proposed to compute the key bytes sum σ_i (in PTW attack) using the correlations of Korek attack. However, in the case of no client or low communication, the amount of data frames is not sufficient for these correlations. Hence, we propose to adopt the way of using the chopchop attack to acquire enough key stream bytes and implement “chopchop + Korek + PTW” combinational attack. This mode can solve the problem of lacking data frames in the Korek and PTW attacks.

41.4 Improving the Chopchop Attack

We have seen that the chopchop attack can not only recover the plaintext, but also can combine with other kind of attack by providing the necessary key stream bytes. This makes other popular attacks more suitable for the environment of low communication. Nevertheless, the present version of chopchop attack (including Sun’s improvement) has the following disadvantages:

1. It has to recover 4 bytes ICV before recovering the message M . Moreover, the recovery order is from right to left. So no matter how short the message is, it always has to recover the ICV at first. This property is unpleasing.
2. The recovery of key stream is from the XOR operation of ciphertext and the recovered plaintext $M||ICV$. So the order of key stream recovery is also right back to left, but these latter key stream bytes are not applied in the Korek or PTW attack, which brings a waste of effort and increscent risk of being detected.

In order to solve these two problems, we propose the following improvement for chopchop attack. The most impressive advantage is that the recovery begins from the front. So we can just recover the key stream bytes of what we need in Korek or PTW attack, which saves a lot of ARP injections, and therefore also reduces the risk of being detected.

The detail of our improvement is as follows.

Here, we also consider every binary data frame as a polynomial in $F_2[x]$. But the corresponding way is different from the standard way in Sect. 41.2. For example, we look the binary 10011101 sequence as $x^8 + x^6 + x^5 + x^4 + x^3 + 1$, while it is looked as $x^8 + x^5 + x^4 + x^3 + x^2 + 1$ before.

Let $M'_H(x)$ be the polynomial of $M' = M||ICV$ in our corresponding way. Apparently, $M'_H(x)$ and $M'(x)$ are reciprocal polynomials (recall that $M'(x)$ is the standard corresponding of M' in Sect. 41.2). Let N be the degree of $M'_H(x)$, then $M'_H(x) = x^N M'(1/x)$. From Eq. (41.1), we know that

$$M'(x) = 0 \bmod R_{\text{CRC}}(x) \Leftrightarrow x^N M'(1/x) = 0 \bmod (x^{32} R_{\text{CRC}}(1/x)),$$

Let $R_{\text{HCRC}}(x)$ be the reciprocal polynomial of $R_{\text{CRC}}(x)$, i.e., $R_{\text{HCRC}}(x) = x^{32} R_{\text{CRC}}(1/x)$. Then we have

$$M'(x) = 0 \bmod R_{\text{CRC}}(x) \Leftrightarrow M'_H(x) \bmod R_{\text{HCRC}}(x) \quad (41.7)$$

Chop the first i bits of $M||\text{ICV}$, and denotes the rest binary sequence by M_{Hi} , write $M'_H(x) = x^i M_{\text{Hi}}(x) + Y_{\text{Hi}}(x)$, and

$$(x^i)^{-1} M'_H(x) = M_{\text{Hi}}(x) + (x^i)^{-1} Y_{\text{Hi}}(x).$$

From Eq. (41.7), we get

$$M_{\text{Hi}}(x) + (x^i)^{-1} Y_{\text{Hi}}(x) = 0 \bmod R_{\text{HCRC}}(x) \quad (41.8)$$

Let C_{Hi} be the binary sequence chopped the first i bits in $C = (M||\text{ICV})X$ and so is the X_{Hi} of X . That is $C_{\text{Hi}}(x) = M_{\text{Hi}}(x) + X_{\text{Hi}}(x)$.

So we have

$$C_{\text{Hi}}(x) + (x^i)^{-1} Y_{\text{Hi}}(x) = M_{\text{Hi}}(x) + (x^i)^{-1} Y_{\text{Hi}}(x) + X_{\text{Hi}}(x).$$

Let $C''_{\text{Hi}}(x) = C_{\text{Hi}}(x) + (x^i)^{-1} Y_{\text{Hi}}(x)$, and

$$M''_{\text{Hi}}(x) = M_{\text{Hi}}(x) + (x^i)^{-1} Y_{\text{Hi}}(x) \quad (41.9)$$

Then $C''_{\text{Hi}}(x) = M''_{\text{Hi}}(x) + X_{\text{Hi}}(x)$

Like the original chopchop attack version, an attacker can send $\text{IV}||C''_{\text{Hi}}(x)$ to the AP, AP will decrypt and check the integrity of M''_{Hi} by CRC32 algorithm. Let $M''_i(x)$ be the polynomial of M''_{Hi} in the standard way, then according to the CRC32 algorithm, checking M''_{Hi} is successful if and only if

$$M''_i(x) = -0 \bmod R_{\text{CRC}}(x) \quad (41.10)$$

It is easy to see that $M''_{\text{Hi}}(x)$ and $M''_i(x)$ are reciprocal polynomials, hence

$$M''_i(x) = 0 \bmod R_{\text{CRC}}(x) \Leftrightarrow M''_{\text{Hi}}(x) \bmod R_{\text{HCRC}}(x).$$

From Eqs. (41.8), (41.9) and (41.10), we know if Y_{Hi} is the first i bits sequence of $M||\text{ICV}$, then the congruence $M''_i(x) = 0 \bmod R_{\text{CRC}}(x)$ (or $M''_{\text{Hi}}(x) \bmod R_{\text{HCRC}}(x)$) holds.

As before, actually the attacker does not know the value of Y_{Hi} , and he will guess. Now, he can also exploit Sun's improvement, and recovers M bit by bit, note that here he does not need to recover the ICV .

41.5 Conclusion

For the real attack environment, where there is no client or only low communication available, it is difficult to execute the popular attacks because of lacking enough key stream bytes. Moreover, if an attacker implemented many ARP injections to acquire key stream bytes, he will probably be detected promptly. So in this chapter, we propose the “chopchop + Korek + PTW” combinational attack mode. To some extent, this way solves the problem of lacking data frames in the low communication scenario.

The recovery order of present chopchop attack is from the rightmost. For the plaintext recovery, it has to recover 4 bytes *ICV* at first, but this value is useless. For the key stream recovery, we usually need only the first 2 or 15 bytes, so the attack will waste much effort to recover the latter bytes. Especially, the waste and the risk of being detected become higher as the ciphertext is longer.

Our chopchop improvement has the following advantages:

1. For the plaintext recovery attack, our version does not need to recover *ICV* any more, which reduces 32 frames forgery and broadcast.
2. For the key stream recovery attack, counting in case of data payload with average length 1,156 bytes (the maximal length 2312), the combinational mode “chopchop + PTW” saves 1,141 bytes plaintext recovery, which improves the attack efficiency by 98 %. Furthermore, the attack mode “chopchop + Korek + PTW” saves 1,154 bytes plaintext recovery, receiving 99 % efficiency improvement.
3. Meanwhile, our combinational attacks greatly reduce the risk of being detected because of decreasing much forgery and broadcast of the data frames. So it is more suitable for the real environment, especially when there is no client or only low data communication.

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Chapter 42

Reliability Analysis of Triple-Redundant CompactPCI SBC

Peng Wang and Yan Bai

Abstract Embedded systems based on field-programmable gate arrays (FPGAs) are popularly used in space system. However, as FPGA is especially susceptible to radiation generated by special particles which could lead to soft errors, it is quite important to adopt fault-tolerance technologies to mitigate these problems. In this paper, the research object—a CompactPCI SBC with advanced safety features could realize the functionality of three-redundant systems on a single board. Its complex FPGA-based design technology, which automatically manages the system's triple-redundant processors and memory, could help dramatically lower software development costs. Reliability assessment technology is introduced to quantitatively evaluate the performance of the CompactPCI SBC. From the hardware architecture and fault tree models of redundancy configurations, probability of failure on demand (PFD) calculation formulas and the corresponding safety integrity level (SIL) for each component unit could be derived.

Keywords CompactPCI SBC · Fault tolerance · Reliability analysis · Triple redundant

42.1 Introduction

With the development of digital information technology, embedded system design has been widely used. Due to the advantages of low volume, low power, and high integration, embedded systems based on field-programmable gate arrays (FPGAs)

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are popular applied in space system [1, 2]. However, as FPGA is especially susceptible to radiation generated by special particles which can lead to soft errors, the adoption of fault-tolerance technologies to mitigate these problems is an increasingly important subject [3–5]. Triple modular redundancy (TMR) is taken as a frequently used fault tolerance technology for the FPGA design to resist single-event upset (SEU) [6]. TMR has been shown to significantly improve the reliability of FPGA designs, but it is very expensive in terms of circuit area and power costs. Due to resource and system constrains, it is not possible to realize TMR for the entire design, but sacrifice some reliability and apply TMR to parts of the FPGA design.

Partial triplication of the FPGA design cannot reach the same reliability level provided by the full TMR, so it must focus on the components which most affect the reliability of the whole system. In this paper, the research object is a CompactPCI SBC with advanced safety features that realize the functionality of three-redundant systems on a single board [7, 8]. Its complex FPGA-based design technology, which automatically manages the system's triple-redundant processor unit and memory unit, can help dramatically lower software development costs. From safety and reliability analysis of subsystems in different redundant architectures, it is confirmed that this system could achieve higher safety and reliability level and fully take advantage of software designed for a standard single-CPU card [9].

42.2 Modular Redundancy Architectures

The CompactPCI SBC is designed for deterministic operation and extensive features which include monitoring of all internal voltages, error correction of internal buses, and fault-tolerant (fail-operational) implementation, with the architecture illustrated in Fig. 42.1. Three processors run in lockstep mode with 2-out-of-3 voting implemented in FPGA and software-assisted resynchronization. Triple-redundant dynamic memory unit automatically corrects upsets caused by cosmic radiation and hardware faults. The system is powered by redundant local power supplies with separate power supplies for the three CPUs and the three main memory ranks. Technology parameters for each part of triple-redundant CompactPCI SBC are shown in Table 42.1

42.2.1 Triple CPU Redundancy

Three processors run the same program and do the same thing synchronously clockwise. The CPU voter compares outputs from all the processors, and then request is forwarded to backbone in the case of at least two processors producing the same output. If one of the three processors differs from others, it can be judged that this one is in fault, which will be put in reset permanently. Then the voter switches to compare the outputs of the remaining two CPUs and the system is still fully functional and safe unless one fault happens on another CPU. This voting logic is accordance with 2-out-of-3 (2oo3) voting mechanism.

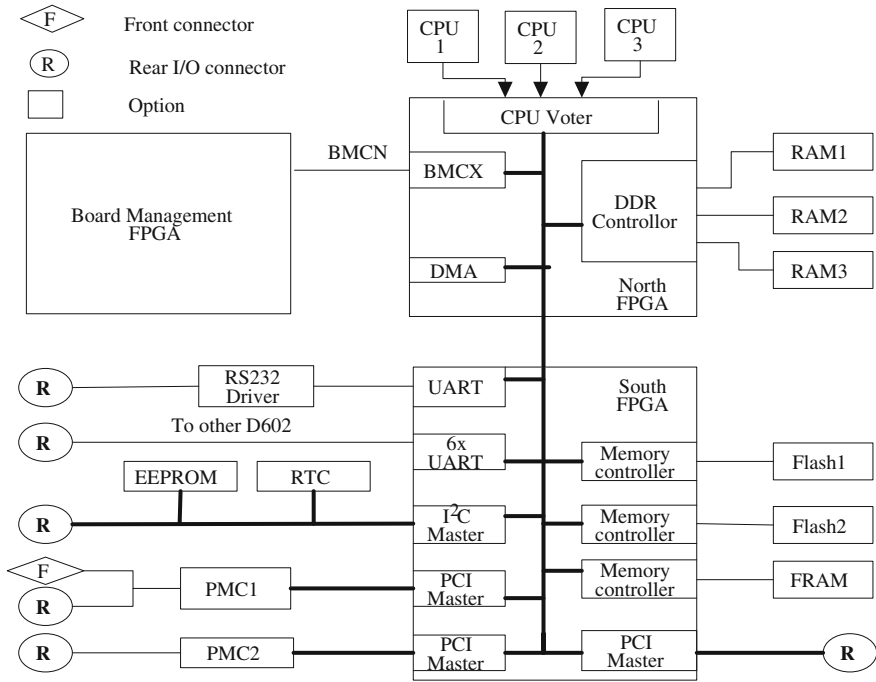


Fig. 42.1 Architecture diagram of triple-redundant CompactPCI SBC

Table 42.1 Technology parameters of triple-redundant CompactPCI SBC

CPU	3 redundant power PC 750CL, 1 GHZ
CompactPCI	32 bit/33 MHZ CompactPCI system slot
Memory max	3 redundant 512 MB DDR SDRAM 2 redundant 256 MB ECC Flash 1 MB ECC FRAM
Interfaces	6UARTs, 1 RS232, I ² C
Onboard FPGA	Northbridge and Southbridge with redundant structure
Local extensions	1 standard PMC slot and 1 customized PMC slot for AFDX with rear I/O

42.2.2 Triple Memory Redundancy

The memory unit consists of three physical separate banks which have identical content with each other. The voting mechanism is also 2oo3, which could provide much better error correction capabilities by correcting single- or multi-bit errors and tolerates even total loss of one physical memory bank.

42.2.3 Two Flash Banks

In order to deal with the problem that Flash devices may lose content after a few years and improve the system reliability, it takes double redundancy for flash banks. Both banks contain the same data, and the system is fully functional even if one bank is completely lost. This voting logic is accordance with 1-out-of-2 (1oo2) voting mechanism.

42.3 Reliability Assessment of CompactPCI SBC

In accordance with IEC61508, reliability and safety assessment plays an important role in the area of electric, electronic, and programmable electronic components and systems design. IEC 61508 proposed two important concepts, safety life cycle and safety integrity level (SIL). SIL is determined by the range of probability of failure on demand (PFD) for low demand operation mode or by the range of probability of failure per hour (PFH) for high demand operation mode, shown in Table 42.2. SIL verification is a necessary procedure of safety life cycle which verifies if the safety measurement meets the required standard. There are several analysis techniques, such as failure modes and effects analysis (FMEA), simplified equations, reliability network, fault tree analysis (FTA), and Markov analysis (MA).

42.3.1 Failure Modes and Effects Analysis

FMEA is a systematic technique which is used for identifying the critical failures within the whole system. It is a systematic technique to form a detailed list of all components within the system. With the addition of the diagnostic ability evaluation, FMEA can be extended to failure modes, effects and diagnostic analysis (FMEDA).

According to IEC61508, failure modes can be divided into three categories: safe, dangerous, and no effect. As diagnostics and common cause failures are modeled, failure categories are extended, as shown in Table 42.3.

Table 42.2 SIL categories

	Low demand operation mode	High demand operation mode
SIL	PFD	PFH
4	$10^{-4} - 10^{-5}$	$10^{-8} - 10^{-9}$
3	$10^{-3} - 10^{-4}$	$10^{-7} - 10^{-8}$
2	$10^{-2} - 10^{-3}$	$10^{-6} - 10^{-7}$
1	$10^{-1} - 10^{-2}$	$10^{-5} - 10^{-6}$

Table 42.3 Failure mode categories

SDN	Safe detected normal	DDN	Dangerous detected normal
SDC	Safe detected common	DDC	Dangerous detected common
SUN	Safe undetected normal	DUN	Dangerous undetected normal
SUC	Safe undetected common	DUC	Dangerous undetected common

Table 42.4 FMEA format of triple-redundant CompactPCI SBC

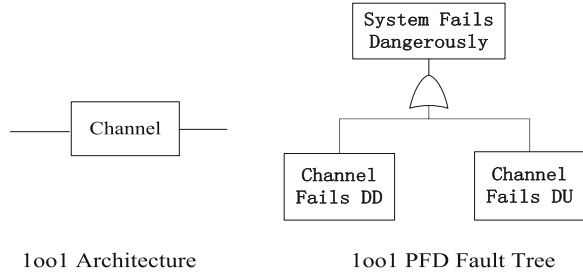
Name	Code	Function	Mode	Cause	Effect	Criticality	Failure Rate	Remarks
Power PC								
CompactPCI								
SDRAM								
ECC Flash								
ECC FRAM								
UART								
RS232								
I ² C								
Onboard FPGA								
PMC slot								

Steps required in the FMEA process include:

1. Define a failure;
2. Complete a system-level FMEA
 - Identify and list all system components
 - Identify all failure modes and system effect for each component;
3. Classify failures according to effect and diagnostic;
4. Determine the level of model detail;
5. Develop the model
 - List all failure rates;
 - Build a model accounting for all failure rates.
6. Solve the needed reliability and safety measurements (Table 42.4).

FMEA is a “bottom-up” method which starts with a detailed list of all components within the system, and is fit for the design phase of a system. However, the FMEA technique also has many limitations. Since each component is reviewed individually, combinations are not addressed; and in fault-tolerant systems, common-cause failures are rarely identified.

Fig. 42.2 PFD fault tree of 1oo1 configuration



42.3.2 Fault Tree Model Construction of Redundancy Configurations

Fault tree analysis (FTA) is a top-down approach to identify the system problems. FTA is a very complementary to the FMEA, which helps to identify design problems in complex systems. The end result of an FTA is a diagram which shows the combinations of events contributing to the system failure.

The process of fault tree model construction contains:

- Draw top-level event showing system failure mode
- Draw all lower events which will trigger the top event
- Continue the process with all failure rates.

42.3.2.1 1oo1 Configuration

1oo1 configuration contains only one channel providing no fault tolerance, the system can fail dangerously if the channel fails dangerously. Failure categories include: dangerous detected (DD), dangerous undetected (DU), safe detected (SD), and safe undetected (SU). PFD fault tree of 1oo1 is shown in Fig. 42.2.

Assume RT is the actual repair time and TI is the test interval for a periodic inspection, formula of PFD calculation for 1oo1 configuration is:

$$PFD_{1oo1} = \lambda^{DD} \times RT + \lambda^{DU} TI \tag{42.1}$$

42.3.2.2 1oo2 Configuration

1oo2 configuration contains two channels with the output of each one connected in series. Both channels that fail dangerously can lead to the dangerous failure of the system. PFD fault tree of 1oo2 is shown in Fig. 42.3.

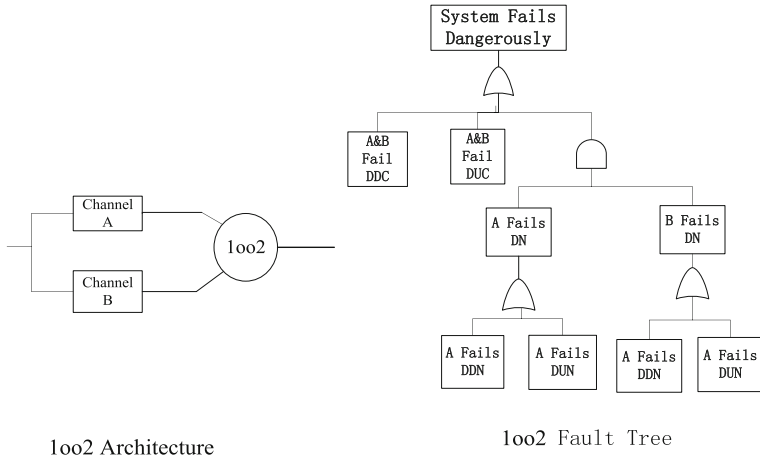


Fig. 42.3 PFD fault tree of 1002 configuration

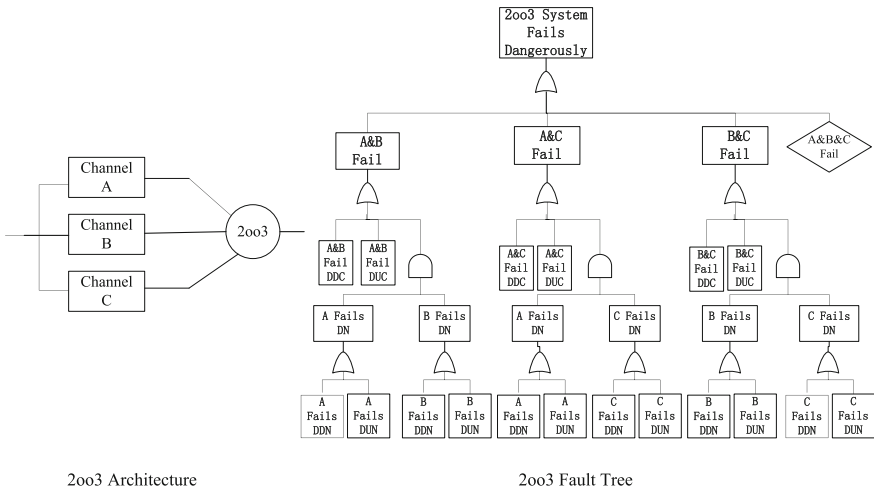


Fig. 42.4 PFD fault tree of 2003 configuration

Formula of PFD calculation for 1002 configuration is:

$$PFD_{1002} = \lambda^{DUC} \times TI + \lambda^{DDC} \times RT + (\lambda^{DUN} \times TI + \lambda^{DDN} \times RT)^2 \quad (42.2)$$

42.3.2.3 2003 Configuration

2003 configuration contains three channels, and outputs are compared for each two channels. Only one channel failure could not affect the system, but two or more

channels that fail dangerously could lead to the system failure. PFD fault tree of 1oo2 is shown in Fig. 42.4.

Formula of PFD calculation for 2oo3 configuration is:

$$PFD_{2oo3} = 3\lambda^{DUC} \times TI + 3\lambda^{DDC} \times RT + 3(\lambda^{DUN} \times TI + \lambda^{DDN} \times RT)^2 \quad (42.3)$$

42.4 Conclusions

CPU and RAM units are both in 2oo3 configuration, flash unit is in 1oo2 configuration and others are all in 1oo1 configuration, PFD for each unit and corresponding SIL can be reached from formulas (1), (2), and (3) and Table 42.1.

This paper introduces the reliability analysis process of a CompactPCI SBC. From the hardware architecture and the fault tree models of 1oo1, 1oo2, and 2oo3 redundancy configurations, PFD calculation formulas and the corresponding SIL for each unit could be derived.

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Chapter 43

Research on Security Mechanism of Sharing System Based on Geographic Information Service

Guang-shi Li

Abstract In order to enhance the security of the spatial data in the information sharing system based on the WFS services, this paper analyzes the hidden danger of the spatial data in the calling WFS service process. On this basis, the paper built a WFS security service module based on the XML key management, the XML digital signatures, the XML digital encryption security specifications, and geospatial extensible access control markup languages. The module is located between the client and geographic information server, before providing the WFS geographic information services, it can quickly and effectively distinguish the user's identity, operating authority, and has the ability to encrypt transmitted spatial information and accomplish integrity, nonrepudiation verification.

Keywords Geographic information service · Web feature service · Security service module · Xml key management specification · Xml encryption

43.1 Introduction

In order to achieve the information sharing and the interoperability of various types of heterogeneous information systems, the open geographic information systems consortium (OGC) launched a variety of topics open specifications. Thereinto, a series of geographic information services are drafted in OpenGIS web services architecture, which has brought new opportunities for the sharing of the spatial information [1].

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At present, many well-known commercial GIS softwares (e.g., ArcGIS) have provided interfaces to publish or call Web Feature Service (WFS), Web Map Service (WMS). The same time, in the open source world has emerged a large number of open source GIS platform to support geographic information services (e.g., geoserver). Geographic information services have become a mainstream technology of realizing cross-platform GIS application systems [2], principally solve the sharing of geographic information resources in the network environment [3]. WebGIS systems built on geographic information services have been successfully used in many industries at home and abroad. However, most of these systems focus on information sharing, and do not pay much attention to the spatial information security issues. This paper analyses the security of the information sharing system based on WFS, and strives to build a WFS safe service module.

43.2 Several Key Conditions Needed to Be Met in Safe WFS Service System

The WFS supports INSERT, UPDATE, DELETE, QUERY, and DISCOVERY of geographic features. WFS delivers GML representations of simple geospatial features in response to queries from HTTP clients. Clients access geographic feature data through WFS by submitting a request for just those features that are needed for an application [4]. The past file-level data sharing is elevated to the feature level. In WFS-based information sharing system, its basic calling model is shown in Fig. 43.1

From above calling mode can be seen that safe WFS service system must meet following conditions:

Can ensure the security of calling WFS: At present, the clients in many geographic information sharing systems is still using the user name and password to complete accessing control, when calling the WFS service, the simple method cannot safeguard the safety of confidential spatial data. Therefore, the sharing system must be able to divide the user's or role's permissions strictly according to security level of spatial data, can ensure the user to get the corresponding spatial

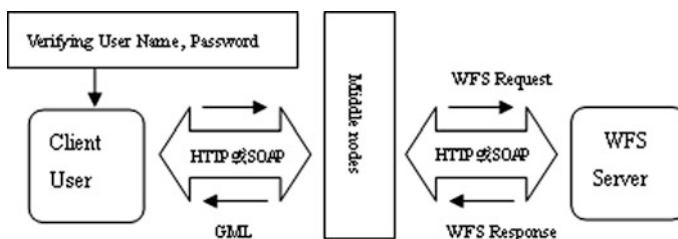


Fig. 43.1 The basic calling mode of the WFS

data and metadata description of accessibility services, which calls the GetFeature and the GetCapabilities requests of the WFS.

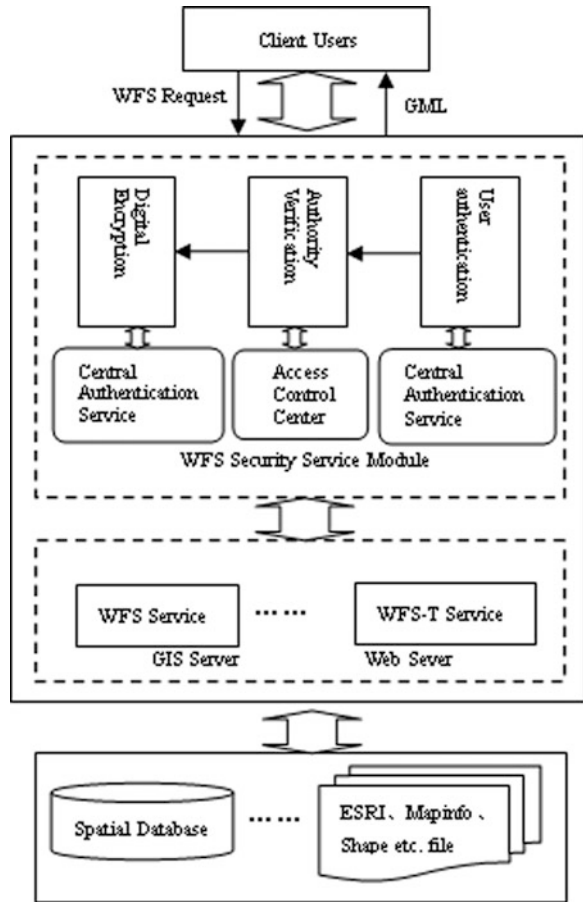
Can ensure the storage security and network transmission security of the response results: The final result of the WFS request returns in geography markup language (GML) format. GML is an XML-based, data-oriented markup specification. It always strives to explain the data itself meaning accurately and clearly, which brings advantages for its application, at the same time it also brings a great deal of security risks. Currently, the secure sockets layer (SSL) security mechanism on network layer is usually adopted, to ensure the transmission safety of GML data. However, the SSL can only protect the transfer security of the spatial data, rather than the security of the data itself. That is to say, the SSL can only provide point-to-point safety, once an attacker has taken over a node, and then the GML data will be viewed and even tampered with by anyone. Therefore, the safe WFS service system should provide end-to-end security mechanisms to ensure the storage security of the spatial data in intermediate nodes.

Can provide a flexible data encryption mechanism: Usually, GML file used to describe the geographic features have the massive amount of information. In order to reduce the information transmission time, improve the response speed of WFS request, the encryption mechanism used by the safe WFS service system should be able to implement encrypting on the part file according to the security level of spatial data in GML files.

43.3 The Building of the WFS Security Service Module

Aiming at above analyses, the paper constructs a security service module that is located between the client and geographical information server. The module is mainly composed of two submodules: a digital certificate submodule and an access control submodule. Thereinto, the digital certificate submodule is based on digital certificates to achieve user's authentication, integrity, and confidentiality protection of spatial data. The digital certificate is a digitally signed file by certificate authority (CA), which can be used to protect point-to-point security in HTTP network transmission, can also be used as end-to-end security in the web services environment. The access control submodule principally completes the user permission control for spatial data. The flow chart of accessing spatial data based on the WFS security service module is shown in Fig. 43.2.

Fig. 43.2 The flow chart of accessing geospatial data is based on the WFS security service module



43.4 The Key Technologies to Achieve the WFS Security Service Module

43.4.1 The Digital Certificate Submodule

In this paper, the key technology to achieve the digital certificate is the XML key management specification (XKMS). Its main features include the registration of public key, release, revocation, verifying, querying, and so on [5]. Through the XKMS, the authentication, digital signature, and the encryption service can be integrated into a web-based application, which allows developers to avoid the inconvenience that must use software tools from the PKI software vendors. More importantly, the greatest benefit of using the XKMS is minimizing the complexity of implementing the PKI, the client does not require too much configurations, only needs to support such as SOAP, WSDL, etc., standards.

43.4.1.1 The User Authentication

The identity verification of the WFS requester is based on the user login information and user information in the database. First, the user information is performed SHA-1 hash algorithm, and an interference value is added to the calculation results, and then performs a Salt operation, finally, the ultimate hash value and the Salt value will be written into the database. When the user logs in, the same operations were executed for the login information and results were compared with the values in the database, to complete authentication.

43.4.1.2 The Digital Encryption

For improving the encrypting speed, the paper adopts AES symmetric encryption algorithm to encrypt the GML file. Symmetric encryption has only one key. In order to facilitate key management, the paper will randomly generate an encryption key, when encrypts data. After encryption is completed, the service requester's information together with the key, data identification, and time information are written to the database, when the user has got the key, the key will be destroyed.

The paper using digital encryption specification XML encryption to achieve encrypting/decrypting GML file, which has the following two advantages: ① To support any encryption granularity, includes the entire file, which can selectively encrypt on a part of the file according to the sensitivity of spatial data in GML file. ② Can ensure that the encrypted data cannot be spied by an unauthorized personnel, both in transmission or in storage.

43.4.1.3 The Integrity and the Nonrepudiation of the Information Exchange

In the digital certificate submodule, the integrity and the nonrepudiation of the information exchanges are achieved mainly through digital signature. In the digital signature process, first calculate a message digest of fixed length for the message via the SHA-1 algorithm, then calls the RSA algorithm function to randomly generate a public key and a private key, and uses the private key to encrypt the hash value of the message to generate a digital signature. The verification process of the digital signature and the digital signature process on the contrary.

This paper adopts XML Digital Signature Specification that has the following advantages: Only need to sign sensitive spatial data, need not sign unimportant data; the signed GML file is still XML structure, which is conducive to understanding and operating the document content for the receiver; can achieve multiple digital signatures at different portion of the same GML file.

43.4.2 The Access Control Submodule

Access control submodule is composed of geospatial policy enforcement point (GeoPEP) and geospatial policy decision point (GeoPDP). GeoPDP derives authorization decision for GeoPEPs based on information received from authorization decision request and GeoXACML policy. GeoPEP intercepts communication from client to service and controls access based on authorization decisions received from GeoPDP. The control process is as follows: GeoPEP converts a received service request into a local request, and sends to Content Handler. On the collected resources, subjects and environment attributes information, the Content Handler converts the decision request in the native request format to the GeoXACML canonical form, and sends it to GeoPDP. According to the policies, GeoPDP evaluates and sends authorization decision to GeoPEP through Content Handler, thus determines the accessibility of local resources.

The access control submodule is realized based on the SunXACML development kit, mainly increases Point, LineString, LineRing, Polygon, BOX and other data types, and Disjoint, Touches, Crosses, Within, Overlaps, Intersects, Equals, etc., spatial function [6]. But what needs to point out is geographic information in which services run before, should customize GeoXACML policies, and store them into the policy repository. The GeoXACML policy is composed of a set of rules, an identifier for the rule-combining algorithm, and a set of obligations. Each rule is expressed in a tuple (Grant-type, (Subjects, Resources, and Actions), Condition). It shows that if conditions are satisfied, then a grant type such as “permit” or “deny” is given to (Subjects, Resources, and Actions), denoting Subjects can perform Actions on geospatial Resources. The following statement illustrates an example of a geospatial policy that grants the employee_A to access a feature type “roads” within the area specified in the polygon, in specified condition. The simplified policy is as follows:

```
<Rule RuleId = "P1_a" Effect = "Permit">
<Target>
<Subjects> <Subject> <SubjectMatchMatchId = "function:stringequal">
<Attribute ValueDataType = #string> employee_A <AttributeValue>
</SubjectMatch> </Subject> </Subjects>
<Resources> <Resource> <AttributeSelector> RequestContextPath=
"count(//wfs:Query[@typeName='tiger:tiger_roads'])"/>
<Resource> <Resources>
<Actions> <Action> <ActionMatch MatchId = "function:string-equal">
<AttributeValue> GetFeature </AttributeValue>
<Action> <Actions>
</Target>
<Condition> <Function FunctionId = "function# within"/>
<AttributeValue DataType = "gml# polygon">
<gml:Polygon xmlns:gml gid = "P1" srsName = "EPSG:4326">
<gml:LinearRing> <gml:posListdimension = 2> = 74.287987678285,
```



```

40.724009553109 -74.125526217360,40.7226059983714..... </gml:posList> </
gml:LinearRing> </gml:Polygon>
</AttributeValue> <AttributeSelector DataType = "gml#box" RequestContext-
Path = "gml :Box"/>
</Condition>
</Rule>

```

43.5 Conclusion

This paper analyzes drawbacks of existing security mechanism of geographic information sharing system based on WFS; thereby determining basic conditions that a safe WFS service system should meet. On this basis, the paper builds a WFS security service module, which is able to complete the user authentication, the digital encryption, digital signature, the user access control, etc. The module selects XKMS key management specification to achieve public key management, greatly reduces the complexity of implementing PKI in the client, uses XML encryption digital specification and XML digital signature specification, can selectively realize encryption and signature for any content in the GML file. For the user access control, the module carries out the access control of geographic information services based on the GeoXACML, can flexibly customize access control policies according to the specific application. The application of the safe service module greatly enhances the security of spatial data in geographic information sharing system, but it also has some disadvantages. For example, a user who calls the service before must apply for a digital certificate, which increases the use threshold for the user, and the certificate management brings a greater workload for the server side.

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Chapter 44

Analysis on Technical Risk of Product Development

Yuxian Zhang, Xiaoshuang Men, Hong Wang and Qinghua Zhou

Abstract From the view point of the product development process system and products system, this paper discusses the definition of technology risk, which points out the composition of the technical risks of the product development and concept. Then analysis the identification of technical risks from the process technology risk and product risk from two aspects separately. Setup relevant model of the process technical risk analysis and the bayesian network model of the product technical risk analysis. Finally, through the introduction of the weight parameters, get the technical risks of the product development composed by technology risk in activities, technology risk among activities, and the product technology risk in the product development process.

Keywords Technical risk of product development · Process technical risk · Product technical risk

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44.1 Introduction

The aim of developing product is to gain a product which has special purpose and satisfies market. One of the uppermost risks for developing product is technical risk. For analyzing the technical risk of developing product, we must do with an eye to not only the purpose of developing product but also the process of product development. Entering on product system and process system of product development, expatiates the method of analyzing the technical risk, and estimates the technical risk.

44.2 The Technical Risk of Product Development

The product development is developing a new product which satisfies market and buyer by using new material and new technology according to market needs and the result of basic research. With the development of the process of product development, the requirements specification, i.e., requirements product is gained after the requirements design, then the conceptual product after conceptual design, the technical product after detailed design and the prototype after experimental validation [1].

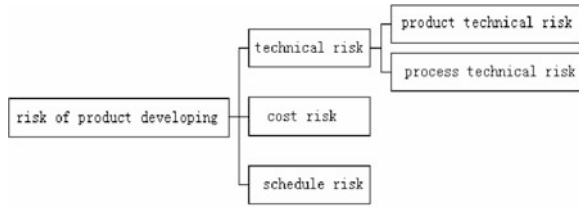
The risk is a measurement that cannot accomplish the whole object of the researching item under the constraints of prescriptive expenditure, schedule, and technology. It consists of two parts. One is the probability that fail to receive concrete goal and the other one is that fail to receive results of the item. With an eye to process, the risk is a measurement of difference between the factual operations for a process with the optimal operational example known for the same process [2, 3].

The technical risk of product development consists of technical risk, cost risk, and schedule risk.

The technical risk is a risk that affects the level of capability during the design and manufacture. The cost risk is a risk existed in order to realize the cost goal of lifetime cycle. The schedule risk is a risk resulted from less time of estimation and distribution in research, manufacturing, and planning. The technical risk also affects cost risk and schedule risk. For example, the developing item cannot satisfy the risk of cost goal and schedule goal because of the immitigable technical risk.

The level of capability in definition of technical risk is a level of capability that must be possessed to meet using demand. It consists of process technical risk and product technical risk. It is shown in Fig. 44.1.

Fig. 44.1 The compose of risk of product development



44.3 The Recognition of Technical Risk

The recognition of technical risk is the first step for management of technical risk. The recognition of technical risk is confirming in which technical risk maybe affecting the developing item or brings endangerment because of the inconsiderateness in technology. The characters of these risks are adjusted into files after recognition of technical risk.

44.3.1 The Recognition of Process Technical Risk

The developing process can be disassembled to many design phases such as requirement design, conceptual design, detailed design, and experimental validation, etc. Each phase consists of different developing tasks. Each developing task can be disassembled activities. These activities are finished through different steps. The phases, tasks, activities, and steps are called process elements.

In these process elements, we take activity as analytic cell. Each of the researching activities of researchers have done maybe all having potential technical risk. Therefore, it is necessary that recognizing technical risk to every developing activities. By inducing the risk factors may appear in each activity during development, which take it as a question listing. With the help of the question listing, the researchers can recognize that the activity presents technical risk or not.

Due to the demand of technologies and management, there are logistic relations such as sequence, concurrent, and iteration, etc. between phases, tasks, activities, and steps. Therefore, the potential technical risk factor must be found from the relation between these process elements.

44.3.2 The Recognition of Product Technical Risk

In the beginning source of product developing viz. market investigation, we can analyze whether the product needs has shortcoming or not, and from the product function, the vice of function is found. The product vice of function equals product technical risk.

The vices of needing design are examined step by step based on the “requirements specification for engineering”. The function is analyzed orderly so as to analyze the influence of function and relation between functions and the action of target product to environment, find out the questions arising possibly in the future.

With the development of the product design, the analyzing of technical risk is analyzed orderly from system to subsystem and parts. Through the recognition of product technical risk, the source, omen, sort, and scene of technical risk can be outputted.

1. The source of technical risk. All the technical risks recognized are listed and their sources are illuminated. It includes the probable sequel, anticipation, and frequency happened.
2. The omen of technical risk. It is the out representation when the technical risk has occurred or will occur on hand. It is the presentiment or trigger of the technical risk. Here are two examples about the omen of the technical risk. One is that a technical program which cannot be obtained though discussion for a long time. The other one is that a technical way which has no using experience is ready to be adopted.
3. The sort of technical risk. Distinguish process technical risk from product technical risk.
4. The scene of technical risk. Offer the indirect information between the technology and description of risks, such as events, conditions, restrictions, suppositions, environment, influencing factor and correlative questions, and so on.

44.4 The Analysis of Technical Risk

The analysis of technical risk is calculating the degree of risk to technical risk identified by method of technical risk analyzing. The degree of risk is product of the probability risk occurs and the sequent once risk occurs.

44.4.1 The Analysis of Process Technical Risk

Through the recognition of technical risk above, it is shown that the process technical risk includes the technical risk R_a within activities and the technical risk R_r between activities. The analysis of R_a is that a question list is gained by analyzing factors producing activity technical risk first, and then the process technical risk obtained by the question list was written by researchers. There are only two results of yes and no; the two results of yes and no can be evaluated 0 or 1. So the technical risk for every activity is:

$$R_{ai} = \frac{\sum_{j=1}^d w_{ij} \times a_j}{\sum_{i=1}^l w_{ij}} \quad (44.1)$$

where, R_{ai} is technical risk for No. i , d is factor of technical risk for activity i , a_{ij} is the value of factor of technical risk for activity i and technical risk j , $a_{ij} = 0$ or 1 , w_{ij} is weights for activity i and technical risk j . Therefore, the total technical risk for activity is:

$$R_a = \sum_{i=1}^l R_{ai} \quad (44.2)$$

where, l is the amount to develop course.

The R_a is a orderly, parallel, iterative, and synergetic relationship between activity. As parallel activity, because the latter technical activity has begun before the anterior technical activity has finished, the more intense of parallel, the easier for producing risk. There is the same question for the synergetic relationship; the risk is related to geographical location, communication measure, and professional background between both sides.

As lack of historical data and experience is related, there is locality and relativity for people who understand the frequency and probability in which technical risk occurs, and result in the variety and complexity of risk. There is no specific extension for risk values, and thus there is a gradual change and transition between “big” and “small” of risk values, i.e., the technical risk has a fuzzy property of sensual risk. Therefore, the model of technical risk can be built with the help of fuzzy theory.

Some factors such as parallel degree, commutative degree of technology and information, technical background of cooperate with both sides, geographical span, and commutative measures, etc. are established as a set A of factors on important degree, and establish an evaluate set B marked by group of experts, and then establish a evaluate matrix E . So the probability of technical risk between activities is:

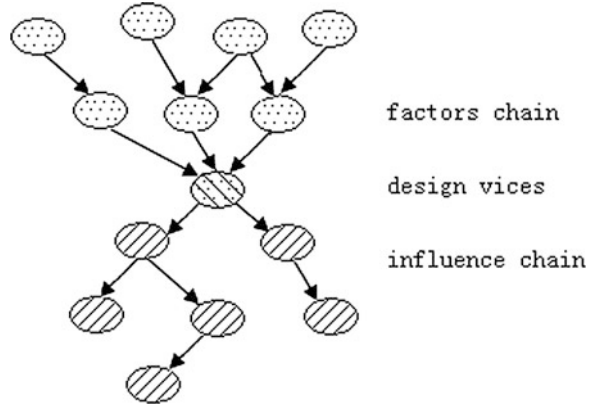
$$P_{fi} = AE_i B^T \quad (44.3)$$

Because the arising of technical risk must result in losing, a set X of factors on important degree and evaluation of set Y are established. An evaluate matrix R is established through the evaluation of losing of technical risk between activities. Therefore, the losing of risk can be obtained:

$$C_{fi} = X R_i Y^T \quad (44.4)$$

Finally, the technical risk R_r between activities can be numerated.

Fig. 44.2 The Bayesian belief network model of product technical risk



44.4.2 The Analysis of Product Technical Risk

Because product has obvious hierarchy, there is a clear consequence between the phenomena of occurring technical risk and product structure. The large-scale and complex product add the analytic difficulty as a great many components for system, structure complex, and a great many relating among system components, thus the model of product technical risk must be established.

First, the product technical risk recognized must be classified through the course of risk recognition above, sum up the form of product design vices, and then analyze the influence of product environment produced by product design vices and the factors (factors of technical risk) producing design vices, constitutes a chain about factors of product design vices and influence. This is the analytic model of product technical risk [4, 5]. It is shown in Fig. 44.2.

Experts can preparatory confirm prior probability and conditional probability according to themselves experience, cipher product technical risk R_p through the Bayesian Belief network. And then adjust the conditional probability, recalculate R_p based on practice.

44.4.3 The Technical Risk of Product Development

The final technical risk of product development is a sum of three kinds of risk above, viz.:

$$R_t = w_a R_a + w_r R_r + w_p R_p \tag{44.5}$$

where, R_t is technical risk of product development, w_a , w_r , and w_p are weights of technical risk inner activities, technical risk among activities, and product technical risk, respectively.

44.5 Summary

We can gain conclusions as below according to the analysis above:

1. The technical risk of product development consists of process technical risk and product technical risk.
2. The process technical risk consists of technical risk inner activities and technical risk among activities. It can be obtained through analysis activities and relation between activities.
3. Through analyzing the function, behavior, and structure of the target product, create the product technology risk factors, establish the Bayesian network model, and get product technical risk.

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Chapter 45

Failure Analysis of Power Battery Under High Environment Temperatures in Impact Test

Hongwei Wang, Haiqing Xiao, Yanling Fu, Hongmei Yu
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Abstract The impact tests of the power battery were performed at 40 and 65 °C environment temperatures. The results showed that the impact and the high environment temperatures can induce the internal short circuit, the heat can accumulate inside the battery, and those accumulated heat can lead to thermal runaway and even battery burning and explosion. The other result is that the higher the environment temperature is, the worse the battery's thermal stability is.

Keywords Power battery · Impact test · Thermal runaway

45.1 Introduction

Lithium-ion battery has become the important choice of the electric vehicles (EV) and hybrid electric vehicles (HEV) due to its advantages such as high operating voltage, no memory effect, long using life, and operating range, etc. [1, 2].

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At present, the standard GB/Z18333.1-2001 lithium-ion batteries for electric road vehicles [3] and QC/T 743-2006 lithium-ion batteries for EV [4] have been issued in our country. The impact tests of these standards are generally performed at room temperature, but in fact, the power battery work in variety of different environment temperatures. Therefore, the impact tests of the power battery were performed at 40 and 65 °C environment temperatures, and the reason of battery thermal runaway or burning/explosion was investigated °C.

45.2 Impact Test Under 40 and 65 °C Environment Temperatures

45.2.1 Test Sample

The model and the parameters of sample battery in this paper are as follows: (1) The model: domestic power battery, rated voltage 3.7 V, rated capacity 11 Ah; (2) Battery dimensions: 133 × 66 × 18 mm; (3) The battery material: the cathode material is LiMn_2O_4 , the anode material is graphite, the electrolyte is LiPF_6 , EC, and DMC, and battery separator is celgard 2325.

45.2.2 Test Method

The method of impact tests in this paper is as follows: (1) The SOC100 % battery was put in the thermostat box whose temperature is set 40 and 65 °C for 180 min. (2) A test sample battery which is taken out from thermostat box is to be placed on a flat surface. A 15.8 ± 0.1 mm ($5/8 \pm 0.004$ inch) diameter bar is to be placed across the center of the sample. A 9.1 ± 0.46 kg (20 ± 1 pound) weight is to be dropped from a height of $1,000 \pm 15$ mm (32.8 ± 1 inch) onto the sample. And the sample is laid aside for 6 h.

The battery narrow surface and battery wide surface were impacted in this impact test. The location of battery and bar during the test is shown in Fig. 45.1.

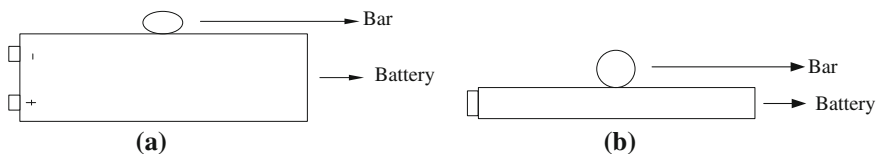
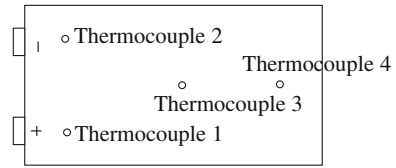


Fig. 45.1 The location of battery and bar during the test. **a** Battery narrow surface that was impacted. **b** Battery wide surface that was impacted

Fig. 45.2 Schematic diagram of thermocouple distribution



The temperatures are collected with four thermocouples; schematic diagram of thermocouple distribution of the sample battery is shown in Fig. 45.2.

45.2.3 Test Instrument

Thermostat box, model SPHH-101, Integrated battery tester, model Xin Wei TC53 High-precision battery performance test systems; Explosion-proof crash box, model H-FZ-500; Data acquisition system, model FLUKE 2620.

45.3 Results and Discussion

The results of power battery which were tested at 40 and 65 °C environment temperatures in impact tests are shown in Table 45.1. Two samples of battery burnt in the 40 °C impact tests and three samples of battery burnt in the 65 °C impact tests.

We can see that battery has dent in the battery middle in the impact test, which can induce the internal short circuit. Internal short circuit is a major safety concern. Thermal behavior of battery system for an internal short circuit depends on various factors, the environment temperature is one important factor, the environment temperature made exothermic accumulation inside the battery, those will lead to the battery’s thermal runaway and even the battery burning and explosion [5, 6].

Table 45.1 The results of impact tests

Sample	Temperature (°C)	Sample place	Maximum temperature/ °C	Burning/explosion
IT403	40	Fig. 45.1 b	189.6	Yes
IT404	40	Fig. 45.1 b	74.4	No
IT405	40	Fig. 45.1 b	109.2	Yes
IT401	40	Fig. 45.1 a	40.0	No
IT402	40	Fig. 45.1 a	41.0	No
IT651	65	Fig. 45.1 b	65.2	No
IT654	65	Fig. 45.1 b	318.4	Yes
IT652	65	Fig. 45.1 a	121.6	Yes
IT655	65	Fig. 45.1 a	146.2	Yes
IT653	65	Fig. 45.1 a	63.9	No

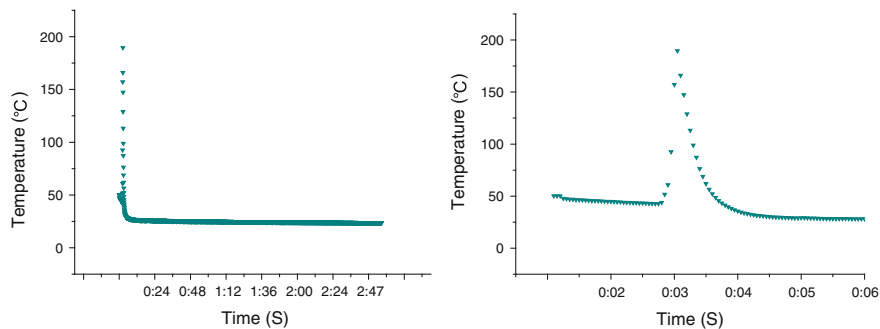


Fig. 45.3 The temperature curve of thermocouple 4 of sample IT₄₀₃

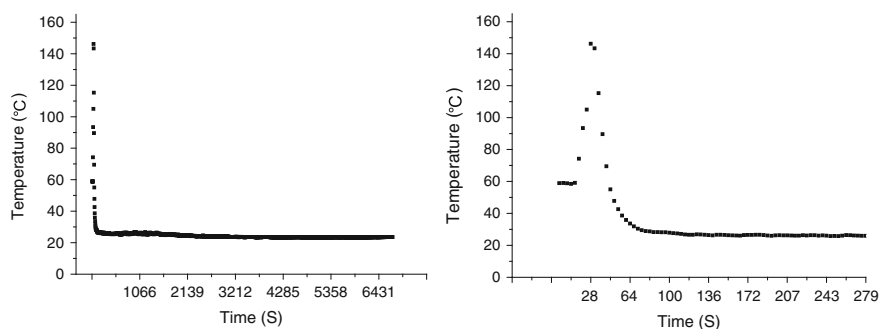


Fig. 45.4 The temperature curve of thermocouple 1 of sample IT₆₅₅

The temperatures were collected with four thermocouples in those impact tests, the temperature curve of thermocouple 4 of sample IT₄₀₃ is shown in Fig. 45.3, the temperature curve of thermocouple 1 of sample IT₆₅₅ is shown in Fig. 45.4.

In those impact tests, the temperature data of sample that burnt in tests are shown in Table 45.2.

At 40 and 65 °C, the resistance and polarization of LiMn₂O₄/electrolyte is increased and the structure of active materials was changed; those phenomena will produce a mass of gas [7, 8], which will induce the battery's capacity fading, and the battery will be prone to induce thermal runaway when the temperature rise rate is high.

Table 45.2 The temperature data of sample that burnt in tests

Sample	Maximum temperature/ °C	Temperature rise rate/ °C/s
IT405	109.2	4.6
IT652	121.6	3.9
IT655	146.2	5.2
IT403	189.6	8.6
IT654	318.4	9.3

45.4 Conclusions

The impact tests of the power battery were performed at 40 and 65 °C environment temperatures. The results obtained are as follows: (1) The impact and the high environment temperatures can induce the internal short circuit, the heat will accumulate inside the battery, and the accumulated heat can lead to the battery's thermal runaway and even the battery burning and explosion. (2) That the higher the environment temperature is, the worse the battery's thermal stability is.

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Chapter 46

Patent Information Extraction from XMLs

Yanling Wang and Guancan Yang

Abstract This paper explores the information extraction from patent eXtensible Markup Language (XMLs), the methods that integrating XML into databases. Differences between patent information in XML and in database were analyzed. And after analyzing the three types of information in the XMLs, this paper constructed the rules for extraction. The methods of how to process the structured information, the unstructured information, and the patent citation information have been discussed. XML now is the general standard for information online to share, convey, filing, and storage. Patent-specific XMLs are seldom researched or analyzed how to be used. The research on XML-based patent information extraction is a basis for the future research on XML-based information automatically querying or converting into data in full-structured database. Parsing methods for the tree-like structure and different methods for structured, unstructured, and citation information extraction are performed as the results of this paper.

Keywords XML · Extraction · Standards of WIPO · DTDs · Structured information · Citation

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46.1 Introduction

As far as back as 1995, World Intellectual Property Organization (WIPO) issued first edition of ST.32-“Markup of patent documents using Standard Generalized Markup Language (SGML)”. This is the startup of WIPO to standardize electronic patent information worldwide, in order that patents are filed in different countries, regions can be shared, published, communicated without barriers.

With more and more countries entered the electronic filing scheme of WIPO. The XMLs of patent information during different stages of patents are becoming rich, multilayered, and more convenient to use. Patent information in XMLs is very different with traditional information in office-specific database or commercial patent database. XML has long been a hot topic in the extraction research, since it is spotlighted as the standard for data representation and exchange on the Web [1]. XML is a markup language, but it supports a richer set of features, such as user-defined tags that allow both data and descriptive information about data to be represented within a single document [2]. A comprehensive data extraction process must deal with such obstacles as session identifiers, HTML forms, client-side JavaScript, incompatible datasets and vocabularies, and missing and conflicting data [3]. To manage XML data-centric documents, a DBMS must support both data extraction and data formatting services [2]. Inferring a semantic and structured XML document type definition (DTD) for an archive and subsequently transforming the corresponding texts into XML documents is a successful method to achieve this objective [4]; as shown in Fig. 46.1.

46.2 XML and Standards of WIPO for Patent Information and Document Processing

46.2.1 XML and Patent Information Organization

WIPO recommends XML resources to be used for filing, processing, publication, and exchange of all types of patent information. All the standards for patent information of WIPO are applications of the XML 1.1.

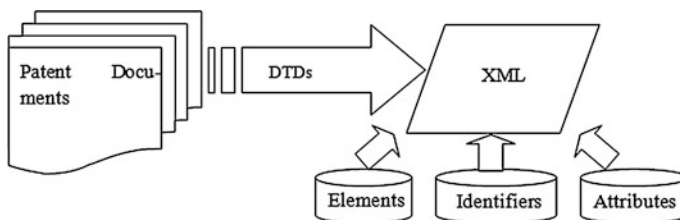


Fig. 46.1 From patent documents to XML

“The XML is a subset of SGML that is completely described in this document. Its goal is to enable generic SGML to be served, received, and processed on the Web in the way that is now possible with HTML. XML has been designed for ease of implementation and for interoperability with both SGML and HTML” [5].

In fact, the process to markup patent information or patent documents is also the process by which an XML is produced. Thus, in order to standardize that information, the standards of WIPO-defined elements, generic identifiers (tags), and attributes for marking up a patent document. Therefore, all the information in a patent document is organized. The elements, generic identifiers, and attributes used to define an XML are “XML resources”.

The term “XML resources” is intended to refer to any of the components used to create and operate an XML implementation [6].

Although XML resources normally encompass style sheets, World Wide Web Consortium (W3C) SUnited Stateschemas, and other objects, this standard presently includes only DTDs, content models, elements, and a small set of character entities [7].

XML instances of patent documents which conform to the standards of WIPO must be well-formed XMLs. “Well-formed” XMLs are conforming to the office-specific DTDs that conformed to all the standards. During different periods, the edition of DTDs in different patent offices is also different. Once the modification is approved, the new edition of DTDs will be updated as soon as possible.

46.2.2 An XML Instance

As we know that all types of patent information in patent documents are included in the XML resources. A part of Patent Grant Bibliographic Data of United States Patent and Trademark Office (Uspto):

```
<?xml version = "1.0" encoding = "UTF-8"?>
<!DOCTYPE us-patent-grant SYSTEM
.....
country = "US" date-produced = "20110919"
date-publ = "20111004">
<us-bibliographic-data-grant>
<publication-reference>
<document-id>
<country>US</country>
<doc-number>D0646046</doc-number>
<kind > S1 </kind>
.....
</us-term-of-grant>
<classification-locarno>
.....
</classification-locarno>
```



```

<classification-national>
.....
<document-id>
<country>US</country>
<doc-number>D6535</doc-number>
<kind>S</kind>
<name>Fogelstrand</name>
<date>18730300</date>
.....
</assistant-examiner>
</examiners>
</us-bibliographic-data-grant>
</us-patent-grant>

```

46.2.3 Differences Between Patent Information in XML and in Database

Usually, we search patent information with various database constructed by dominant information institutes or patent offices. There are advantages and disadvantages of this kind of online information. Advantages: (1) Information is updated without delay. (2) Structured or unstructured information is integrated in the online databases; one can download anywhere, at anytime. Disadvantages: (1) Downloading the data is really an overload work to do; we commonly analyze those patents of some technology field or some product. Since one technology field usually encompasses some subfields and a large amount of patents are included. (2) If you do not use some downloading tools for the extraction of online information, the work is also time consuming. (3) Some databases are not free, such as Derwent Innovation Index (DII), etc. Thus, when you do not have the passport for this kind of database, the analysis of patent especially the citation analysis is impossible. (4) You can only download the information by record, but hardly by year. (5) It is very hard to acquire both patent information and citation information.

46.3 Extration of XML

46.3.1 Types of Information in XMLs

From the perspective of data structure, the information in a patent document XML can be divided into three kinds: (1) Structured information. The information which is independent with other information, it describes the basic characteristics in

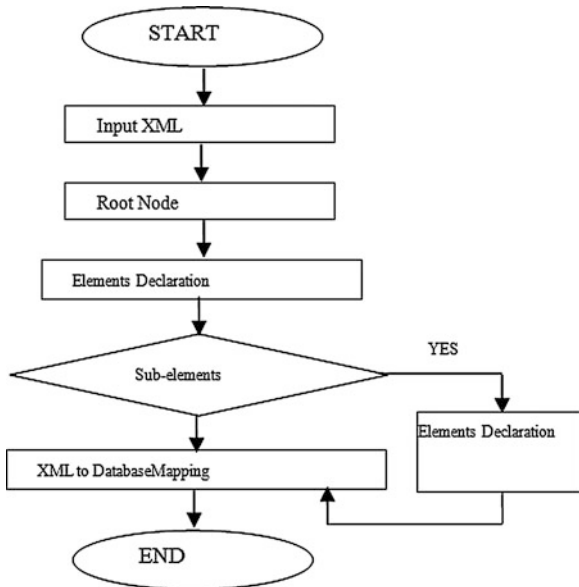
technology and attribute. Such as the patent kind, inventor, International Patent Classification Code (IPC), United States Patent Classification Code (UPC), etc. (2) Unstructured information, we specify the abstract of a patent as the unstructured information. To utilize this kind of information is harder than structured information. However, nowadays, the semantic analysis of the unstructured information develops more and more rapidly. (3) Citation information. This kind of information is very different from neither of the former two kinds of information. Since one patent may cite one or more patents that published before, there is a “one-more” relationship between the current patent and the patent that it cited; as shown in Fig. 46.2.

XML can be parsed into Document Object Model (DOM) tree. The elements or attributes can be defined as nodes. A DOM tree has multilayered nodes. In the same layer, the nodes represent the same layer of information. Relations between elements and sublayer elements and attributes are the lines between nodes.

46.3.2 Extraction Rules

To extract information in XML, we may at first make clear whether the XML is a well-formed XML or not. As we know, all the XMLs that conform the WIPO standards are conformed to DTDs. Thus, the extraction is a schema extraction or pattern extraction. For pattern extraction, the extraction rules are as following:

Fig. 46.2 Flow chart of XML extraction rule



- Read about the XML;
- Construct a root node;
- Produce the declaration of elements;
- Produce the declaration of attributes if elements have the attribute values;
- Produce the subelements if there are subnodes above root nodes; and turn to (3) to produce the declaration of subelements and attributes;
- Produce the declaration of elements and attributes if there are elements in the same layer and turn to (4); if not, export the XML2DB mapping file.

46.3.3 Parsing XML into DOM Tree Structure

Currently, the XML parser is a very useful tool to help identify different tags, entities, and identifiers. Automatic extraction of an XML can be realized in different computer compiling language tools. XML parser is specific to every compiling language tools. XML parser can analyze the XML and transform it into a DOM.

XML can be parsed into DOM tree. The elements or attributes can be defined as nodes. A tree has multilayered nodes. In the same layer, the nodes represent the same layer of information. Relations between elements and sublayer elements and attributes are the lines between nodes.

As for database, the DOM tree is just like the data structure, nodes are fields in database. Nodes on different layers may map in different tables which are related with identical tags in the database.

46.3.4 Extracting Structured Information

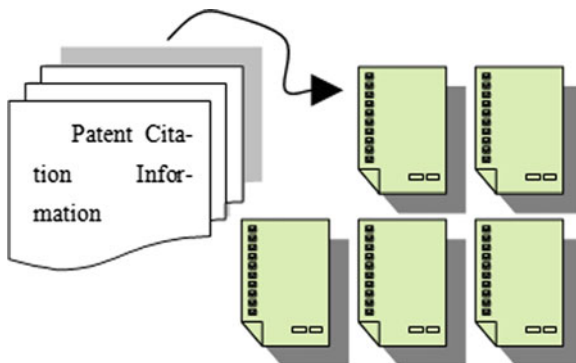
Structured information is organized in the XML which conform to the DTDs. We can compile a program to extract contents between tags automatically. For different XMLs conformed to different editions of DTDs, we should define specific extraction rules. The essential steps are: (1) Locate node information; (2) element declaration; (3) construct the structure of the database; (4) look through the XMLs to extract information and at the same time put it into the database.

And the program can look through all the XMLs to separate each patent with the start and end identifiers. The WIPO standard demand that all the XMLs must start with a first line:

```
<? Xml version = '1.1' encoding = 'utf-8'?>
```

This can be used as the start tag for the automatic extraction and automatic separation. And the first tag in the sharp brackets is “<us-patent-grant>”, the counterpart is </us-patent-grant> which is the last tag in the sharp brackets. It can be used as the end identifier.

Fig. 46.3 Citation information to database



46.3.5 Methods to Extract Unstructured Information

Utilizer's information needs to determine whether the unstructured information should be extracted or not. Since the abstract is text information, semantic analysis is especially important to extract. There are so many methods to carry through the semantic analysis that we can choose the most appropriate methods for patent unstructured information extraction.

Patent abstracts include five parts of information: (1) purpose; (2) technology field; (3) technology, operating principle; (4) structure; and (5) evaluation of the patent.

Some semantic methods are: (1) Ontology-based knowledge extraction of patent abstracts [8]; (2) Conditional random fields (CRFs) method; and (3) Text mining.

46.3.6 Citation Data Extraction

Patentee cites the former patents or nonpatent literature when he proposes the patent to patent office. And examiners in the patent office also cite former relevant patents or nonpatent literature. Thus, a patent has at least tens of citations. These citations in the patent XML are listed in the “<references-cited>”.

To extract this kind information, we need to construct relation database that contains citation table and main data table. These two tables are connected with the patent number which serves as the identical tag to identify citations and the patent it belongs to. Patents cite each other. All the cited or citing patents compose a huge net. It is published earlier; the chance to be cited is larger. Thus for a patent, it may be cited by another patent, the patent may be cited by the third, we call this situation multistage patent citation. Multistage patent citation is the most difficult problem to be resolved, since it need to be identified not only the citation but also the citing date; as shown in Fig. 46.3.

46.4 Conclusion

XML now is the general standard for information online to share, convey, filing, and storage. Patent-specific XML Information can be divided into structured , unstructured, and citation information. For different kinds of information, with a basic information extraction rule, the extraction methods are very different. However, as we analyzed before, the XML of patent document is semistructured, it itself can be indexed, retrieved with the methods of semistructured information. XML can be parsed into DOM tree. The elements or attributes can be defined as nodes. A tree has multilayered nodes. Especially for the citation information, the methods of construction of a relation database or the social network analysis is also necessary according to the demand of different customers.

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Chapter 47

Intrusion Prevention System Design

Zongjian Wang and Xiaobo Li

Abstract Facing an increasingly severe situation of network security, the traditional firewall and intrusion detection systems cannot meet people's needs; intrusion prevention system (IPS) started up on the historic stage. This article discusses the principles of IPS design and final design of the specific IPS model.

Keywords IDS · Firewall · IPS · Attack · Data stream

47.1 The Concept of an Intrusion Prevention System

We define the intrusion prevention system (IPS) which detect any known and unknown attacks without human intervention and can automatically stop the attacks under the hardware or software equipment. Gartner for IPS gave a further explanation: "IPS combination of multiple algorithms to block malicious behavior, you can know attacks while can also use anti-virus and IDS use of those methods at least one support strategies, behavior and anomaly-based the detection algorithm [1]. Algorithm must operate at the application layer, as standards, the network layer firewalls deal to add. It must also have the distinction between attacks and normal events of intelligence. IPS and firewall and IDS different, it is a can detect and respond to the invasion of "active defense" system."

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47.2 The Classification of Intrusion Prevention System, Deployment, and Operation Principle

47.2.1 Classification of Intrusion Prevention System

As far as the IPS is concerned, there are two common classifications are based on the timeline of attack and action-based platform.

Based on the timeline of attack: The categorization is based on the new “zero-day”, the ability of attack distinguishes between those that generally were classified as either detection of known attack or unknown attack by intrusion detection defense system.

Based on the platform: This classification is based on intrusion defense systems to distinguish between platforms, normally divided into network-based intrusion prevention system (NIPS) and host-based intrusion prevention system (HIPS). NIPS monitors network traffic to identify malicious network segment or indifferent activities and is not certified to block [2]. HIPS is usually monitoring system calls and prevent any harmful requests. Problems tend to provide more advanced warning and to protect the wider computing environment, while HIPS tends to do host-specific identification of specific acts deeper. IPS deployed and working principle and the choice of platform is closely related, so in the following we discuss about the NIPS and HIPS.

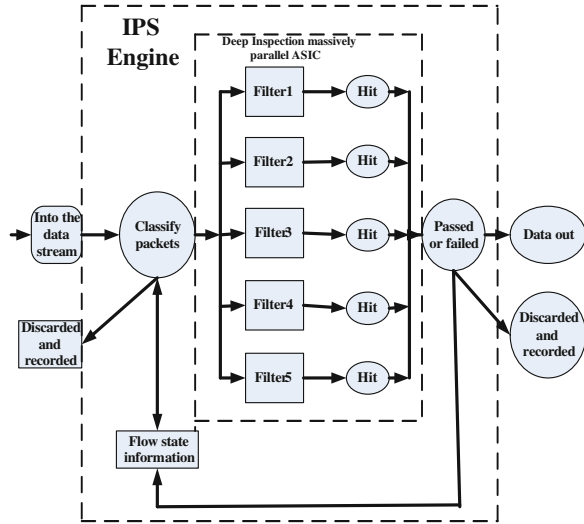
47.2.2 Intrusion Prevention System Deployments

NIPS is usually online installation, you can have real-time control over the flow. The general location of their deployment in the border gateway behind a firewall, DMZ area in front of the front, and the internal server behind the VPN endpoint, the corresponding location of the traffic must flow through it completely, by its decision through [3]. IPS, by installing the software agent to the server, workstation, and important host, in between the operating system kernel and applications, closely integrated with the operating system to provide protection against the host. Various software agents unified management by the central controller, including the agent installation, uninstallation, and upgradation, incident reports, communication with each other, and so on.

47.2.3 Intrusion Prevention System Works

Two different platforms of IPS and their working principles are quite different. We analyzed several existing IPS and related research results; the general working principle of the IPS is systematically summarized as follows:

Fig. 47.1 NIPS principle diagram

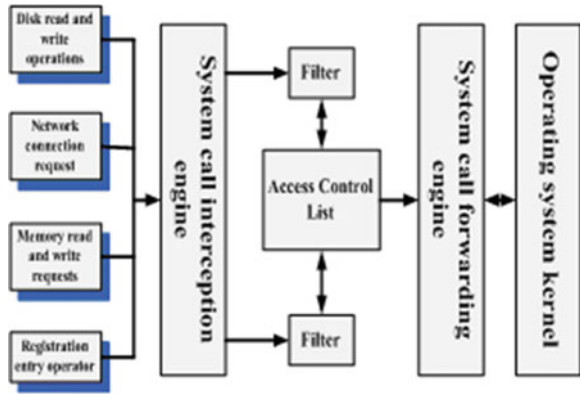


IPS based on network: NIPS takes online installation that is embedded into network traffic, through a network port to receive traffic from the external system through self-checking the filter, through which it has been confirmed that no unusual activity or suspicious content that contains the flow through the other port forward to the internal systems is present, and those malicious packets and the other from the same session follow-up data packet will be discarded by NIPS [4]. The Specific works are shown in Fig. 47.1.

When the data packet goes through NIPS, according to classification engine, and reports header information of source IP address and gives IP address, port number, and application domain for each packet classification, different types of data packets will be sent to the appropriate filter device. The filter engine is professional custom-integrated circuits, can be deep packet inspection data content, if the attacker from the data link layer to application layer vulnerabilities attacks, NIPS can check out from the data stream to prevent these attacks. And all filters are used in parallel, and can also implement packet filtering thousands of times to check if any data packets meet the match requirements, then the packet will be marked as hit and was labeled packets hit discarded, the associated flow state information will be updated to indicate NPIS discard the rest of the data stream of all the content. Parallel processing ensures that packet filtering can be done continuously and as quickly through the system, improves system performance of NPIS [5].

IPS Based on Host: The operating system has control of such as memory, IO devices, and CPU resources, access to these systems, and the general prohibition of direct access to the user. In order to use system resources, user program has to initiate the request, or to the kernel system calls, the appropriate action by the

Fig. 47.2 HPIS principle diagram



kernel. Need to perform any malicious code is to gain privileged system call access to resources or services. Therefore, the agent HIPS is located between the operating system kernel and applications to the software and to be embedded into the application calls of the operating system which, in the bottom of the interception system that is called disk read and write requests, network connection request, try to change the registry and memory write operation, then use the definition under the policy access control list to check these system calls, to allow or prevent access to system resources, as shown in Fig. 47.2.

Some HIPS are in the agent bank or under the signature database to detect attacks. It can also act according to the known normal library or a special service for the detection of the rules. Whatever the approach, as long as the system calls beyond its normal range, the software agent must terminate the process.

47.2.4 Comparison of Intrusion Prevention System

HIPS and NIPS are aimed for active detection and active defense toward known and unknown attacks, but still there are differences between them. Through analysis and comparison, given the existence of two types of IPS differences, as shown in Table 47.1. The table gives the HIPS and NIPS in the deployment, testing objects, protected objects, identify means of attack, and ways to achieve the distinction; and both the advantages and disadvantages are compared. Thus, there are large differences in NIPS and HPIS, developers base on specific requirements to develop IPSs, and users select according to their needs to the appropriate IPS [4].

Table 47.1 Comparisons of two types of intrusion prevention systems

For comparison	HIPS	NIPS
Deployment	The form of software installed on the need to protect the host, usually in between application and kernel.	To online forms installed in the network, generally at the boundary between the firewall and internal network.
Test object	System call, file system access, registry access, I/O operations.	Packet header information, load information, the reorganized object, data flow and flow statistics.
Protection of objects	Servers, workstations and critical hosts and applications running on them.	Hosts within the network, routers, switches, and other devices
Means of identifying known attacks	Matching process safety incidents, Behavior of the virus match.	Pattern matching, protocol anomaly analysis are known, the context and flow-based rule matching.
Identify the hand of unknown attacks	Policy violations, statistics, and depth of detection.	Unknown protocol anomaly detection, traffic anomaly detection.
Realization	The form of software-based agents, and the operating system, in different platforms require different software agents.	Custom integrated circuits based on specialized hardware to achieve platform-independent.
Advantage	A “zero-day protection”, little do even need the security update, the kernel layer to prevent attacks.	It can prevent the spread of worms and prevent unknown attacks, and platform-independent.
Shortcoming	Expensive and platforms related to the deployment of complex.	It may cause single point of failure, the deployment of high cost, need for security updates.

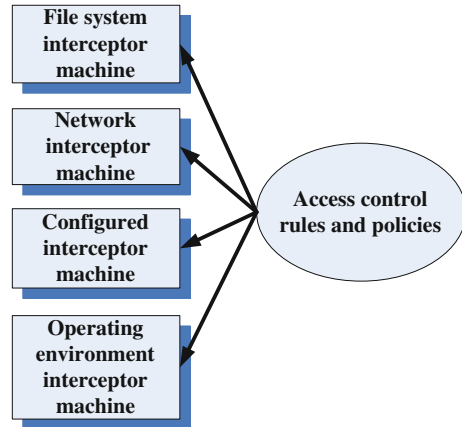
47.3 Intrusion Prevention System Realization

47.3.1 HIPS Implementation

HIPS works on the server or workstation, using the strategies and acceptable behavior-based access control rules, intrusion detection and prevention. It has four for the system call interception machine, shown in Fig. 47.3.

- File System interceptors: block all file read and write requests.
- Network interceptor: the driver (NDIS) or transfer (TDI) layer to intercept packets incident.
- Configure interceptor: interceptors of the Windows registry or Unix-rc file read and write requests.
- Implementation of the space (operating environment) interceptor: interceptors that do not belong to the host application’s memory space to write requests. For example, the buffer overflow attack will be blocked here. Each application can maintain the integrity of dynamic operating space.

Fig. 47.3 HIPS block diagram



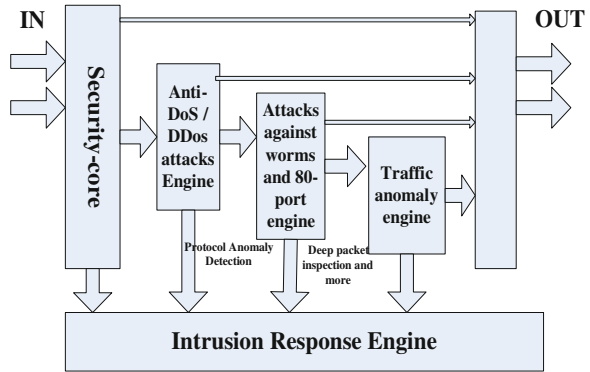
System call interceptor through four blocking files, network, configure and run the environment's operations, then to them with specific application to access control rules and policies are compared, the normal of the system sent to the kernel, on the malice of the system call on them to stop.

47.3.2 NIPS Implementation

NIPS able to detect and prevent a large number of attacks, the reason lies in its large number of filter engine. NIPS and the key also lies in the realization of filter engine, NIPS is a highly reliable, high-performance, ASCII-based forwarding device. It can attack and a growing network of accurate and reliable intrusion detection can be forwarded to limit or drop traffic operations such as precise control. NIPS has five modules, it is shown in Fig. 47.4.

- Secure the core engine: this is a state based on Layer 4–7 testing engine that can filter a single sub-packet attacks and is attacked, it can block by using the IP address and TCP/UDP port number of the strategies identified in the flow. Normal conversation is known to high rate of traffic transmitted out to identify the malicious traffic to be sent to the intrusion response engine, the suspect was taken to the next traffic engine.
- Anti-Dos/DDoS engine: identify and stop the (distributed) denial of service attacks.
- Anti-worm attacks and 80-port engine: matching algorithm using the state standardized identification of the worm and its variants, using the HTTP protocol verification, format string match and check the identification of HTTP URI length attack.
- Traffic Anomaly Engine: to use intelligent traffic analysis system for traffic anomaly detection.
- Intrusion Response Engine: Set response measures and is responsible for forwarding, limit, stop, reports the implementation of specific measures.

Fig. 47.4 NIPS block diagram



47.4 Intrusion Prevention System Development

- IPS and compared to the traditional firewall and IDS, does have more advantages, it can be more fine-grained way of checking network traffic and proactively respond to security incidents, to prevent attacks at all levels took place. At the same time, we should also see IPS also faces some problems.

47.4.1 Problems

Single point of failure: Whether NIPS or HIPS are all the way to embed the work, and this increases the possibility of the formation of a single point of failure. If the IDS fail, the worst failure is open, resulting in attacks cannot be detected. The embedded IPS fails, it will seriously affect the normal operation of systems and networks, if IPS fails closed, and then the business and users will face a denial of service caused by the IPS problem.

Performance bottlenecks: If the IPS is not failure, because it is embedded in the work that is still to become a potential performance bottleneck in the same way. IPS to deal with all the network traffic or system calls will inevitably increase the lag time, and this might lead to lower network and system efficiency.

False positive and false negative: False positive and false negative is the IPS must seriously face. For the IPS, if the produce false positives will lead to legitimate traffic accident or the request is intercepted, the formation of a denial of service. For real-time online NIPS, once data packet interception attacks, the attacker would be questionable from the data stream to intercept all. If you produce omission will lead to the success of the attacks occurred. For the HIPS as a last line of defense is, once a breakthrough event will lead to inevitable destruction. The above problems, it is IPS should be solved in the future, combined with the current status of security technology; we can predict the IPS trends.

47.4.2 IPS Trends

Using a dedicated hardware acceleration system: NIPS must be based on a specific hardware platform, network traffic can achieve gigabit deep packet inspection and blocking capabilities, this particular hardware platform usually divided into three categories: first is the network processor, second is dedicated to FPGA programmable chip, and the third category is dedicated to ASIC chip.

Integrated with a variety of detection techniques: In order to reduce the false positive and false negative as much as possible, IPS integrated using a variety of detection technologies, including pattern matching, state matching, protocol anomaly, traffic anomaly and statistical anomaly, etc., from each other, greatly enhancing its detection ability.

The redundant architecture: To avoid single point of failure, IPS redundant architecture, when there is a failure, redundant equipment, replaces faulty equipment immediately to continue to provide intrusion prevention capabilities, and enhance the robustness of the IPS.

From intrusion prevention to intrusion management: In order to more effectively respond to future large-scale network increasingly rampant security events, providing active defense of IPS also should have good visual, controllability, manageability, intrusion management system (IMS) development.

47.5 Conclusion

Faced with an increasingly serious problem of network security, IPS is particularly important. This paper studied the theory and IPS specific design method; it will certainly help in future research. IPS is a very deep research in the field, its further study and practice of specific applications, further efforts are still needed.

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Chapter 48

The Model of Credit Risk Discriminant in Online Trading

Hao Zhang

Abstract The e-commerce is different from the traditional trading, which has fictitious reality, asymmetric information, and other characteristics. Therefore, its integrity issue has become more prominent than physical market. This paper using the game methods analyzes trader's honest behavior selection strategies under the condition of incomplete information, and proposes a method to reduce internet trading integrity risk by increasing the transaction probability and the transparency of trading information, which provide reference in e-commerce credit system and management for government.

Keywords Incomplete information · Transaction probability · Game model

48.1 Introduction

According to China's online shopping in 2009, Shanghai and Beijing's annual online shopping amount is more than 10 billion Yuan. In central and western regions, online shopping by consumers compared to the previous amount was found at an annual rate of more than double [1]. Online shopping market is developing rapidly, however, many problems still exist in the market, among them, and honesty is the major concern when people choose online shopping [2]. The main reasons are the virtual and main complexity and social strangers and distance, which have the risk of trading more than the virtual entity market. Integrity has become an obstacle to consumers and a key factor in online shopping [3].

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48.2 Game Theory and Credibility

Game Theory is a game situation, rational behavior choice in each of the theory. In game situations, each person's effectiveness depends not only on his own decision and behavior, but also depends on other people's behaviors [4].

Analysis of network transactions, the main consideration trading game is the C2C because the C2C is anonymous between individual, there will be offline distrust of fraud and further expansion [5], so the study pays attention on C2C.

The first is to determine the assumptions about the participants, the action, the information, the strategy, and payoff function and results, balanced, etc.

1. Participant assumptions, participants refer to the transaction mode of trade C2C parties, namely the buyer and seller.
2. Participants action assumptions, action hypothesis refers to the participant's decision variables.
3. Information assumptions, the information refers to the participants in the game, especially the relevant knowledge of the characteristics and the action of other participants. Generally, divide into full information and incomplete information. Complete information refers to all other participants each participant's characteristics, the strategic space, and payoff function understanding accurately, otherwise, it is incomplete information, which is based on incomplete information on specific discussion.
4. Strategic hypothesis assumptions, a strategic choice of the participant's action, these game rules of honesty and credit strategy, but not the sincerity and honesty, will be described.
5. The market hypothesis assumptions, the virtual market exists with only a kind of products, to provide the product of merchants, still follow the classical theory, which is the reason the hypothesis of "economic man", whose goal is to maximize profits.
6. Payment function hypothesis assumptions, this is very important in function, this paper introduces trading rate pay and conditions are discussed.

48.3 Incomplete Dynamic Information Game Model

In reality C2C transactions both informations are the model of asymmetrical, especially in some less known or no awareness of the website for trade, traders will certainly think of their strategies and tactics, the choice is based on probability, namely comprehensive trade credit transactions shopping network factors index system, this will never have complete information dynamic game model and the game model under the probability trading analysis.

48.3.1 Theoretical Assumptions

In view of this, and I quote “information transparency” one word, and quantization θ , for $1 \geq \theta > 0$. Specific assumptions are as follows:

1. Set the transparency of information θ ($1 \geq \theta > 0$), this paper will be divided into $1 \geq \theta > 0.5$ and $0.5 \geq \theta > 0$ two situations discussion,
2. Both parties are rational agent, the pursuit of profit maximization,
3. Both parties have two strategies: honesty and dishonesty, credit transactions in the traders, regardless of whether his inner honesty, as long as he is taken to the behavior of agreement, can think he has the credit behavior, for the seller, as long as it is provided with the description of the goods, the buyer's and seller can accept that has credibility, 3 for buyer, in which he is able to act on the integrity of the contract to the seller within the period of capital account,
4. Buyers and sellers of the actions are discussed in this paper, first, the seller to buyer payment delivery this,
5. Social credit system and the corresponding laws and regulations are not perfect, no effective regulation and supervision,
6. W_1 and W_2 are greater than zero, w as the constant because of information asymmetry; the buyer may benefit loss due to migrant w' information asymmetry of the extra income.

48.3.2 Game Model

In the static game, other players do not know what kind of strategies each participant chose beforehand. But the reality is not the same as the most trading action; as for the buyer, they shall pay on delivery, before shipment, as for the seller, the buyer to pay after promising products. In the dynamic game, the player's actions, and after the order is successively in action before can clearly understand what strategies adopted first by actors. Dynamic game by game theory can be more convenient to say, as shown in Fig. 48.1.

According to the scope of information transparency, game tree branch, draw respectively from the start, two hollow nodes. When $1 > 0.5$, the choice of dishonest trade ended when entering their returns to 0, When the choice comes, then the seller integrity into two scheme selection, honesty and trustworthiness, not from solid start, when the node, their choice when honesty earned W_1 and W_2 , when the seller, the buyer not choose benefit for the newly $\neg W_1$ profit, the seller $2W_2$. Using reverse induction can see, when $1 > 0.5$, the choice of the integrity of the optimal choice is not, because the choice not to get more benefit ($2W_2 > W_2$) in the first stage, so the buyer will not choose the optimum choice, both sides have (not); honesty, sincerity. With $0.5 \geq \theta > 0$, purports to $0.5 \geq \theta > 0$ both optimal choice is (not) dishonest. The buyer paid function for the first letter, the seller's profit is the second letter, trading square gaming matrix is shown in Fig. 48.1.

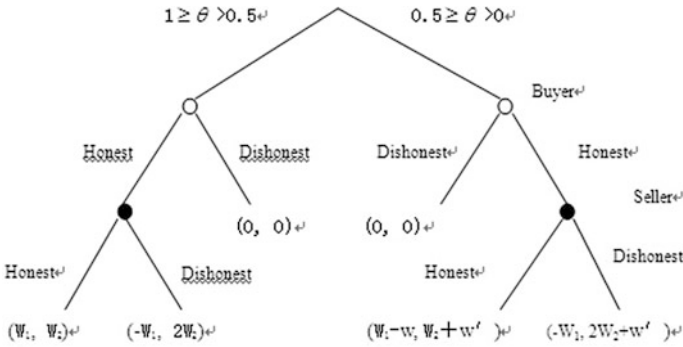


Fig. 48.1 Incomplete dynamic information game model

Therefore, in the social credit system and the corresponding laws and regulations are not perfect, no effective regulation and supervision, not complete information dynamic game model subgame refined Nash equilibrium for (dishonest, dishonest). This is obviously a negative result, but the equilibrium in the relevant seller and buyer under the condition of the institutional deficit ideal choice. This explains in real condition, inevitable that some bidders in order to pursue the short-term interests and choose the intrinsic reason. Under the condition of incomplete information, because of the information asymmetry, the confidence is decreased and the transaction uncertainty is increased. Assume that the trading rate of buyer and seller are α, β and $1 \geq \alpha, \beta > 0$, due to the information asymmetry, the true trading rate are $\alpha\theta$ and $\beta\theta$, $1 \geq \alpha\theta > 0, 1 \geq \beta\theta > 0$. And according to the dereferencing of information transparency θ and trading rate α, β , actually the trading rate has a demarcation point which is 0.5. We will have a discussion as follow:

1. When $\begin{cases} 0.5 < \alpha\theta \leq 1 \\ 0.5 < \beta\theta \leq 1 \end{cases}$, incomplete information dynamic game model shows in Fig. 48.2. We can see that when buyer chooses to trade honestly, the best choice of seller is also honesty. That is to say the best choice of both sides is (honest, honest).
2. When $\begin{cases} 0 < \alpha\theta \leq 0.5 \\ 0 < \beta\theta \leq 0.5 \end{cases}$, incomplete information dynamic game model shows in Fig. 48.3.

From the picture above, we may see that whatever the numerical value of information transparency is, the dereferencing of trading rate is very low. When buyer chooses trade honestly, the best choice of seller is honesty because it can make them get the most benefits. And the buyer knows seller will choose dishonesty in the second step, so they will be dishonest at first. As a result, the trade is unsuccessful.

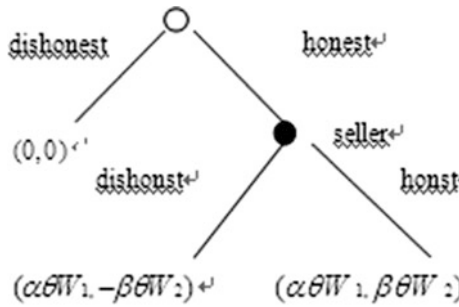


Fig. 48.2 Incomplete information dynamic game model ($0.5 < \alpha \theta \leq 1, 0.5 < \beta \theta \leq 1$)

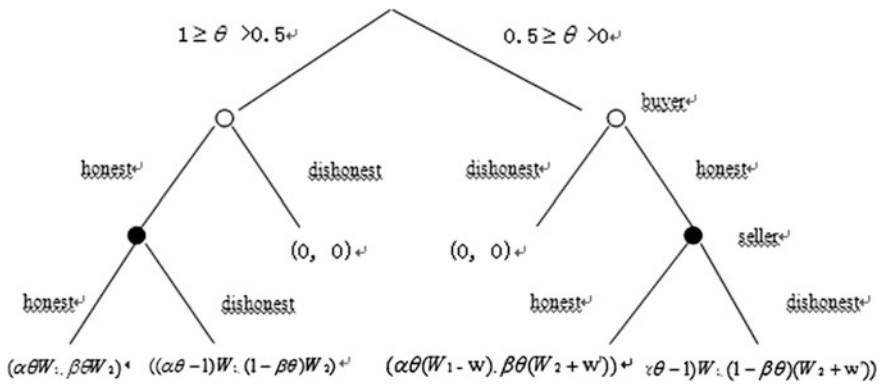


Fig. 48.3 Incomplete information dynamic game model ($0 < \alpha \theta \leq 0.5, 0 < \beta \theta \leq 0.5$)

48.4 Conclusion

According to the analysis above, under the condition of incomplete information, the choice of whether honesty or not for the traders in C2C, and anonymous mainly depend on the amount of information transparency. And when leading trading rate into it, information transparency and trading rate become the major reasons for traders to choose honesty or dishonesty. Thus, I point that we should improve both of them to decrease the risk in network trading.

Such as improving the reputation and fame, business and services, distribution, To improve the quality of the goods, the lower the price of commodities, improve product purchase participation; etc. Improve your user interface and navigation safety, etc., Improve the corresponding laws and regulations, and strengthening the

government supervision and punishment strength promise: on one hand, to undesirable businessman or intermediary organizations should be severely punished, increase the cost of the subject, not to punish lawfully, On the other hand, the honest enterprise to increase its credibility to the benefits.

Most of the site as dragons simply provides C2C online identity and address and authentication, the bank account to the seller can provide a large space of the fraud. Second, establishing personal credit system, establish credit information disclosure system. In developed countries, and personal credit market economy is called the “first in modern society, as the network card” and financial development, our country can vigorously promote personal credit system, credit card transactions in credit card online, establishing personal credit database settlement. Real-life network transactions must be of asymmetric information, this paper tries to explain that “information transparency” is a word to quantify, good solution under asymmetric information distortion of trade risk for this transaction uncertainty provides the traders quantitative reference index. Using the method of game theory discussed under the condition of incomplete information customer behavior choice model, the optimal strategies that accord with people understand and analyze the problems. The trade credit risk aversion in local certain e-commerce enterprises is operating in good application, but also for the government in e-commerce system construction and management provide reference.

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Part VI
Artificial Intelligence

Chapter 49

Evaluation of the Automatically Built IT Security Domain-Specific Vocabulary

Liping Qian and Lidong Wang

Abstract The volume of the published scientific literature available on Internet has been increasing exponentially. Many projects have been funded aiming to online scientific literature mining, especially in biomedical research. The scientific literature covers most of the hot topics in the research field and has a very large domain-specific vocabulary. The exploitation of domain knowledge and specialized vocabulary can dramatically improve the result of the literature text processing. In this paper, a large-scale annotated corpus was built from abstract content in the IT security literature, from which the domain vocabularies were constructed with TF/IDF-like schema. To evaluate the discriminating capability between single word vocabulary and co-occurrence phrase vocabularies built respectively from positive and negative corpus, this paper introduced the concept of discrimination index computed by Cosine similarity and Jicard distance, presented a yearly distribution analysis of the retrieved paper and listed some new emerging bilexical co-occurrence phrases. The experimental result shows the effectiveness of domain vocabulary in discriminating domain-specific documents.

Keywords Information retrieval · IT security · Vocabulary · TF · IDF

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49.1 Introduction

The volume of the published scientific literature available on Internet has been increasing exponentially. Some of them reflect the latest achievement of the specific research domains. These publications are published by their authors online in their homepages, or being organized and indexed by large-scale database system. Some free-to-access literature databases, such as biomedical domain paper databases PubMedCentral and computer sci. and tec. full-text articles database CiteseerX deposit a lot of articles in their repository and serve as rich resources for corpus supporting for massive text processing.

Researches on information retrieval from the online literatures can be mainly divided into two areas. The first area is paper structure-based metadata retrieval. Using customized rules and description criterions (e.g. Dublin Core and ISO 23950 Bib1), metadata of title, author affiliation, and references can be obtained and then be used for deep-thinking works such as author profiling, expert finding, affiliation network analyzing. The second area is paper content-based knowledge mining. By recognizing the meaningful entities and relations in the content, implied knowledge inner- or inter-papers can be discovered and then be used for works such as named-entity recognition, text classification, synonym finding, concept or relation extraction, and hypothesis generation. In recent years, many projects have been funded aiming to the biomedical literature mining. Petric tried to identify potential contributions to a better understanding of autism focusing on articles from database PubMedCentral [1]. Shilin presented a method of mining physical protein-protein interactions by exploiting profile feature from full-text articles [2]. Yudong identified Protein-Organism-Location relations in the text of biomedical articles [3]. Cohen and Hersh [4] Computed the distance between keywords and gene names.

Natural Language Processing (NLP) plays an essential role in text processing. NLP can process information on syntactic, semantic, or pragmatic level. Syntactic deals with the structure of symbols, the related concept includes term frequency and co-occurrence. Semantic level deals with the meanings of symbols, a common architecture of semantic classification (e.g. ontology) is built to describe the properties of and relations between entities and events in document. Pragmatics has to do with context-dependent features of language. Currently, the combined exploitation of syntactic structures and semantic knowledge has effectively improved the performance of text processing tasks, while pragmatics is still a field under research and not widely applied to text classification due to its complicated knowledge representation and reasoning mechanism.

The purpose of this paper is to construct a domain-specific vocabulary and evaluate its effectiveness in automatically discriminating domain documents and can further be used in domain document identification and classification. The documents are the IT security-related literature retrieved from Internet. Different feature sets are selected under Vector Space Model (VSM). With annotated corpus, features were selected by computing their TF/IDF-like weight and

discriminating capabilities. Three vocabularies are constructed respectively from positive corpus, negative corpus, and their union; each includes a single word vocabulary and a co-occurrence phrase one. These vocabularies are used to build feature sets. An experimental system was developed to evaluate their discriminating capabilities.

The rest of this paper is organized as follows. [Section 49.2](#) describes our methodology. [Section 49.3](#) presents our experimental results and some discussion. [Section 49.4](#) is the conclusions.

49.2 Domain-Specific Vocabulary of IT Security

Compared with Web pages, scientific papers are always well organized, presented the ideas in a clear, logical way and the scientific and technical terminology is standardized. But it does not lower the level of difficulty of text processing tasks since the scientific literature also lacks of formal structure and presented with natural language. In addition, the scientific literature covers most of the hot topics in the research field and has a large domain-specific vocabulary. The exploitation of domain knowledge and specialized vocabulary can dramatically improve the result of the literature text processing [5]. Ramakrishnan leveraged the availability of a controlled vocabulary called MeSH and domain knowledge in the form of the UMLS and combined them with NLP techniques for relationship extraction. Their experiment showed that domain knowledge can be effectively combined with NLP techniques to achieve good effect [6]. In this paper, vocabularies constructed from abstract content of the IT security and non-IT security literatures will be evaluated.

49.2.1 Construction of IT Security Domain Vocabulary

Keywords listed in scientific articles can serve as a source of domain vocabulary. But English publications seldom particularize them. As an emergent branch of IT, security has a dynamically changing terminology without available semantic taxonomy and domain-specific vocabulary. Furthermore, there is a fundamental ambiguity in the use of phrase “IT security”. The research and construction of IT security vocabulary usually focus on taxonomy of vulnerabilities and Internet attacks [7, 8]. RFC 2828 provides an internally consistent, complementary set of abbreviations, definitions, and explanations for use of terminology related to IT security [9]. For self-containedness and completeness, RFC 2828 also includes many nonsecurity terms besides somewhat outdated.

In this paper, first a controlled vocabulary is built, $Seed_{AND}$, as a bootstrapping vocabulary to retrieve IT security-related Web documents. The items in $Seed_{AND}$ are selected by experts from RFC 2828 and the CFP of some top security-related international conferences in recent years, the taxonomy of Internet attack research

and several online network security dictionaries (e.g. <http://www.Itsecurity.com/dictionary/>). The size of Seed_{AND} is 201.

Keywords analysis is performed on all nonstopping words over the large corpus retrieved from the online literature database and annotated by experts. TF/IDF-like analysis is conducted on the corpus to build feature sets.

49.2.2 Methodology

Three feature sets are automatically constructed from positive, negative, and raw corpus separately. The experimental corpus is retrieved from CiteseerX by implementing a metasearching interface. Shallow NLP techniques were exploited with TF/IDF scheme to compare the classification result for the three feature sets.

49.2.2.1 Documents Preprocessing and Representing

Preproceession includes data clean and stop-words removal. A record is deleted from corpus if its title or abstract information was missing. A two-round method is used to remove stop word. The first round is using Glasgov stop-words vocabulary and the second is a customized stop-words vocabulary selected manually from the initial result of our feature weighting. Three sets are constructed, C_Pos consists of all items annotated positive, C_Neg of negative, and C_Raw is the union of the above two. VSM is used to represent documents. Each document was separately represented by features with the first n terms from the corresponding feature set.

49.2.2.2 Feature Weighting

The weight of each feature is computed with TF/IDF-like scheme. There are a lot of variants of TF/IDF weighting methods. Let $tf_{t,d}$ be the frequency of term t in document d , n the total number of documents in the corpus, n_t the number of documents including term t , the common TF/IDF method as in Eq. (49.1) is chosen to computer $W_{t,d}$ of feature t in document d . Formula (49.2) is used to measure the aggregated importance of a term t for corpus C.

$$W_{t,d} = tf_{t,d} \times \log(n/n_t + 0.01) / \sqrt{\sum_{t_i \in d} [(tf_{t_i,d} \times \log(n/n_{t_i} + 0.01)]^2} \quad (49.1)$$

$$W_t = tf_w \times \log(n/n_w + 0.01) / \sqrt{\sum_{w_i \in C} [(tf_{w_i} \times \log(n/n_{w_i} + 0.01)]^2} \quad (49.2)$$

49.2.2.3 Discrimination Index Measuring

Let a_i be a feature and w_{ai} the weight of a_i . Suppose two feature sets A and B , $A = \{a_1, w_{a1}, a_2, w_{a2}, \dots, a_k, w_{ak}, \dots, a_n, w_{an}\}$, $B = \{b_1, w_{b1}, b_2, w_{b2}, \dots, b_k, w_{bk}, \dots, b_n, w_{bn}\}$, $w_{ai} \geq w_{ai+1}$, $w_{bi} \geq w_{bi+1}$, $A_k = \{a_1, w_{a1}, a_2, w_{a2}, \dots, a_k, w_{ak}\}$, $B_k = \{b_1, w_{b1}, b_2, w_{b2}, \dots, b_k, w_{bk}\}$. Cosine similarity and Jicard Distance is used to measure their Discrimination index. Cosine similarity $\text{Cos}(A_k, B_k)$, formulated by Eq. (49.3), is a measure of similarity between two vectors by measuring the cosine of the angle between them. It determines whether two vectors are pointing in roughly the same direction. Jaccard index measures similarity between sample sets, and is defined as the size of the intersection divided by the size of the union of the sample sets. The Jaccard distance, $J_\delta(A_k, B_k)$, formulated by Eq. (49.4), measures dissimilarity between sample sets, is complementary to the Jaccard coefficient and is obtained by subtracting the Jaccard coefficient from 1.

$$\text{Cos}(A_k, B_k) = \frac{\sum_{i=1}^k w_{ai} \cdot w_{bi}}{\sqrt{\sum_{i=1}^k w_{ai}^2} \cdot \sqrt{\sum_{i=1}^k w_{bi}^2}} \quad (49.3)$$

$$J_\delta(A_k, B_k) = 1 - J(A_k, B_k) = 1 - |A_k \cap B_k| / |A_k \cup B_k| \quad (49.4)$$

49.3 Experimental Results and Discussion

49.3.1 Experimental Corpus

For the purpose of evaluation, a prototype system is implemented and test datasets are created. The experimental corpus is collected by querying CiteseerX with keywords in Seed_{AND} and accessing the description page corresponding to paper URL parsed out from result page. Our system implemented an automatic querying interface to CiteseerX. It submits 201 phrases in Seed_{AND} one by one to CiteseerX and processes the result. The description page links of papers are extracted out and then are further accessed to retrieve necessary items including paper title, abstract, published year. In retrieving, the submitted query phrases were parsed by CiteseerX using OR-logic by default so our system can collect more results. In this way, The system collected 18,608 papers after duplication data clean.

The total of 18,608 papers are annotated by IT security experts and split into two sets: the positive set is IT security-related and has a total of 10,336 papers, the negative set contains the other 8,272 papers. Our feature reduction steps are as follows: words less than three characters and appearing in less than three documents were removed. After feature reduction, 22,081 words and 75,850 bilexical co-occurrence are generated from C_{Raw} , 14,487 words and 42,023

bilexical co-occurrence from C_Pos, and 16,144 words and 27,374 bilexical co-occurrence from C_Neg.

49.3.2 Discrimination Index

Formula (49.2) is used to compute aggregated weight of every single words and bilexical co-occurrence respectively over different corpuses and then rank each list by the weight. After that, six feature sets are generated, three of them are for single words and the others for bilexical co-occurrence: Vsw_Pos and Vco_Pos built from positive corpus, Vsw_Neg and Vco_Neg from negative corpus, Vsw_All and Vco_All from the union of the above two corpus.

Now, evaluate the discrimination index between two different feature sets A and B . Let $A = \{a_1, w_{a1}, a_2, w_{a2}, \dots, a_k, w_{ak}, \dots, a_n, w_{an}\}$, $B = \{b_1, w_{b1}, b_2, w_{b2}, \dots, b_k, w_{bk}, \dots, b_n, w_{bn}\}$, $w_{ai} \geq w_{ai+1}, w_{bi} \geq w_{bi+1}$. Compute discrimination index of A and B for n -dimensions as follow. First, an union feature set of n -dimension, denoted as U_n , is constructed from the first n most weighted terms in A and B . Consider three means to construct U : balanced, left-skewed and right-skewed type, denoted respectively as U_{Bn}, U_{Ln} and U_{Rn} . $U_{Bn} = \{a_1, b_1, a_2, b_2, \dots, a_{n/2}, b_{n/2}\}$, $U_{Ln} = \{a_1, a_2, \dots, a_s, b_1, b_2, \dots, b_n\}$, $U_{Rn} = \{b_1, b_2, \dots, b_t, a_1, a_2, \dots, a_n\}$. Second, compute cosine similarity between and Jicard distance of A and B over U_{Bn}, U_{Ln} and U_{Rn} with n starts from 100 to 10,000 increased by step of 50.

The cosine similarity of single word feature sets and bilexical co-occurrence feature sets is respectively shown in Figs. 49.1 and 49.2, with AN-UL denotes the result of V_All versus V_Neg with left-skewed union set, AN-UR of V_All versus V_Neg with right-skewed union set, AN-UB of V_All versus V_Neg with balanced union set, PN-UB of V_Pos versus V_Neg with balanced union set, etc. As we can see, the cosine similarity between V_Pos and V_Neg is greatly lower than that between V_All and V_Neg, and that between V_All and V_Pos, while the Jicard distance between V_Pos and V_Neg is much higher. The best value belongs to V_Pos versus V_Neg on co-occurrence with balanced union. The

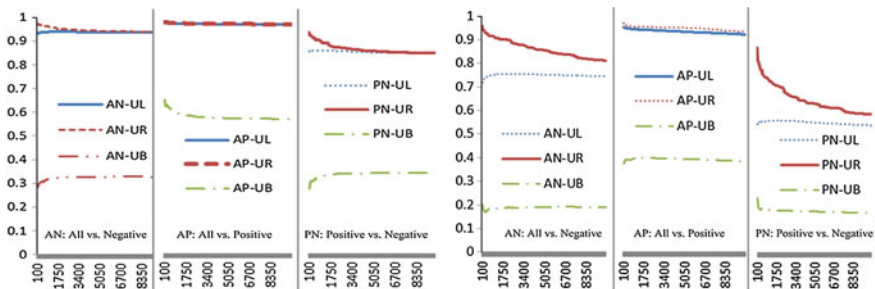


Fig. 49.1 Cosine similarity of single word and bilexical co-occurrence

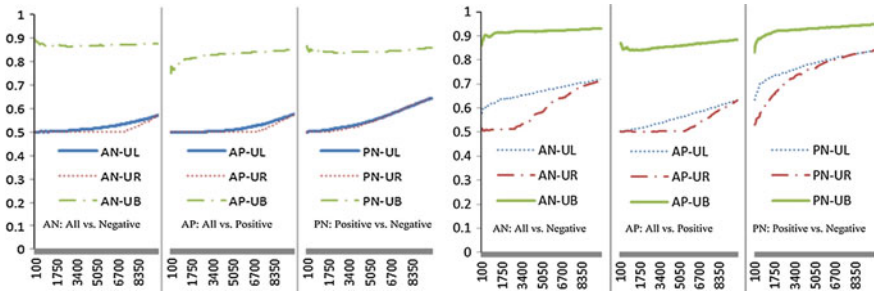


Fig. 49.2 Jicard distance of single word and biletical co-occurrence

experimental result shows the positive feature set is more representative than the other two sets.

49.3.3 Yearly Analysis

In the total 18,608 papers, there are 4,963 with unknown published year and 626 (24.60 %) published in 1990 and before. Our lexical analysis has been greatly affected and heavily biased toward years between 1996 and 2007. Annual distribution of the retrieved paper from 1991 to 2010 is [total (positive %)]: 174 (28.16 %), 234 (27.35 %), 319 (32.29 %), 440 (30.91 %), 508 (34.25 %), 651 (42.24 %), 773 (40.49 %), 868 (47.24 %), 914 (50.11 %), 1,085 (54.84 %), 1,049 (54.53 %), 1,164 (60.40 %), 1,137 (62.09 %), 1,072 (69.68 %), 1,053 (72.93 %), 754 (74.67 %), 436 (72.02 %), 217 (71.89 %), 138 (57.97 %), 33 (57.58 %).

Since co-occurrence is more representative for domain lexical analysis, focus our yearly analysis on Vco_Pos. Vco_Pos consists of all biletical co-occurrence with document frequency no less than two in two years. There are 151 phrases coincide with their counterparts in Seed_{AND}. Some phrases in Seed_{AND} that not found in our biletical co-occurrence statistics are acronyms. Another observation is that document frequency for majority of terms before 1995 and after 2008 appears zero, with most of them only appear in several years during 1996 and 2007. Frequent co-occurrences include: access control, authentication protocols, cryptographic protocols, diffie Hellman, intrusion detection, network security, public key, secret key, etc. Most of them are attribute to cryptography.

The first emerging of some phrases are: intrusion prevention (2004), malware (2005), dos attack (1998), DDoS attack (2001), trust computing (2001), honeypot technology (2006), anonymous communication (2000), cyber attacks (2002), forensic analysis (2002), grid security (2001), information warfare (1994), internet attacks (2001), pki technology (1999), quantum cryptography (1992), rbac model (1997), web security (2001), wormhole attack (2003). With the increasing number of retrieved documents, more hot words can get a timely detection.

49.4 Conclusions

The scientific literature covers most of the hot topics in the research field and has a large domain-specific vocabulary. The primary focus of this paper was to evaluate how domain-specific lexicon can be used to improve performance of identifying the IT security literatures. Our method is to select some generally accepted IT security keywords, submit each of them to CiteseerX, retrieve and parse the search results and the relevant paper description page. Items as titles, abstract, authors, and publishing year are extracted to build our corpus. The corpus is annotated by IT security experts. Over the corpus, we perform words frequency statistics, word co-occurrence analysis and yearly distribution analysis. A lexicon can be recommended based on the above result and then used to build feature sets. The experimental result shows that the domain vocabulary is more representative and effective in automatically discriminating domain documents.

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Chapter 50

Patent Analysis Based on Information in XML Documents

Yanling Wang

Abstract This paper set out to explore the information in extensible markup language (XML) documents for patent analysis. Patent information in the XML form has been carried out by WIPO for nearly 20 years. Conforming to the unified structure document of XML—document type definitions (DTD), the XML documents can be utilized by different patent analyzers in different countries with the same tags, identifiers, and elements, etc. The types of patent make a difference of the structure of patent information. After studying thoroughly the information in the XML documents and the classification of the information, this paper tries to find how the patent information in the XMLs can be served as a data basis for patent analysis. With the development of patent information in XML forms, the main patent offices worldwide not only publish patent application and granted bibliographic data every week on line but transformed the published patent data during the early period (before 1995) into XML documents. Patent information in XML documents is another very important data resource for patent information sharing, communicating, inquiring, and utilizing. The automatic tracking, extraction, and database producing is one of the most important research area in the future.

Keywords XML · Patent information · Patent analysis

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50.1 Introduction

Patent documents are usually published by different patent offices of different countries. And now this information can be available on Internet. However, patent information is separated in different websites, to acquire a great deal of information for patent analysis is very hard. Even if there are some databases constructed by dominant information institutes, such as the Derwent Innovation Index, Espacenet or WPI, etc. By accident, we found the extensible markup language (XML) documents of patent information of USPTO on Google Website [1]. This data resource opens another window for us to utilize the XML-kind information as an important data basis for patent analysis. There are ample researches on patent information and patent data collection methods. And the researches on the information extraction from XML documents are popular during recent years. However, few researches on thorough analyzing of the structure of patent XML documents and utilizing the XML documents into patent analysis.

50.2 Brief Introduction to XML and the Patent Information Marking Up and Processing Standards of WIPO

50.2.1 Patent XML Documents

In the past, some solid characteristics made documents that are written with SGML hard to be utilized since it is too complicated and to be widely used on Web. In order to enable SGML to be conveniently “served, received and processed on the Web in the way that now possible with HTML”, W3C proposed the XML Consortium which has been “designed to ease of implementation and for interoperability” with both SGML and HTML.

The XML documents are the data or information that are defined as the specification by XML standards. “Each XML document has both a logical and a physical structure. Physically, the document is composed of units called entities. An entity may refer to other entities to cause their inclusion in the document. A document begins in a “root” or document entity. Logically, the document is composed of declarations, elements, comments, character references, and processing instructions, all of which are indicated in the document by explicit markup. The logical and physical structures MUST nest properly.” [2]

The patent XML documents or instances are well-formed and conformed with the standards specified by World Intellectual Property Organization (WIPO). Usually, there are two kinds of standards for the structure standards of the XML. One is the XML schema, the other is document type definitions (DTD). WIPO adopted the XML DTDs for the specification of patent XML documents structure. Now, every country of patent cooperation treaty (PCT) has developed own DTDs for XML that conformed to ST.36 of WIPO. “XML instances that conform to this

Standard must be well-formed XML, conforming to one of the DTDs contained in Annex F or to an office-specific DTD that itself conforms to this Standard.” [3]

In order to standardize that information, the standards of WIPO defined elements, generic identifiers (GI) (tags), and attributes for marking up a patent document. Therefore, all the information in a patent document is organized. The elements, GIs, and attributes used to define a XML are “XML resources.”

Each XML document contains one or more elements, the boundaries of which are either delimited by start-tags and end-tags, or, for empty elements, by an empty-element tag. Each element has a type, identified by name, sometimes called its “generic identifier”, and may have a set of attribute specifications. Each attribute specification has a name and a value [2].

50.2.2 WIPO Standards for Organizing Patent Information Using XML

“As far as back to 1995, WIPO issued the first edition of ST.32—‘Markup of patent documents using SGML’. This is a startup of WIPO to standardize electronic patent information worldwide, in order that patents filed in different countries, regions can be shared, published, communicated without barriers [4].” Now, the ST.32 is replaced by ST.36—“Recommendation for the Processing of Patent Information Using Xml (Extensible Markup Language)” which was published in 2004, and revised in 2007. This standard recommends that during the stages of patent filing, processing, publication, and exchange of all types of patent information. The purpose of ST.36 is to provide logical, system-independent structures for patent text or image data processing. And the ST.36 can take place of WIPO Standards of ST.30, ST.32, ST.33, and ST.35 for filing, processing, publishing, and exchanging bibliographic data, abstracts, or full text of all patent document types. With more and more countries entered the electronic filing scheme of WIPO. The patent information in XML documents is becoming rich, multilayered, and more conveniently to be used.

50.3 XML Instances from USPTO

50.3.1 Patent Grant Bibliographic Data of USPTO

Patent Grant Bibliographic Data of USPTO contains patent information in DAT, SGML, and XML format from the year 1975. The information in XML format of bibliographic text of each patent grant that was issued weekly since the year 2002 till now. The information in all the three formats does not contain the images and drawings of patents. Bibliographic data in XML format from USPTO has been

issued on a weekly basis and compressed into zip files which must be downloaded separately.

The name used to identify each zip file takes the following form:

ipgbyyyymmdd_wknn.zip

where the date of publication is represented by “yyymmdd” and “nn” is a two-digit, fixed-length number (with leading zero) representing the sequentially numbered week of the year [5].

Bibliographic Data is available in XML format in accordance with various versions of the U. S. Patent Grant DTD. Starting with version 4.0, International Common Element (ICE) compatibility was established [5].

50.3.2 The Types of Patents in the Patent Grant Bibliographic Data of USPTO

After downloading the “ipgb20111004_wk40.zip”, a thorough analysis was committed on the XML document. There are only two kinds of patents included in the Patent Grant Bibliographic Data of USPTO. One is design patent, the other is utility patent. The XML contains different data and structure.

50.3.3 Patent XML Documents

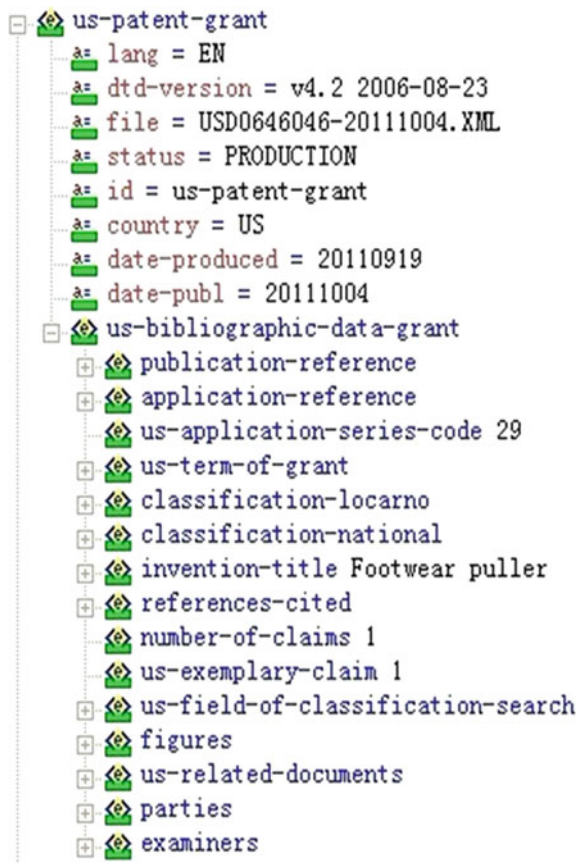
Information of every patent in the XML document is organized according the DTDs. Information is multilayered. It can be divided into three layers: (1) the information for the XML pre se; (2) the information of bibliographic data of the patent; (3) the abstract of the patent.

With an XML reader, the tree structure of the information in XML documents can be laid out. Figures 50.1 and 50.2 illustrate the structure of information in the design patent and utility patent. If we just look from the first layer of the information, the only difference is that the information of the design patent is just two-layered. For the design patent, there is no abstract information. However, the structure of the lower layer of the information is more different since the characteristics of different patents are so different from each other.

50.3.4 Patent Grant Bibliographic Data of USPTO

Patent information includes: (1) technology information, such as patent classification code, date of application, patent title, patent abstract, etc.; (2) information of inventors or patentees; (3) patent citation information, the citation category,

Fig. 50.1 Information tree of design patent XML document of USPTO



citation patent number; citation patent technology information, etc.; (4) information of patent rights, such as priority, claims, and date of publication.

Patent analysis

The object of patent analysis is mainly utility patents of the United States, which in China we call them invention patents. In the United States, utility patent “protect any new invention or functional improvements on existing inventions. This can be to a product, machine, a process, or even composition of matter.” “The difference between a design patent and a utility patent is that a design patent protects the ornamental design, configuration, improved decorative appearance, or shape of an invention. This patent is appropriate when the basic product already exists in the marketplace and is not being improved upon in function but only in style.”

Fig. 50.2 Information tree of utility patent XML document of USPTO



50.4 Information in Patent XML Documents as a Basis for Patent Analysis

50.4.1 Structure of the Bibliographic Data of Design Patent of USPTO

The information of the bibliographic data of design patent is also multilayered, mainly; information in the entity has a lower-layer information. In Table 50.1, entity marked up with “*” is single-layered; there is no lower information under it.

Information of design patents is not the research object in this patent. We just list the main structure for readers to have a whole perspective of the information.

50.4.2 Structure of the Bibliographic Data of Utility Patent of USPTO

Utility patents in the United States represent the invention or radical innovation of existing inventions. The information in the XML documents has been divided into 17 parts. From the perspective of patent analysis, the 17 parts of information can be

Table 50.1 The first layer of information of the bibliographic data of design patent

Serial number	Entity	Information
1	Publication-reference	
2	Application-reference	
3	US-application serious code	※
4	US-term of grant	
5	Classification-Locarno	
6	Classification-national	
7	Invention title	※
8	Reference cited	
9	Number of claims	※
10	US-exemplary claim	※
11	US-field-of-classification search	
12	Figures	
13	US-related documents	
14	Parties	
15	Assignee	
16	Examiner	

Table 50.2 The information in the utility patents and classification

Serial number	Index	Classification
1	Publication-reference	Technology/Patent
2	Application-reference	rights information
3	US-application serious code	
4	US-term of grant	
5	Classifications-ipc	Technology
6	Classification-national	information
7	Invention title	
8	Reference cited	Citation information
9	Number of claims	Patent rights
10	US-exemplary claim	Patent rights
11	US-field-of-classification search	Technology information
12	Figures	–
13	US-related documents	Citation information
14	Parties	Information of
15	Assignees	inventors or patentees
16	Examiners	Citation information
17	Abstract	Technology information

divided into four classifications. Table 50.2 illustrates the classifications of the 17 parts of information. However, some parts of information cross the classification of technology information and patent rights information. When the patent analysis is carried out, to extract the smallest entity of information is necessary.

The information in the XML documents by table is harder to display explicitly than by XML documents. The tree structure of XML can display the information in different layers very explicitly. Since the information is multilayered and the data and layer identifiers compound in the table, the information of the XML document is harder to be read than XML tree structure. However, with a very careful exploration of information, we parsed the structure of the XML document, and can find which information can be utilized and which information can be ignored. Patent analysis compass many research fields which the patent information can reflect. If we need to analyze the technology trend, change, and evolution, the technology information of patents is very important. Information about patent publication and application accompany with the patent classification codes.

50.5 Conclusion

With a thorough identification of the classification of the information in XML documents, we can find the information we need for the analysis of the patent and this work is a basis for the automatic extraction of information from numerous patent XML documents. Only when we make clear the content and structure of XML documents for different kind of patents, can we know how to extract this information. Although information extraction is a heavy work, it is still easier than the information extraction from the Web. Except for the basis of XML documents themselves, the auxiliary data such as the IPC code database of different edition in different period, the document number database, and the UPC code is very necessary to be constructed. In the future, extraction and utilization of patent information in different Patent Office can be automatic. The prealert of patent information publication is a main method for patent information tracing, which can realize the automatic information collection.

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Chapter 51

Design of Recognition System for Rice Planthopper over Digital Signal Processor

Xiuguo Zou

Abstract To design a rice planthopper recognition system based on digital signal processor and target recognition algorithm over wavelet transform. The hardware system included mobile device using single-chip microcomputer as the core of control, and algorithm processing platform using digital signal processor as the core. The software system consists of image segmentation based on single-threshold segmentation, and target extraction of rice planthopper is based on wavelet transform. It used video camera to shoot crop video. Then input video signal to the digital signal processor of the recognition system and extract pictures, and identify the image of rice planthoppers. This system can realize that people do not need to visit the farm estate and easy to grasp the overview of rice planthopper and to keep abreast of the internal field details of the pest and to develop appropriate treatment measures.

Keywords Single-chip microcomputer · Digital signal processor · Rice planthopper · Mathematical morphology · Wavelet transform

51.1 Introductions

Identification of rice planthoppers in the laboratory was realized through the general purpose computer processing. Its real time is relatively poor. The rice planthoppers recognition system is a laboratory device. The system can avoid the

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shortcoming of the background moving. It uses the shooting device mobile way to collect images and digital signal processor (DSP) to process. The core of the system is designing the planthoppers recognition hardware system based on DSP DM6437, and uses recognition software to run on the identification hardware system. Development of this system using machine vision technology, digital image processing, and DSP embedded system design technology. It can achieve rapid, accurate identification of crop pests, and have a certain significance to develop pest real-time identification system over digital image [1].

51.2 Overall Scheme of System

The system hardware include mobile shooting device, rice planthoppers identification devices, display equipment, and other components. Mobile shooting device provides different point of image acquisitions for real-time identification subsystem, thus to get objects for processing. The rice planthoppers recognition system is based on the minimum system of DSP processor, and embedded the rice planthoppers shape feature extraction processing algorithms to process the acquired image by real time. The processing results can be displayed through the LCD TV.

Framework map of recognition system is shown in Fig. 51.1.

51.3 Mobile Device Design

51.3.1 Mobile Platform Design

The mobile shooting device includes a 1 m long horizontal track, each with a fixed column on both sides of the track, and a mobile car on the track. The devices use two same size wheels, and each wheel has a motor control wheel of the same model. The wheel is fixed on one side of the car. Stepper motor driver IC ULN2003 was driven by the microcontroller AT89S52. It makes two wheels one clockwise rotation, the other counter-clockwise rotation, and the rotational speed is equal. One terminal of the rope was fixed on a wheel, and the other terminal is fixed in the fixed column, so that the motor drives the wheels to make the car move around in the horizontal track through pulling or putting the rope. The camera is

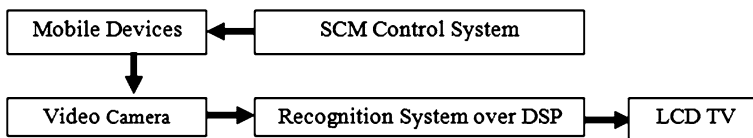


Fig. 51.1 Sketch map of recognition system

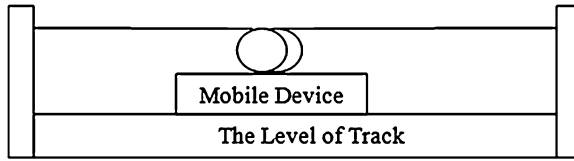


Fig. 51.2 Sketch map of mobile devices

fixed in the car, so it can shoot the curtain containing rice planthopper in any position of the track.

Sketch map of mobile shooting device is shown in Fig. 51.2.

51.3.2 Control Circuit of Mobile Device

This mobile device is mainly composed of the microcontroller AT89S52 minimal system, key control circuit, ULN2003 driver circuit, stepper motor circuit, and stepper motor. Stepper motor control is mainly used through the five keys, “Forward”, “reverse”, “accelerated”, “slow down”, and “stop”, to enter the SCM system. Microcontroller outputs four pulse signals to trigger ULN2003 chip of the drive circuit. Four groups amplifier inside the ULN2003 chip is connected to four phase windings of stepper motor, and the corresponding windings of the stepper motor get electricity by the amplifier signal output. Microcontroller order continuous output timing pulse and the rotation of the stepper motor can be achieved [1, 2].

Framework map of control circuit board for mobile device is shown in Fig. 51.3.

51.4 Design of Rice Planthoppers Recognition Hardware System

Design of rice planthoppers recognition hardware system is based on DSP chip, and select TI’s DM6437. The camera is a designated collection. Video frame is transmitted into the video decoder of the video interface and convert analog

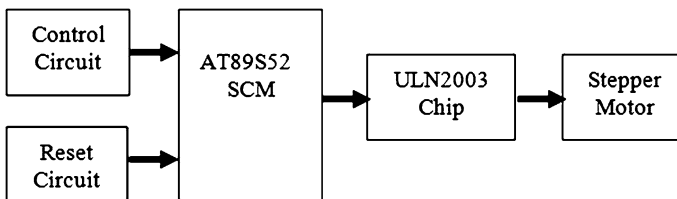


Fig. 51.3 Framework map of control circuit board for mobile device

signals into digital signals, then it was input buffer of recognition system in the form of the image. DM6437 runs processing algorithms for pest identification. The results displayed by the video encoder output to prompt the user or transmitted the digital signal into the backend server from the cable.

51.4.1 Digital Signal Processor DM6437

The core processor of the system uses the TMS320DM6437. DM6437 processor is TI's next-generation high-performance digital media processor. It is a processor with operating frequency up to 600 MHz, and has the following outstanding performance: short 1.67 ns instruction cycle, per clock cycle can be executed eight 32bitC64x+ instruction in parallel, performance up to 4800MIPS, and feature-rich video processing subsystem [3].

51.4.2 Camera Interface

The system uses 2-way standard analog video input and can only select one through the appropriate control options. Video decoder selected TVP5150APBS which is a high-performance video decoder. It can transform a standard NTSC or PAL analog video signals into the BT.656 standard format for digital video signals. The encoder is connected to the DM6437 by IIC bus, and consists of a serial data input/output line (SDA) and clock input/output line (SCL). The decoder is only a slave device, not as a master device. IIC bus data transfer rate of this system is under 100 kbit/s, and the IIC address is B8H [4].

51.5 Rice Planthoppers Recognition Algorithm

First segment the image containing rice planthoppers. Image segmentation is the unique nature of the area separation from the image. It is the premise of image analysis, and is a basic machine vision technology. Image segmentation algorithm uses single-threshold segmentation. A grayscale image is defined as $f(x, y)$, and set a gray threshold T , the pixel of $f(x, y)$ is divided into two categories [5]. The threshold binarization is shown in formula (51.1).

$$g(x, y) = \begin{cases} b_0 & f(x, y) < T \\ b_1 & f(x, y) > T \end{cases} \quad (51.1)$$

51.5.1 Mathematical Morphology Denoising

The basic algorithm of mathematical morphology that is used in planthoppers recognition includes erosion, dilation, opening, and closing, and so on. This system mainly uses erosion and dilation [6].

51.5.1.1 Erosion Algorithm

A structure element 'S' moves on a given target image 'X'. On every present location point 'x', S[x] has only three possible states.

- S[x] is included in X.
- S[x] contains the complement of the X.
- S[x] intersect at X and S[x] intersect at a complementary set of X's.

The first state shows the largest correlation. The second state shows no correlation. The third state shows partly correlated. Therefore, the set of all x that meets the formula (51.2) forms the maximum correlation point set with the structure element. This point set is called erosion denoted as $X \ominus S$. The set is defined as formula (51.2).

$$X \ominus S = \{x | S[x] \subseteq X\} \quad (51.2)$$

51.5.2 Dilation Algorithm

The dilation is on the contrary to the erosion. Each point x in image X is expanded to S[x] denoted as $X \oplus S$. The set is defined as formula (51.3).

$$X \oplus S = \{x | S[x] \cap x \neq \Phi\} \quad (51.3)$$

51.5.2.1 Opening Operation and Closing Operation

For image X and structure element S, it can use $X \circ S$ to express the opening operation of X and S, and use $X \cdot S$ to express the closing operation of X and S. They are defined as formulas (51.4) and (51.5).

$$X \circ S = (X \ominus S) \oplus S \quad (51.4)$$

$$X \cdot S = (X \oplus S) \ominus S \quad (51.5)$$

51.5.3 Pests Edge Extraction Based on Wavelet Transform

Edge is the most important characteristics of the image on the visual. Wavelet transform has the ability to detect local mutation, so it is a good tool for the edge detection. It can be combined with the multi-scale information to detect [7].

In the image $f(x, y)$, let $\theta(x, y)$ is a smooth function and regard two first derivatives along x and y directions as the two basics of wavelet. They are shown in formula (51.6).

$$\begin{aligned}\psi^1(x, y) &= \frac{\partial}{\partial x} \theta(x, y) \\ \psi^2(x, y) &= \frac{\partial}{\partial y} \theta(x, y)\end{aligned}\tag{51.6}$$

$\psi^1(x, y)$ and $\psi^2(x, y)$ of formula (51.6) can be used as the wavelet function, and wavelet transform as shown in Eq. (51.7) in the scale 2^j .

$$\begin{aligned}W_{2^j}^1 f(x, y) &= f * \psi_{2^j}^1(x, y) \\ W_{2^j}^2 f(x, y) &= f * \psi_{2^j}^2(x, y)\end{aligned}\tag{51.7}$$

Two-dimensional (2D) wavelet transform vector is the gradient, and detects coefficient modulus local maxima of wavelet transform along the gradient direction; it can get the image edge points [8].

51.6 System Experiment

According to rice planthoppers, flutter of light and quality assurance experts to capture the insect specimens, we choose 160 W self-ballasted fluorescent high pressure mercury lamps to attract rice planthoppers to white Dacron acquisition curtain. Experiment used emulator. The emulator adopted Beijing Ruitai Company's ICETEK-XDS560 which connects the computer by USB2.0 and using JTAG interface to connect the DM6437. First DSP reads the original image, and put the image into the buffer, the two rice planthoppers image taken by the CCS3.3. The schematic diagrams are shown in Fig. 51.4.

51.6.1 Image Binarization and Morphology Denoising

Aim at filter smoothing processing of the binary images, such as the removal of the foot, tentacles, noise, and other nontarget area, thus to retain the rice planthoppers trunk area. The results are shown in Fig. 51.5.

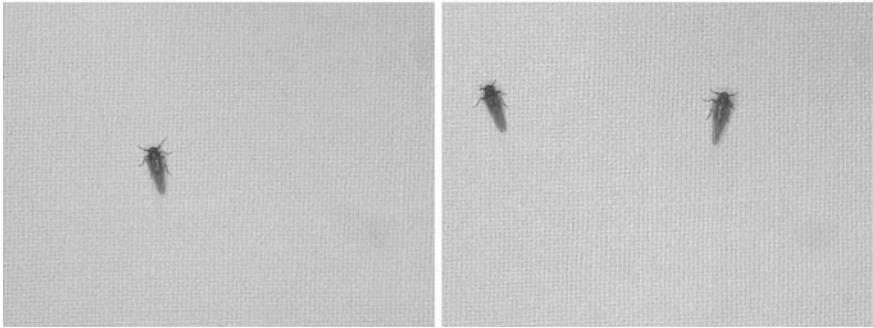


Fig. 51.4 Schematic diagram of rice planthoppers on the curtain

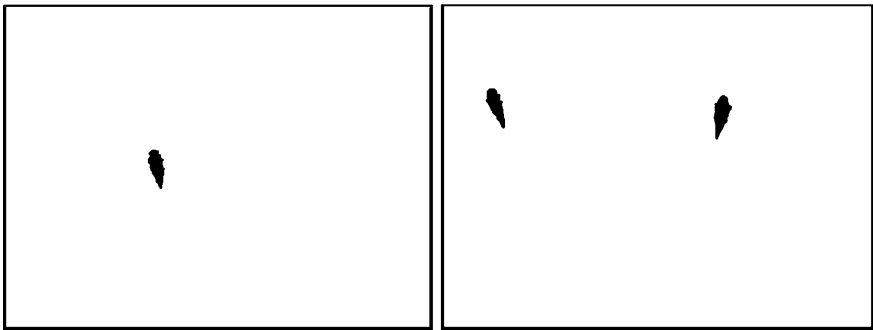


Fig. 51.5 Image after morphological denoising

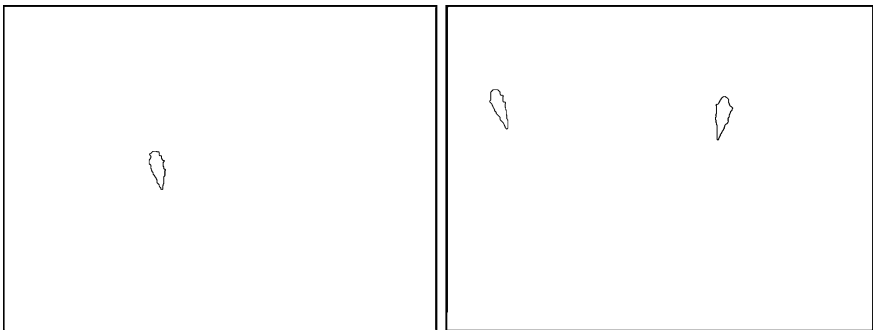


Fig. 51.6 Outline image of rice planthoppers extracted by wavelet transform

51.6.2 Extract Planthoppers Outline by Wavelet Transform

To extract the outline of rice planthoppers by wavelet transform, the images are shown in Fig. 51.6.

51.7 Conclusions

Rice planthoppers outline which was extracted by the system can be used as shape features to identify planthoppers. The shooting device has a simple structure, and easy to control. Recognition system which based on DSP running quickly and the image processing technology is very sound. The rice planthoppers shape recognition algorithm uses the conventional algorithms, including the binary arithmetic based on threshold values, mathematical morphology denoising, pest edge extraction algorithm based on wavelet transform, and so on. These algorithms are compiled program and run in the DSP that can achieve real-time identification requirements.

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Chapter 52

Chinese Standard Comparative Sentence Recognition and Extraction Research

Liqiang Xing and Lu Liu

Abstract Information extraction is the first and foremost important task of Standard Knowledge Mining. The paper focuses on comparative sentence recognition and extraction. There are three steps, respectively Comparative Sentence Recognition, Technical Index Parameter Recognition and Technical Index Extraction. At first, we search the standard by keywords from a feature set lists in order to categorize the documents into its specific class. In addition, we build the regular expression to spot technical index parameter. Lastly, we treat the technical index extraction as a sequence labelling problem and treat the keyword, noun phrases, and theirs position as features training by CRF model. The final experiments show that the result performs very well in standard document comparative sentence recognition and extraction.

Keywords Standard knowledge mining · Comparative sentence recognition · Technical index parameter recognition · Technical index extraction · CRF model

52.1 Introduction

Standard Knowledge Mining is defined as a framework consisting of three steps, including information processing by digitalization and structural formatting, information retrieval in terms of multiple perspectives and dimensions, as well as

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information extraction and linking from all areas and fine granularity. The standards are published as the electronic version or in book form, therefore, the standard literature text is mostly existed as the data format of the semi-structured or unstructured data formats, there is not doubt that it will increase the difficulty of standard knowledge mining. Comparative sentence identification of Chinese technical standard document and extraction are divided into three sub-tasks, namely, comparative sentence identification task, parameter identification task of technical indicators and recognition task of technical indicators. The first task is issue of statement classification; the second and third task is problem of information extraction.

The paper mainly focuses on the above three problems. Its research contribution is mainly reflected in the following aspects:

1. Separate the different processing tasks, the first task focuses on recall rate, namely, extract sentences containing characteristic words as much as possible, while the second and third task focus on precision, so that enhance the overall recognition effect.
2. Recognition task of the technical indicators deals into a sequence annotation, using CRF model to practice.

This paper focuses on comparative sentence recognition of the Chinese technical standards and extraction. At first, [Sect. 52.1](#) state the related status of the comparative sentence identification and extraction. Then [Sect. 52.3](#) is described according to [Sect. 52.2](#). Finally, [Sect. 52.4](#) summarizes the study and presents the future direction and focus in the study.

52.2 Related Research

This study mainly focuses on comparative sentences recognition and extraction of the Chinese technical standards. According to Chinese standard <<GB/T 20000.1—2002: the work guidelines for standardization Part 1 General vocabulary of standardization and related activities>> the definition of standard, which is a normative document of common use and reuse in order to get the best order within a certain range, developed by consensus and approved by the recognized institution.

At present, there are not many researches about comparative sentences. In English, Jindal et al. [1] firstly identify comparative sentences by supporting vector machine (SVM) and CSR (class sequential rules) algorithm, they achieved accuracy of 84 and 83 % recall rate at most by using comparative and the most advanced label tag and other keywords; and then they take advantage of the LSR (label sequence the rules) algorithm to extract compare elements [2], and achieved good results. Feldman et al. [3] extract name and attributes of products from the

forum by using the rules and compare different products. Sun et al. [4] seek the relationship between the two products through Web search. Li et al. [5] dig English comparative sentence problem submitted by users online, they find a series of comparable entities based on input entities of users.

In the aspect of Chinese, researching on comparative sentences mainly focuses on the field of linguistics, including the scope of comparison, a typical comparative sentence, semantic of comparison. However, there is a little research on Chinese comparative sentences from the field of computational linguistics and data mining. Huang et al. [6] of Peking University identify Chinese comparative sentence by using SVM and CSR algorithm based on the research of Nitm, achieving a higher accuracy rate, however, the recall rate is not high, which is an average of only about 70 %. Huang et al. [7] improves recognition algorithm of comparative sentence and analyze comparison relationship of Huang et al. by using conditional random fields (CRF) model.

52.3 Identification of Comparative Sentence

Comparative Sentences Research in this paper is different from traditional comparative sentence studies, which focused on the position relationship of two or more objects in an attribute. With the definition of the [1, 6], the example can be expressed as <formaldehyde content of textiles in toys, 30 mg/kg, shall not exceed>.

Characteristic word is defined as terms that can reflect if it is comparative sentences in the sentence of this paper. Characteristic word mainly including five classes by researching technical standard document, namely: greater than, less than, equal to, greater than or equal to, and less than or equal to. For each class, each Characteristic word can be presented by its synonyms, for example “shall not exceed”. The results of the comparison can be classified to the category of less than or equal. When identify these types of synonyms, the algorithm will automatically identify the sentences of comparative sentences, and classified into a specific category of comparative sentences. Therefore, it is very necessary to establish thesaurus of characteristic and synonyms word, as specified in Table 52.1. We assume that each comparative sentence only belongs to a class. Therefore, when using the features word to match keyword, the matching order of the characteristic word is particularly important. Take two types of keywords “Less than” and “less than or equal to”. For example, if we take the order from top to bottom to identify, then meeting the “less than or equal to” sentence will be identified as “less than” class. Therefore, we take the matching order of characteristic word from bottom to top: less than or equal to, greater than or equal to, equal to, less than, greater than. We can guarantee that the subsequent sentence category does not have a large error rate by matching order of the characteristic word.

Table 52.1 Characteristic and synonyms word

Characteristic word	Synonyms word
More than	Exceeded, should be greater than
Less than	Should be less than, or at least lower than be
Equal to	The application
Greater than or equal to	Not less than, equal to or greater than, shall not be less than, not less than, or at least should be
Less than or equal to	Not greater than, shall not exceed, not exceed, not more than, should be less than or equal to, not greater than, equal to or less than, shall not be greater than

52.4 Parameter Identification of the Technical Indicators

Because indicator parameters existed in comparative sentences is relatively simple, there are only two cases, the first case exists only digital, the second situation is a combination of numbers and units, and it can be identified with a regular expression.

Before carrying out identification task of comparative sentence, we define sentence punctuation at the end of the list, and assume that every sentence is its any punctuation character at the end, not just end with a period. This assumption can ensure the technical indicators corresponding to their figure in the single sentence to a large extent. We match each sentence by regular expressions based on this assumption. The regular expression consists of two parts, namely: match part of digital and units. The digital part must be present, while the unit part is optional. Before conducting regular expressions, in order to reduce the noise of data, we convert the standard document, thereby enhancing the recognition effect.

The main words in all headings (even run-in headings) begin with a capital letter. Articles, conjunctions and prepositions are the only words which should begin with a lower case letter.

52.5 Recognition of Technical Indicators

Because candidate word of compare topic can allow several nouns, we need to pretreatment to candidate word of compare topic, and at the same time in order to simplify the process and increase processing speed. Each noun is marked as a “N” by simplifying. Take “formaldehyde content of textiles in toys shall not exceed 30 mg/kg” for an example, by simplifying the process, before the results of the comparison the sentence simplified into “N contained in N, N”. Based on this, we will select part sentence only marked as N or consecutive N as the candidate word of compare topic.

Table 52.2 Characteristic list of candidate word

Example sentence	Formaldehyde content of textiles in toys shall not exceed 30 mg/kg
POS tagging	Toys/NN/LC/MSP containing/VV textiles/NN/DEG, formaldehyde/NN content/NN/NN/AD/VV Over/VV, 30 mg/kg/NN./PU
Simplified sentence	Toys/N (SE)/LC/MSP containing/VV textiles/NN (SE)/DEG, formaldehyde/N (SE), content/N (SE),/AD/VV Over/VV, 30 mg/kg/N (OE)./PU
Relatively standard feature	<NN NN NN NN>, formaldehyde content of textiles in toys
Baseline feature	<NN>, 30 mg/kg
Position characteristic of technical indicators related to its parameters	1
IOB characteristics of the technical indicators	Toys/B-Index textile content/I-Index formaldehyde/I-Index content/I-Index shall not exceed 30 mg/kg

Based on this, we define the following characteristics: POS tagging labels, candidate word of compare topic itself, technical indicators relative to the position of parameters of technical indicators, IOB show of technical indicators. Take “formaldehyde content of textiles in toys shall not exceed 30 mg/kg” for an example, Table 52.2 specific lists the characteristic show of the comparative sentence.

The second line of Table 52.2 lists the sentence; we can find out that the technical indicator of “formaldehyde content of textiles in toys” is indeed made of more than one noun or noun phrase after speech tagging. In addition, there are total three nouns as comparative theme of candidate words before not more than compare feature words. The third row of Table 52.2 is a simplified sentence, we have labeled the real comparative themes and baseline, replaced with N, so that distinguish speech tagging. The fourth line and fifth line of Table 52.2 lists the feature of comparative characterization and comparative baseline, there are three main features, take the fourth line for an example, the first feature is speech tagging tags <NN NN> of comparative theme, The second feature is compare themes itself “formaldehyde content of textiles in toys”. The sixth line of Table 52.2 is location feature that technical indicators related to its parameters, this feature could take three values, 0 indicates that the comparative sentence has no technical indicators, 1 indicates that technical indicators exist before the parameters of technical indicators, 2 indicates that technical indicators exist after the parameters of technical indicators. The seventh line of Table 52.2 is the IOB expression of technical indicators; we only expressed noun phrases in the technical indicators. In this feature, the “toy” is the beginning of the noun of the technical indicators, using B-Index to express, “textiles” and “formaldehyde” content is the middle noun of the technical indicators, using I-Index to express, other words are O-Index, which means that the word does not belong to the technical indicators.

We use the conditional random fields model (CRF) to learn feature. CRF presented by Lafferty et al. [8] in 2001, combining the characteristics of the maximum entropy model and hidden Markov model, is a no-directed graph model, which achieved good results in sequence annotation tasks of segmentation, POS tagging, named entity recognition in recent years.

52.6 Experiment

The paper selects 24 Chinese technical standards of toy field as the experimental data and manual annotation. The data come from the Chinese Institute of Standardization. Because these data sets are stored in PDF format, in order to process data. At first, standard in PDF format should convert into text format for storage. After transformation, the original standard document is undoubtedly increasing a lot of noise, for example, the original data is “2.5 kg”, it is “2.5 kg” in the transformation standard. Therefore, before processing comparative sentence recognition and extraction experiments, we standardized the transformed data, so that got the experiment data for us to carry out. Based on the data, we process comparative sentence extraction and classification of the standard document to receive specific categories of documents by defining feature vocabulary and synonyms. The data set is shown in Table 52.3.

There are a large number of non-comparative sentences in the category of formed comparative sentence. For example, in the “equal” comparative category exists a non-comparative sentence, this type of simulation tests is called the reasonably foreseeable abuse tests, there are a lot of sentences that do not comparative sentences in this category, but because it contains keywords of “for” or “application”, so that the non-comparative sentences classified as comparative sentence. Because this stage focuses on the recall rate; we should extract sentences with characteristic words as much as possible. Although it will extract sentences which are not comparative sentences, we can delete them in the post-processing.

According to obtained comparative sentences, we use regular expressions to identify the parameters of technical indicators. The experiment results of parameter identification of various categories of technical indicators shown in Table 52.4.

Table 52.3 Samples of data set

Comparative sentences category	No. of sentences	Ratio (%)
Greater than	667	20.69
Less than	238	7.35
Equal to	1,212	37.41
Greater than or equal to	613	18.89
Less than or equal to	510	15.74
All	3,249	100

Table 52.4 Experiment results of parameter identification of technical indicators

Category of comparative sentence	Precision/%	Recall/%	F- measure/%
Greater than	93.74	86.16	89.79
Less than	96.48	90.61	93.45
Equal to	81.37	92.09	86.40
Greater than or equal to	92.28	89.17	90.7
Less than or equal to	93.22	91.32	92.21

Table 52.5 Experiment results of technical indicators identification

Category of comparative sentence	Precision/%	Recall/%	F- measure/%
Greater than	84.43	81.66	83.02
Less than	83.31	80.60	81.84
Equal to	82.64	78.32	80.42
Greater than or equal to	87.94	86.89	87.41
Less than or equal to	87.80	86.26	87.02

The reason why there are most of errors is that identified comparative sentences contains more than two digitals with no units and non-existent digital, although parameter of technology indicator is identified, it cannot distinguish which number is the parameter of technical indicators, leading the match error of regular expression identification. We previously assumed that technical indicators correspond to their parameter in each comparative sentence. Based on this, before conducting extraction of the technical indicators, we remove comparative sentence, which exist more than two no digit and no number.

Finally, extract dataset which has processed parameter identification of technical indicator. At first, data is converted into the corresponding feature function representation. Then use the MALLET tool kit [9] to learn its tenfold cross of CRF, assess that by using F-measure. The experimental results of various categories of technical indicators identification is shown in Table 52.5.

From Table 52.5, it can be seen that the F-measure in each category is more than 80 %, the effect of “greater than or equal to” and “less than or equal to” is higher relative to other categories, and the effect of “equal to” is the least. Since what we have done is the technical indicator extraction of a combination of noun phrase, the effect is worse than the effect of a single noun or noun phrase, which remains to be further research.

52.7 Conclusion

Chinese Standard Knowledge Mining is defined as a framework consisting of three steps, including information processing by digitalization and structural formatting, information retrieval in terms of multiple perspectives and dimensions, as well as

information extraction and linking from all areas and fine granularity. Hence, information extraction is the first and foremost important task of Standard Knowledge Mining. The paper focuses on comparative sentence recognition and extraction. There are three steps, respectively Comparative Sentence Recognition, Technical Index Parameter Recognition and Technical Index Extraction. At first, we search the standard by keywords from a feature set lists in order to categorize the documents into its specific class. In addition, we build the regular expression to spot technical index parameter. Lastly, we treat the technical index extraction as a sequence labeling problem and treat the keyword, noun phrases, and their position as features training by CRF model. The final experiments show that the result performs very well in standard document comparative sentence recognition and extraction.

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Chapter 53

Intelligent Terminal Application and Management in College Class Ecology

Lijia Wang, Danhua Wu and Jiankang Zhang

Abstract With the development of intelligent technology, intelligent terminal is gradually coming into Chinese education industry. While intelligent terminal provides convenience for teaching and improvement for the contents of Chinese education, it also brings unexpected impact on Chinese education, especially Chinese college class. The ecological environment of the Chinese college class has been damaged, and the comprehensive effect of education has also declined. Based on the analysis of the intelligent terminal used in China's education, with the methods of literature, case studies and so on, this paper deals with the pros and cons of intelligent terminal on the ecological balance of the college class and analyzes its impact and significance. Then some strategies about intelligent terminal application and management in the ecological environment of the college class are proposed in order to improve the current ecological imbalance in Chinese college class.

Keywords Class ecology · Intelligent terminal · Application · Management

53.1 Introduction

The State Informatization Development Strategy 2006–2010 put forward that one of the strategic focuses of China's information technology development is to accelerate the informatization pace of education and research, to achieve

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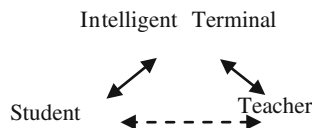
digitization in teaching, research, management, service, and other aspects on campus by advanced information technology[1].

Intelligent terminal is a smart device with multimedia functions. It supports audio and video, data and other functions, such as videophone, conference terminal, PC, PDA with built-in multimedia functions, etc. As an important carrier of global information, intelligent terminal has already come into college class on a large scale: slides, computers, iPad, smart phones, ICAI, etc. Foreign media report that a university in Australia will use iPad to replace paper textbooks and provide its students with iPad for learning [2]. However, the balance of class ecological system has hugely been changed because of its existence. For example, our college students use intelligent terminal to surf on the Internet, play games, and listen to music in the classroom, but teachers cannot control this phenomenon. Compared with the original class ecology, it has been seriously imbalanced. Therefore, “how to manage the application of intelligent terminal in college class and maximize its advantages and minimize its disadvantages” and “how to apply intelligent terminal to maintain class ecological balance” are key scientific topics of exploring the impact of intelligent terminal on class education.

53.2 The Management Philosophy of Intelligent Class Ecology

The “class ecology” in this paper is the most important organizational form of the microecology and a combination of life and environmental systems in a specific space—class [3]. Among them, the life system refers to teachers and students, the subject factors of the class. Environmental system includes material and spirit. The media factors in the material are also important factors in class ecology. Intelligent terminal, the research object of this paper, is a media factor.

Currently, the media factor has been not only the means and tools of teaching, but may have evolved into the teaching contents as well. And the complex relationship between media factors and subject factors can directly affect the teaching efficiency and teaching quality. Based on this, this paper deals with the three factors, namely intelligent terminal, teacher, and student as well as their relationship, then puts forward main points on management concept—direct mode.



In this mode, the ecological subject—students and teachers—has been basically dependent on the intelligent terminal for communication, and the intelligent terminal directly influences teaching contents and effects.

53.3 The Impact of Intelligent Terminal Equipment in College Class

The application of intelligent terminal in education can not only present the teaching contents in the multimedia and network way, but also guide teaching strategies from intelligent and decision-making perspective and carry out teaching evaluation of contextualization and process [4].

53.3.1 Positive Effects

The intelligent terminal makes the college class vivid and active and students' learning life more colorful. Nowadays, students in the class can make class learning exciting and real through computers, mobile phones, and professional equipment.

The widespread use of intelligent terminal can let teachers demonstrate the teaching contents in class by high-tech means. Nowadays, PPT projection technology has been widely used in Chinese colleges, which has largely saved the teacher's time. Students through the combination of pictures, text, and videos can have a better understanding of the teaching contents. At the same time, it can reduce the academic burden on students and enrich the campus life of students.

53.3.2 Negative Effects

In the GCCCE 2011, Professor Nancy Law considered that the essence of the innovation of introducing IT into class teaching to cultivate talents of the twenty-first century is the introduction of "disruptive" technology [5]. With the utilization of desktop computers lowering, the utilization rate of mobile terminal is close to traditional desktop computers [6] (Fig 53.1).

Intelligent terminal has affected the ecological environment of education at school to a great extent, especially in the class, resulting from the incorrect and inappropriate management of intelligent terminal.

53.4 The Organic Integration of the Intelligent Terminal and Class Ecology and Management Points

53.4.1 Optimization and Integration of Intelligent Terminal

In the era of teaching informatization, traditional face-to-face learning and online learning etc. have formed some combination and there is no doubt that intelligent

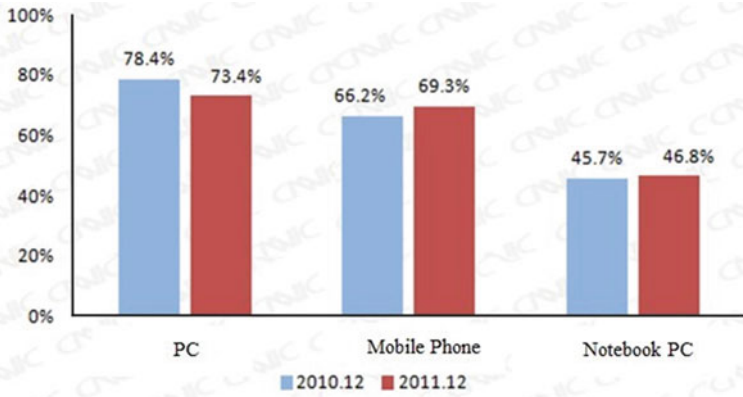


Fig. 53.1 Internet user equipment

terminal is indispensable in class ecology. The introduction of intelligent technology is to weaken the contradiction between them and improve the performance of combining both learning patterns. In order to ensure that students effectively obtain knowledge, they need to learn during the learning process, intelligent technology should lay emphasis on the following points of optimization and integration for organic integration and management in class ecology.

53.4.1.1 Internal Optimal Management, Designing Intelligent Application

According to the data provided by CNNIC, the proportions of our Internet college student users account for 40 and 85.7 % [7], respectively, of total netizens in 2008 and 2010. Learning tools used in class are mostly smart phones, through which students could timely and effectively obtain unknown information in class. However, many students take advantage of this opportunity to browse network information, take part in social activities (micro blog, MSN, QQ and Renren, etc.) and play games etc.

Therefore, we should weaken and reduce this phenomenon by optimization of technology. Concrete operations: intelligent network monitoring application could be added to the intelligent equipment, and intelligent Internet personal assistant could also be added; Designing intelligent application which could feed back to teachers to assess students and offer advice or suggestion based on network use and their class performance.

53.4.1.2 External Optimal Management, Designing Intelligence

Intelligent terminal may emphasize humanized external control system design, such as network control system design. By designing a kind of intellisense device

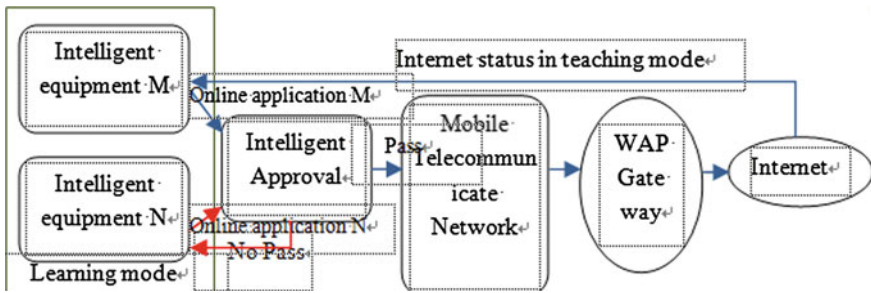


Fig. 53.2 Process of intelligence mode

and installing it in the class, intelligent terminal and network control system could perform intelligisense after students enter the classroom. Intelligent terminal is set in the class mode in the inductive zone, thus students could not access some nonclass information until they apply for it, as shown in Fig 53.2.

The school and the teacher could manage intelligent terminal and students' use at the macro level after intelligent technology has provided effective intelligent management application. Simultaneously, intelligent technology of intelligent terminal will also assist students in self-management. In this way, the media factor, intelligent terminal, could be externally controlled providing guarantee for class ecological balance.

53.4.2 Relationship Between Teachers and Intelligent Terminal and Management

Intelligent terminal and course integration is to incorporate information technology into various factors of course teaching system to lay sufficient material foundation for teachers' classroom teaching and become teachers' teaching tool, students' cognitive tool [8], important textbook form, and main teaching media. As Suchomlinsky put it, "material base at school (including all displays surrounding students) is primarily an essential condition of complete education process; secondly, it is the means to exert influence on students' mental world and cultivate their opinions, belief and favorable habits [9]."

Intelligent terminal is effectively incorporated into multidisciplinary teaching process to create informational teaching environment to realize the teaching and learning mode featured by "independence, exploration, cooperation" which enables teachers to play a leading role and students to fully display their principal position.

53.4.3 Relationship Between Students and Intelligent Terminal and Management

Students and intelligent terminal should maintain a relatively independent relationship: first, ideological education should primarily be emphasized [10], providing open communication and preventing mandatory management, which could merely temporarily solve the problem that Chinese college students depend on intelligent terminal. Second, academic guidance should be strengthened to facilitate the transformation of students' learning pattern. In addition to speeding up the construction of digitized teaching resources, academic guidance should be strengthened, and blended learning pattern of organic combination between class learning and online learning with unlimited time and space should be actively explored for students to play initiative and creativeness and improve learning effect.

53.4.4 Relationship Between Teachers and Students and Management in Intelligence Technology Background

Intelligent terminal is merely a tool to assist teaching, while the teaching focus is contents and students. Teachers could draw support from intelligent method to enrich teaching contents and facilitate students' comprehension and arouse their enthusiasm, but not for attracting their attention. Teaching contents play a key role in arousing students' interest in the class and attracting their attention and teaching form should not be overlooked. Diversified teaching forms could draw students' attention in the class, such as group discussion, team presentation etc.

Favorable communication and effective teaching, teachers, perhaps, should play an even more important role in ensuring the balance of class ecology in the form of applying intelligent terminal in an integrated way.

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Chapter 54

Intelligent Application Service System Based on VNC

Jing Li

Abstract The application service system has been greatly developed and used in recent years. This paper makes an introduction to current situation of Virtual Network Computing (VNC) technology and RFB (Remote Frame Buffer) Protocol, and the inadequacy of VNC technology and RFB Protocol. In order to make it more suitable for the Enterprise application service system, we study out an IAP Protocol (Intrusion Alert Protocol) based on RFB. With the outstanding features of safety and compatibility, we work out an intelligent application service system based on IAP which remarkably improves the efficiency of Enterprise application service system. The intelligent application service system is designed to achieve a variety of applications for the enterprises, not only to meet the needs of the application level, but also has high reliability and interactivity.

Keywords VNC technology · Application service system · Network access terminal · Protocol

54.1 Introduction

Nowadays, following the rapid development of information and technology with the Internet as representative, the computer and its network technology increasingly provide strong support for application service system in which the client can work with the help of only some ordinary display device and input device [1]

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The other procedures and operations can be done in a remote server. Following the continuous improvement of network condition, the application service system has been greatly developed and used in the recent 2 years [2] The relative advantages of functions and cost become so obvious. The application environment of commercial front-end market has been greatly improved, which is in the type of simple microcomputer made considering the cost. Even the diskless workstation may be replaced by a network computer [3]. In addition, some big ISVs begin to overall support the network computer technology which is widely used in many fields such as E-commercial business, educational informationization and multi-media class, Computer agriculture and agricultural technical training class, the hotel informationization and IT business room, and network office.

VNC is the abbreviation of Virtual Network Computing. VNC is great long-range control software which is developed by the famous AT&T European research lab. With the development of client technology and wide use of Cross-platform operation, the combination of VNC technology and client technology, and cross-platform operation technology are more and more valued. VNC can be comprehended as a display system. It obeys the remote display Protocol, that is to say it can transmit the whole Windows interface to another computer screen. VNC is basically formed by two parts: one is VNC viewer, the other is VNC server. The basic working principle of VNC is very similar with those windows remote control software. The VNC application procedures have a strong adaptability under the UNIX and Linux operating system. The graphical user interface is so good and similar as those Windows software interface. Any Linux system computer installed with client application procedure can be easily connected with the computer installed with server application procedure.

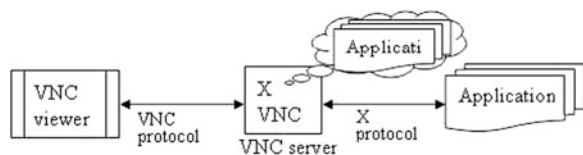
Based on the RFB protocol of VNC technology, we expand another new application layer service protocol—Intelligent Application Protocol (IAP) which is more suitable to the requirement of an enterprise application service system and work out an intelligent terminal system for network access (ITSNA) based on the IPA protocol.

54.2 VNC Technology and RFB Protocol

The working process of VNC technology is as shown in Fig. 54.1.

The desktop of X VNC server shows the client's operation of application procedure under the X protocol, that is X system. And this operation of application

Fig. 54.1 Working principle of VNC



procedure can be displayed and controlled on the remote VNC viewer under the RFB protocol of VNC protocol. Two technical means can be adopted in this process: one way is to make the X VNC server and VNC viewer work independently. The server works in the `inetd-xinetd` way so it can assort more VNC viewers. No matter connected or disconnected, these VNC viewers use the same start service set on the X VNC server desktop. When disconnected, the course of X VNC will stop; for example, the connection status will not start again. The other way is that the X VNC server and the terminal user can share the server's desktop. By X VNC server it can start corresponding server script aim at different terminal users, and run matched desktop. With the development of various fields, more and more users turn their attention to the operation, so the second way is more common.

The advantages of VNC technology are as follows: VNC technology is very suitable for remote operation in the real application. It can provide functions including telnet, password set and remote control, and remote control of client log. In real operation, the style of VNC technology is similar with Terminal Server of Microsoft and Meta Frame of Citrix, its remote operation speed is fast, and the window and full-screen mode are optional. It makes the operation easier, and many clients can work at the same time in the LAN or Internet.

Although the VNC technology can play the role of remote desktop management software in Linux system, it has many functional disadvantages as a kind of intelligent network terminal application service system. For example, it is not so good in network security because there is no network security setting in protocol and network module of VNC technology, so the exposed data transmission can easily be broken and received. Problem also exists in the compatibility of VNC technology and Linux system. For example, in the second working way of VNC technology, the VNC will require registration and identification to the supervisor display in Linux system such as XDM, GDM, KDM, and so on, or the VNC system will not realize identification. So because the display supervisor and window supervisor start at the same time, it will cause waste of starting and operating, and it is so hard to expand afterward. Meanwhile, because the individualized configuration files during the start of VNC is totally different from the desktop management display in Linux system, it will inevitably cause the inconformity of the desktop display and operational aspect between VNC server and client terminal. This can make some inconvenience in the real application.

This paper mainly discusses the disadvantages of RFB protocol of VNC technology, and tries to work out a new protocol to suit those enterprises. The disadvantage of RFB protocol is that the VNC client cannot adapt to the application attribute correspondingly. Now it can only configurative the client according to different color depth, but cannot correct the window attribute such as its size. The only solution is to reboot the client after resetting it when connected with the server. But this solution does not satisfy those different users because it is not so flexible and convenient. Meanwhile users cannot actively disconnect and logout its connection with server. In this two operation ways of VNC technology, the first one has a good performance in multiusers' functions but not so well in

connection status and desktop sharing. The second one has a bad performance in multiusers' functions. In addition, the information check and management are not detail enough in VNC technology. There are no specific log record and management information, and no record of the users' names, registration time, and the disconnection and connection time. So the new IPA protocol must realize the terminal's corresponding service and correct the identification of VNC technology. It realizes the unified management of client users and works out an intelligent network access terminal system—ITSNA based on IPA protocol.

54.3 VNC Technology and RFB Protocol

Intelligent network access terminal and the network server application system can interact with each other by the intelligent application service protocol. In other words, the users can use the network access terminal to complete all kinds of application program operations with the help of intelligent application service protocol. The purpose of ITSNA is to make users feel more convenient.

To meet these disadvantages of VNC technology, the ITSNA system should strengthen the security and compatibility with Linux. At the same time, the IPA protocol should be designed to realize the management of log information and support multiusers' disconnection, connection, and logout; thus, to realize stronger system interaction.

54.3.1 The Structure of the Intelligent Application Systems ITSNA

The structure of the ITSNA system including Network Computing Client, Network Terminal Service and Security System, as shown in Fig. 54.2.

The ITSNA system (Network Computing Client-NCC) is also the Terminal Viewer System, primarily responsible for the information transmission based on the input of the IAP protocol, the client input information through the mouse and keyboard transmitted to the server-side, finally through the computational

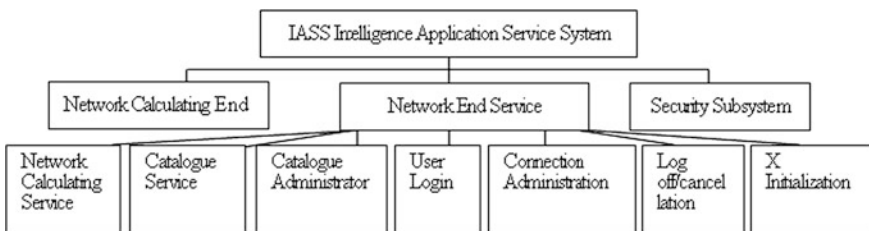


Fig. 54.2 The structure of the ITSNA system

processing can be a feedback to the user of the client. The security subsystem module of the ITSNA system installation on ITSNA server ensures the server and client data security by data transfer with the encryption algorithm.

The design purpose of the ITSNA network terminal service module is to achieve the remote service for design purpose including network computing service, session management, session service, user login, connection management, disconnect/cancellation, and X initialization as shown in figure. The network computing service to establish the connection to the client, the network monitoring service functions to initialize at the same time. Session management is on the ITSNA system the server-side session management, including establishment and disconnection of the session, management and maintenance for session state at the same time. The process of the session service includes the first session service based on X Server; with the client in the IAP protocol for session communication is the server-side protection to the connected client applications. Receiving the client information through keyboard and mouse input device, to ensure that the information in the IAP protocol send to X Server calculation, calculation based on IAP protocol information and feedback to the network client terminal, to achieve the session. The user login for login of the Module system is to identity management certification when users sign-on. Disconnect/logout module notice between the client and the system session manager, to complete disconnect or terminate the session. X initialization for logging, user login ID, terminal environment settings, and display the initialization of the window manager. Connection Manager manages to complete the user disconnect and connect, could automatically query the logged in user belongs to state, the corresponding entry selection screen interface, the user in the selection screen interface to connect or disconnect operation, will select the transmission of information to the session management, thus completing the management of the user to disconnect and connect.

54.3.2 Safety and Compatibility of the Intelligent Application Systems ITSNA

The security of the ITSNA system realize through the system structure of the user login module and security system. Ensure the legality of the registry system user, to achieve safety certification. Asked to enter a user name and corresponding password in the system startup, the password authentication subsystem will log the identity verification of certification, the system also provides graphical input certification. The security system is based on SSH (Secure Shell) to achieve the transmission of network information security, the technology in the data transmission between the computer port using SSH protocol encryption to ensure network security segment data transmission security, as shown in Fig. 54.3.

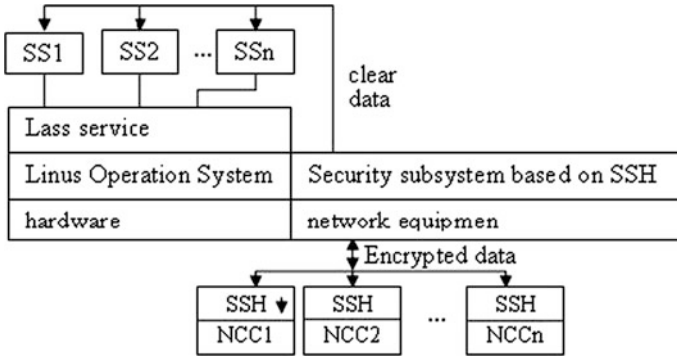


Fig. 54.3 The data transmission of the ITSNA system

SSH technology characteristics matching the ITSNA system information data according to a fixed-port transmission characteristics to meet the secure transmission of data between the terminal client and server. The security system also listens on fixed ports of when the message data transfer, the administrator of the use of monitor safety procedures whether need to open in the man-machine interface for different network security segment.

By using the virtual network to improve the ITSNA system’s compatibility with the Linux, if the user authentication system using VNC technology to login, it will not be compatible to have a Linux user authentication mode. The ITSNA system in addition to VNC technology user authentication, uses unified Linux user authentication methods to solve the compatibility of the user authentication system issues. As the Linux desktop to start the process is very complex. It even corresponds to the user’s login system and will start with relevant, personalized settings profiles, includes not only the user directory shell but also corresponds to open the display manager. The ITSNA system simulated the Linux boot process to solve the compatibility problems of the starting program user profile instead of starting the script to read configuration file, complete the start-up and implementation of user login configuration.

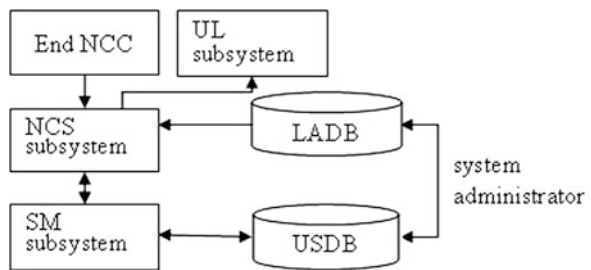
54.3.3 The IAP Protocol of the Intelligent Application Systems ITSNA

Based on the requirement of enterprise users’ design and development of IAP protocol is required. The initialization process of IAP protocol is different from the RFB protocol. Configuration of the different network computing service module is according to the different customer desktop information configuration set as flexible desktop items, the session manager and system server achieve the desktop and window format setting and complete remote control and management. System sets the corresponding service application management, based on enterprises own

characteristics and then establishes the management protocol through the service manager management system in the different user connection and call status, and establishes user session management database management user disconnected state. The IAP protocol can also be based on on the function expansion of functional design, implementation includes connecting time, login licensing, and other functions, and users can log in as administrator to complete the query and management operations. For user management the system, NCS of ITSNA is established, and in which the set of license examination database (License Authentication Database, LADB). This is the extension of the original RFB protocol. The IAP protocol, using LADB module, achieves the license checks in the user management.the management of user information only needs the administrator access system based on license examination database which modify the search strategy can be realized. The ITSNA user management system as shown in Fig. 54.4, When the terminal NCC connection with the NCS subsystem, LADB module to determine the corresponding configuration, and then decided whether to open the permission status, if meet the requirements in LADB module, that can log operation, followed by the SM system, the session service can be opened. The system administrator through USDB module user identity the management certification.

The original RFB protocol of VNC technology is a terminal-driven display protocol, when the terminal sends refresh request in frame units, the system server not only in accordance with the request to the terminal to send information terminal refresh, will continue to receive the new refresh requirements, which causing the client display system and a remote server is inconsistent, affected system operability even to the enterprise users display fault. The improved IAP protocol can be received from a terminal in a frame unit refresh request of the frame as a unit after the first login, confirm login legitimacy, and then set the configuration such as color coded data information transmission in accordance with the IAP protocol. After finishing the client desktop image settings, it will turn into the original VNC RFB protocol, not only in accordance with the configuration of a terminal adapted to display program, but also can login system configuration setting switch to disconnect mode, make the system flexible and convenient operation.

Fig. 54.4 The user management of the ITSNA system



54.4 Conclusion

In this paper, an intelligent application service system based on the improved VNC protocol is designed. The intelligent application service system designed to achieve a variety of applications for the enterprises, not only to meet the needs of the application level, but also has high reliability and interactivity.

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Chapter 55

Offshore Wind Speed Load Predicting Based on GA-SVM

Hong Tang, Huaqiang Zhang and Xiujuan MA

Abstract The accurate measurement of the effective wind speed is the basis of the wind generation system operation. The effective wind speed cannot be directly measured accurately. Because offshore wind farm is a three-dimensional time-varying environment, the wind speed distribution is different on the plane of blade rotation in the wind generation system. This paper uses support vector machine with genetic algorithm (GA-SVM) to estimate the effective wind speed. The simulation results show that this model has high prediction accuracy, which the mean error of the training data can reach 0.5689 m/s. This model can improve the control capability of the wind generation system, when the wind speed changes in a wide range.

Keywords Wind generation system · Effective wind speed · Support vector machine · Genetic algorithm

55.1 Introduction

With the world facing energy crisis, the wind energy as affordable and highly available renewable energy, its large-scale application of technology increasingly matures. Offshore wind field has emerged in recent years as an attractive alternative to conventional land wind farm, due to its rich resource and no land occupation [1]. Though Wind generation technology is well-developed, many problems still need to be solved such as how to reduce the cost of the wind

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generation for safe and effective operation. Measuring the effective wind speed accurately affects the operation control of entire unit. In most of the wind generation systems, the value of wind speed measured from the anemometers as effective wind speed is used for system control [2]. Because the offshore wind farm is a three-dimensional time-varying environment, and there are many influencing factors such as turbulence, tower, wind shear, and the roughness of ground surface; and the wind speed distribution on the plane of blade rotation is different. The wind speed value measured from anemometer is just a point value of the wind speed; it is different with the effective wind speed. So the effective wind speed cannot be directly measured accurately.

When running in the whole wind speed, wind turbine based on effective wind speed for maximum power point tracking, make sure the power generating efficiency and safe operation. Simoes et al. [3] uses fuzzy logic control to achieve maximum power point tracking; but this method needs long time to search the maximum power point when wind speed fluctuations frequent. References [4, 5] put forward wind speed forecasting model based on the neural network. Because the neural network is based on the empirical risk minimization, the results will fall into the local minimum value, not the global optimal solution, and when the number of training increase, efficiency is low and convergence slows down.

In this paper, support vector machine (SVM) is used for effective wind speed prediction. SVM is introduced into the field of machine learning by Vapnik in 1992. It is a machine learning method based on the statistical learning theory. It is established on the principle of the VC dimension theory and structural risk minimization which is superior to the traditional empirical risk minimization principle. Parameters of SVM influence the precision of the result and the generalization ability of the model. Genetic algorithm (GA) is a kind of global optimization search method used to optimize the parameters of SVM [6]. This paper uses GA-SVM model to estimate the effective wind speed. The simulation results indicate that this model has high prediction accuracy and can improve the wind generation system control capability when the wind speed changes in a wide range.

55.2 Estimation Rule of Effective Wind Speed

Variable speed constant frequency wind power generation is the optimal scheme in power generation technology at home and abroad. Variable speed constant frequency technology combined with pitch control system can improve the efficiency and power quality of power generation system. According to the theory of wind energy, the mechanical power that wind turbine extracts from the wind is as follows [7]:

$$P_{\text{mech}} = \frac{1}{2} \rho A v^3 C_p(\lambda, \beta) \quad (55.1)$$

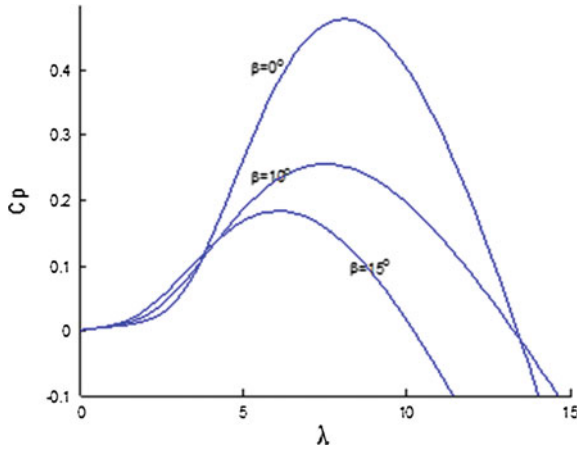


Fig. 55.1 The wind power coefficient $C_p(\lambda, \beta)$

where ρ is the air density (kg/m^3); $A = \pi R^2$ is the wind turbine swept area (m^2); R is the radius of wind turbine blade (m); v is the wind speed (m/s); $C_p(\lambda, \beta)$ is the wind power coefficient; C_p is a nonlinear function of the tip-speed ratio λ and the blade pitch angle β , λ is defined as $\lambda = \omega R/v$. Where ω is turbine angular speed (rad/s). The relation between C_p and λ under different β is shown in Fig. 55.1. Under the condition of β fixed, the tip-speed ratio λ direct effects of C_p . At each of the fixed blade angle β , there exists only one best λ to make sure C_p reach the maximum value. With blade angle β increases the value of C_p down.

Operating conditions of variable speed variable pitch wind turbine generator system summarized as: when wind speed below the rated wind speed, control rotor speed according to the wind speed to maintain optimum tip-speed ratio for maximum power point tracking. When wind speed is higher than the rated wind speed, control variable pitch system to maintain the stability of the maximum power.

From the above analysis, we know that generator output power P is related to v , ω , β . So we can use SVM establish effective wind speed prediction model with P , ω and β as input.

55.2.1 The Theory of SVM

SVM is established in the VC dimension theory and structural risk minimization principle. The expected risk expression is shown in this formula:

$$R(f) \leq R_{emp}(f) + \sqrt{\frac{8}{l} \left[h \left(\ln \frac{2l}{h} + 1 \right) + \ln \frac{4}{\delta} \right]} \tag{55.2}$$

In this formula, the second is confidence interval, right end two is the structural risk, it is expected that the empirical risk is upper bound together with confidence interval. Considering the confidence interval and the empirical risk, introduce the principle of structural risk minimization [8]. Find a decision function f , make the sum of the empirical risk and confidence interval, that is the structure risk minimum.

SVM is presented first with the classification problem. It can solve regression problem by introducing the insensitive loss function. Linear insensitive loss function is defined as

$$L(x, y, f(x)) = \begin{cases} 0 & |y - f(x)| \leq \varepsilon \\ |y - f(x)| - \varepsilon & |y - f(x)| \geq \varepsilon \end{cases} \quad (55.3)$$

where ε is the insensitive coefficient. When the difference between observation value y of the point x and the predictive value $f(x)$ is less than ε , the predicted value of this point is no loss.

The sample set is described as $\{(x_i, y_i), x_i \in \mathbb{R}^n, y_i \in \mathbb{R}, i = 1, 2, \dots, l\}$. Searching the real value $f(x)$, so that to infer the output value y corresponding to any input x using $y = f(x) = (\omega \cdot x) + b$. Under the insensitive loss function fixed minimize the confidence interval, so the optimization problem of variables ω and b is described by:

$$\begin{aligned} \min_{\omega, b} \quad & \frac{1}{2} \|\omega\|^2 \\ \text{s.t.} \quad & -\varepsilon \leq (\omega \cdot x_i) + b - y_i \leq \varepsilon, \quad i = 1, \dots, l \end{aligned} \quad (55.4)$$

Introducing slack variable $\xi_i \geq 0$, the constraint condition is $y_i((\omega \cdot x_i) + b) + \xi_i \geq 1$. Vector $\xi = (\xi_1, \dots, \xi_l)^T$ reflects the situation of allowing the training data classified wrong. Introducing the penalty parameter C and Lagrange function. Lagrange function is show as:

$$\begin{aligned} L(\omega, b, \alpha^*) = \frac{1}{2} \|\omega\|^2 - \sum_{i=1}^l \alpha_i (\varepsilon + y_i - (\omega \cdot x_i) - b) \\ - \sum_{i=1}^l \alpha_i^* (\varepsilon - y_i + (\omega \cdot x_i) + b) \end{aligned} \quad (55.5)$$

where $\alpha^* = (\alpha_1, \alpha_1^*, \dots, \alpha_l, \alpha_l^*)^T \geq 0$ is the Lagrange factor. According to the Karush–Kuhn–Tucker (KKT) condition, make derivatives of ω and b equal 0. Considering the dual problem, the optimization problem is show as:

$$\begin{aligned} \min_{\alpha^{(*)} \in \mathbb{R}^{2l}} & \frac{1}{2} \sum_{i,j=1}^l (\alpha_i^* - \alpha_i)(\alpha_j^* - \alpha_j)(x_i \cdot x_j) + \varepsilon \sum_{i=1}^l (\alpha_i^* + \alpha_i) - \sum_{i=1}^l y_i(\alpha_i^* - \alpha_i) \\ \text{s.t.} & \sum_{i=1}^l (\alpha_i - \alpha_i^*) = 0, \quad \alpha_i \geq 0, \alpha_i^* \geq 0, \quad i = 1, \dots, l \end{aligned} \quad (55.6)$$

So the original optimization problem transform into solving quadratic programming problem. Solving the above the quadratic programming problems, the optimal solution is shown as $\bar{\alpha}_i^{(*)} = (\bar{\alpha}_1, \bar{\alpha}_1^*, \dots, \bar{\alpha}_l, \bar{\alpha}_l^*)^T$. Calculate that $\bar{\omega} = \sum_{i=1}^l (\bar{\alpha}_i^* - \bar{\alpha}_i)x_i$, select $\bar{\alpha}$ positive component $\bar{\alpha}_j > 0$, calculate that $\bar{b} = y_j - (\bar{\omega} \cdot x_j) - \varepsilon$. So the decision function can be described as:

$$y = (\bar{\omega}) + \bar{b} = \sum_{i=1}^l (\bar{\alpha}_i^* - \bar{\alpha}_i)(x_i) + \bar{b} \quad (55.7)$$

Introduction of the largest interval regression method, the optimization problem is show as:

$$\begin{aligned} \min_{\omega, b, \xi_i^{(*)} \in \mathbb{R}^{2l}} & \frac{1}{2} \|\omega\|^2 + C \cdot \frac{1}{l} \sum_{i=1}^l (\xi_i + \xi_i^*) \\ \text{s.t.} & -\varepsilon - \xi_i^* \leq (\omega \cdot x_i) + b - y_i \leq \varepsilon + \xi_i, \quad \xi_i \geq 0, \xi_i^* \geq 0, \quad i = 1, \dots, l \end{aligned} \quad (55.8)$$

Introduce the kernel function to solve the nonlinear regression problems. The input variables x mapped to high dimensional feature space, and build the optimal hyperplane in the feature space. The optimal hyperplane that contains the kernel function is shown as follows:

$$y = (\bar{\omega} \cdot x) + \bar{b} = \sum_{i=1}^l (\bar{\alpha}_i^* - \bar{\alpha}_i)K(x_i \cdot x) + \bar{b} \quad (55.9)$$

The kernel function is $K(x_i, x_j) = \phi(x_i) \cdot \phi(x_j)$. There are three types of Kernel that are used widely: Polynomial function, Radical basis function (RBF), and Sigmoid function.

55.2.2 Parameters Optimization

This paper uses RBF kernel function that is shown as:

$$K(x_i, x_j) = \exp\left(-\frac{\|x_i - x_j\|^2}{2\sigma^2}\right) \quad (55.10)$$

So the parameters of SVM we need to select are the insensitive coefficient ε , the penalty parameter C , and the kernel function parameter σ^2 . Parameter ε controls the width of not sensitive region. It influences the number of support vectors and the sparse of solution. C reflects the degree of punishment of the algorithm when sample data beyond the pipeline, the value affects the model complexity and stability. σ^2 reflects the degree of correlation between support vectors. These three parameters affect the learning ability and generalization ability of the model, and they affect each other. When selecting parameters, we should consider the three parameters. Generally, use the grid search method for parameter selection, but its search range is small, and we need more time to search when search range is bigger. In this paper, we use GA to optimize select parameters.

GA is an evolutionary computation technique; it simulates natural selection and genetic mechanism in the process of biological evolution by Darwin biological evolution theory. It is an efficient global optimization search method [9]. The biological evolution principle of “survival of the fittest, survival of the fittest” is introduced into the optimization of parameters. Population of formation coded according to the selection of fitness function and through genetic reproduction, crossover, and mutation screening individual. Individuals of high fitness retained to form new groups, new groups not only inherit the information of the previous generation, but also better than the previous generation. Such go round and begin again, individual fitness is improving constantly, until a certain condition is satisfied.

55.2.3 Wind Speed Estimation Steps

Figure 55.2 presents the process of the wind speed estimation modeling based on GA-SVM, which is described below.

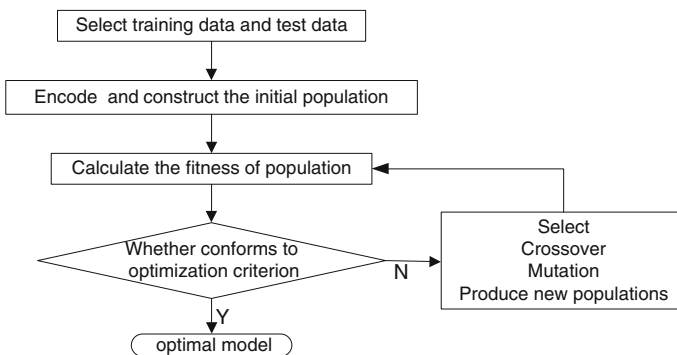


Fig. 55.2 Flow chat of GA-SVM

Step 1: The sample data which is collected from the wind power generation system contains the system full operation. Sample data is divided into training data and test data.

Step 2: Determine the number of the populations and the evolution of algebra. Encoding the parameters of SVM, that is encoding σ^2 , ε and C . Then construct the initial population.

Step 3: Calculate the fitness of population, and check whether it meets the criteria for optimization. If it meets the criteria, we get the optimal model, if not go to the step 4. The fitness function is based on the mean squared error, which is as follows:

$$E_{\text{MSE}} = \sqrt{\frac{1}{l} \sum_{i=1}^l (y_i - f(x_i))^2} \quad (55.11)$$

where y_i is the wind speed true value, $f(x_i)$ is the wind speed estimate value.

Step 4: Select regeneration individual according to the fitness of individual passed from one generation to the next. Individuals of high fitness are selected with high probability. Individuals of lower fitness are eliminated. Producing a new generation of population based on the rule and the probability of crossover and mutation.

Step 5: Repeat step 3, so that the model of SVM optimized continuously, until they meet the conditions, then output optimal model.

55.3 Simulation

The sample data obtained from variable speed variable pitch wind power generation simulation system rated power is 40 KW. The wind turbine cut-in wind speed is 5 m/s, cut-out wind speed is 25 m/s. The average wind speed range of the simulation model is 5–25 m/s. In this simulation system, the simulation of natural wind use the combination wind speed model which consists of basic wind, gust wind, gradient wind, and stochastic wind. In this way, the experimental data contains effective wind speed, blade angle pitch, the turbine angular speed, and the generator output power of various system operation conditions.

The comparing cures between the effective wind speed prediction value of the GA-SVM and sample data are shown in Figs. 55.3a and 55.4a. The mean relative error is shown in Figs. 55.3b and 55.4b. The mean squared error of the training data is 0.4166 m/s. The mean error of the training data is 0.5689 m/s. The mean squared error of the test data is 0.1957 m/s. The mean error of the test data is 0.3671 m/s. From the simulation results, we can see estimate values of the effective wind speed model and sample values of the effective wind speed agree well, the result have high precision.

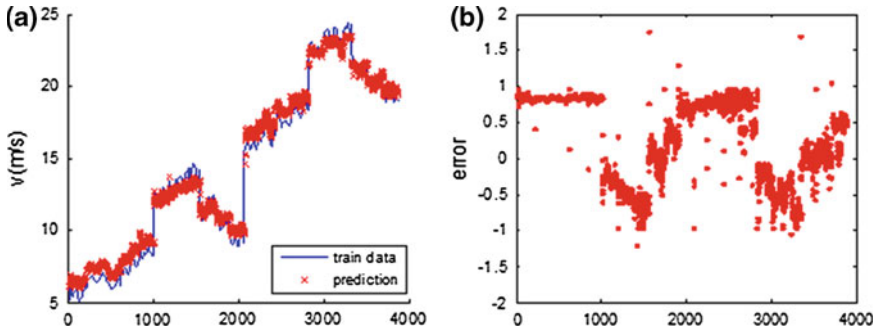


Fig. 55.3 The training results and error

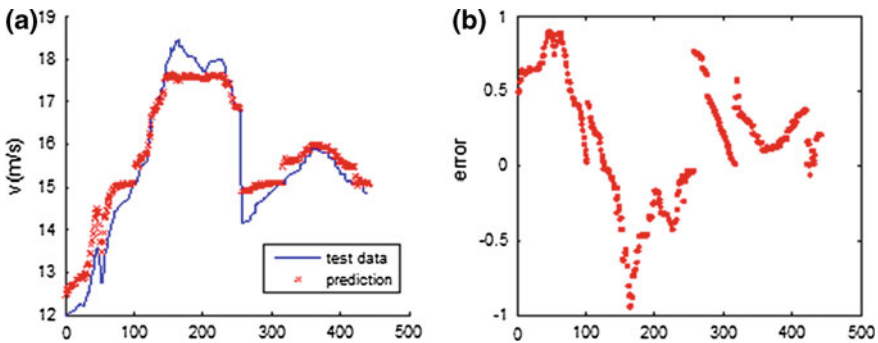


Fig. 55.4 The test results and error

55.4 Conclusion

Since the effective wind speed cannot be directly measured accurately, this paper uses GA-SVM to predict the effective wind speed. The simulation results show that GA can be used to search best parameters of SVM in global scope. Generalization ability of this effective wind speed prediction model is good. Wind turbine can operate efficient and safe.

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Chapter 56

Research on the Methods of Efficiency Evaluation of Logistic Enterprises Based on Gray-Fuzzy Theory

Zheng Li, Yang Li, Xue Yu Mi and Hong Mei Jia

Abstract Organizational efficiency evaluation of logistic enterprises is the rough problems to be solved. This paper introduces the Gray-fuzzy theory into the evaluation of logistic enterprises' organizational efficiency, and establishes an evaluation model on organizational efficiency of logistic enterprises with multi-level gray fuzzy, then takes examples and the results to show that the feasibility and effectiveness of the model.

Keywords Organizational efficiency of logistic enterprises · Gray-fuzzy theory · Comprehensive evaluation · Index system

56.1 Introduction

During the recent years, logistic industry has been well developed and played an important role in social and economic development of our country. Beneath the social condition and requirement, whether the logistic enterprises can realize the predicted targets, which mean which levels the organizational efficiency of logistic enterprises are in, it has become an important index to evaluate a logistic enterprise [1]. The organizational efficiency of logistic enterprises is a complicated construction. It couldn't be scrutinized on a single angle but multi angles. There are many uncertain factors included by the evaluation of organizational efficiency

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of logistic enterprises. It was closely related to the accuracy of evaluation, methods, and experiences of the person who did evaluation and the abundance of data. There are also many factors influence the organizational efficiency of logistic enterprises, such as market factors, creative abilities and productivity [2]. In that case, to make a scientific and proper decision to the evaluation index on the organizational efficiency of logistic enterprises or to estimate its value accurately is a serious problem urgent to solve on evaluation of organizational efficiency of logistic enterprises. In this paper, the integrated evaluation methods of gray-fuzzy theory was introduced to the evaluation of organizational efficiency of logistic enterprises, established its index system and do the quantitative treatment on respective index. In this way, the gray-fuzzy integrated evaluation model of organizational efficiency to logistic enterprises was established and proved its validity by example verification [3].

56.2 Establishment on Evaluation Index System of Logistic Enterprises' Organizational Efficiency

56.2.1 The Principles on Establishing the Evaluation Index

To establish an accurate, comprehensive and effective evaluation index system on logistic enterprises' organizational efficiency is the key of evaluation, therefore, the principles below should be followed as selecting evaluation index.

56.2.1.1 The Dominant Principle

The evaluation index should be proper and reflect the differences in respective factors to decrease the burden of evaluation.

56.2.1.2 The Operable Principle

The data related to evaluation index should be gotten easily and calculated and should follow an explicit evaluation criteria.

56.2.1.3 The Independent Principle

Every selected index should indicate one part of characteristics of evaluation objects. There should be as less relationship in indexes as possible.

Table 56.1 Evaluation index system of organizational efficiency of logistic enterprises

	First grade indexes	Second grade indexes
Evaluation values of organizational efficiency of logistic enterprises	Financial index u_1	Productivity u_{11}
		Profit u_{12}
		Accident rate u_{13}
		Increased rate u_{14}
	Internal process index u_2	Flexibility and adaptability u_{21}
		Programming and target setting u_{22}
		Role and specification confluence u_{23}
		Information management and communication u_{24}
	Consumer index u_3	Customer satisfaction index u_{31}
		Client complaining rate u_{32}

56.2.2 Constructions on Evaluation Index System

According to above principles, the evaluation on organizational efficiency of logistic enterprises is considering a multi-index and multi-level evaluation process [4]. Its system should be determined by the target of evaluation; therefore, the evaluation index system on the logistic enterprises' organizational efficiency is established [5]. As Table 56.1 shows:

56.3 Multilevel Gray-Fuzzy Evaluation Models of Evaluation Values of Organizational Efficiency of Logistic Enterprises

56.3.1 Gray-Fuzzy Basic Theory

The ordered spaces $X = \{x\}$ and $Y = \{y\}$, if x and y to fuzzy relationship \tilde{R} membership grade $\mu_R(x, y)$ has a little fuzzy $\nu_R(x, y)$ then call the gray-fuzzy set $\tilde{R} = \{((x, y), \mu_R(x, y), \nu_R(x, y)) | x \in X, y \in Y\}$ in direct product space $X \times Y$ as the gray-fuzzy relation in $X \times Y$, and short for GF relation, and we can express it as the gray-fuzzy matrix:

$$\tilde{R}_{\otimes} = \begin{bmatrix} (\mu_{11}, v_{11}) & (\mu_{12}, v_{12}) & \cdots & (\mu_{1n}, v_{1n}) \\ (\mu_{21}, v_{21}) & (\mu_{22}, v_{22}) & \cdots & (\mu_{2n}, v_{2n}) \\ \dots\dots & \dots\dots & \dots\dots & \dots\dots \\ (\mu_{m1}, v_{m1}) & (\mu_{m2}, v_{m2}) & \cdots & (\mu_{mn}, v_{mn}) \end{bmatrix}$$

It can also be expressed as $\tilde{R}_{\otimes} = (\tilde{R}_{\otimes}, R_{\otimes})$, in which $\tilde{R}_{\otimes} = \{((x, y), \mu_R(x, y)) | x \in X, y \in Y\}$ is the fuzzy relationship of $X \times Y$, $R_{\otimes} = \{((x, y), v_R(x, y)) | x \in X, y \in Y\}$ is the gray relationship of $X \times Y$. Suppose \tilde{A} is the fuzzy subset of the space $X = \{x\}$, and if to \tilde{A} , the membership grade $\mu_A(x)$ is a gray number in $[0, 1]$, its point gray level is $v_A(x)$, A is the branch set of \tilde{A} , so we call \tilde{A} is the gray-fuzzy subset in X or call it as gray-fuzzy set, short for GF set, note as \tilde{A}_{\otimes} , is

$$\tilde{A}_{\otimes} \triangleq \{(x, \mu_A(x), v_A(x)) | x \in X\}$$

With “even set” expressed as: $\tilde{A}_{\otimes} = (\tilde{A}_{\otimes}, A_{\otimes})$ We call \tilde{A}_{\otimes} as the fuzzy part of \tilde{A}_{\otimes} , A_{\otimes} is the gray part of \tilde{A}_{\otimes} .

If gray part A_{\otimes} of GF set \tilde{A}_{\otimes} is cantor set A , $\tilde{A}_{\otimes} = (\tilde{A}_{\otimes}, A_{\otimes}) = \tilde{A}_{\otimes}$, so fuzzy set is the special case of gray-fuzzy set; but if fuzzy part \tilde{A}_{\otimes} of GF set \tilde{A}_{\otimes} is cantor set A , in that case, $\tilde{A}_{\otimes} = (\tilde{A}_{\otimes}, A_{\otimes}) = A_{\otimes}$, so gray set is the special case of gray-fuzzy set. So on one part gray-fuzzy set is the generalization of fuzzy set, and on the other, it is the generalization of gray set, and we can infer that it is the generalization of classical set [6].

56.3.2 The Establishment of Gray-Fuzzy Evaluation Model

Multi-level gray-fuzzy evaluation model of evaluation values of organizational efficiency of logistic enterprises was established by using the gray-fuzzy mathematic theory and multi-level fuzzy evaluation method.

1. According to the hierarchy relation of logistic enterprises’ organizational efficiency index, when factor subset of evaluated object is $U = \{u_1, u_2, u_3\}$ (first grade index), where every factor in subset can be divided as the second grade factor set $u_i = \{u_{i1}, u_{i2}, \dots, u_{ik}\}$ (second grade index), $I = 1, 2, 3, k$ is a factor number in u_i . And the comment set is: $V = \{v_1, v_2, v_3, v_4\} = \{\text{very good, comparatively good, ordinary, bad}\} = \{90, 75, 60, 45\}$.

On the evaluation of logistic enterprises’ organizational efficiency, the information quantity is hardly measured by the value of number. So here, we would like

to use some descriptive language to describe some gray scale and we can make some degrees: very sufficient, comparatively sufficient, ordinary, comparatively lean, and very lean and the corresponding respective gray value is 0–0.2, 0.2–0.4, 0.4–0.6, 0.6–0.8, 0.8–1.0. And you also should judge it under the real circumstances of the evaluated enterprises.

2. The first gray-fuzzy evaluation

1. Make sure on weight set

We can see the weight set as the gray-fuzzy relation between evaluated objects and factors. The evaluated object u_i 's weight a_{ij} ($j = 1, 2, \dots, k$) of every influenced factor could be make sure by comparative method and its related gray level v_{ij} ($j = 1, 2, \dots, k$) could be got by the expert scoring method and construct the weight set:

$$\tilde{A}_i = [(a_{i1}, v_A(a_{i1}))(a_{i2}, v_A(a_{i2})) \cdots (a_{im}, v_A(a_{ik}))]$$

In which, every weight set is required to normalize, as $\sum_{j=1}^k a_{ij} = 1$

2. The establishment of evaluation matrix

We can see the evaluation matrix as the gray-fuzzy relation between factor set and evaluation set [6]. Using the expert scoring method, give every factor in evaluated object u_i to the membership degree of every element in evaluation set u_{ijs} ($j = 1, 2, \dots, k; s = 1, 2, \dots, n$), and give the relative gray level v_{ijs} ($j = 1, 2, \dots, k; s = 1, 2, \dots, n$) according to the information sufficiency. At the same time, establish the evaluation matrix:

$$\tilde{R}_i = \begin{bmatrix} (\mu_{i11}, v_{i11}) & (\mu_{i12}, v_{i12}) & \cdots & (\mu_{i1n}, v_{i1n}) \\ (\mu_{i21}, v_{i21}) & (\mu_{i22}, v_{i22}) & \cdots & (\mu_{i2n}, v_{i2n}) \\ \cdots & \cdots & \cdots & \cdots \\ (\mu_{ik1}, v_{ik1}) & (\mu_{ik2}, \cdots v_{ik2}) & \cdots & (\mu_{ikn}, v_{ikn}) \end{bmatrix}$$

3. Comprehensive evaluation

In the mathematic model of gray-fuzzy comprehensive evaluation, in order to keep more evaluated information, we will adapt the operator $M(\cdot, +)$ in fuzzy part calculation and adapt the operator $M(\wedge, \oplus)$ in gray part calculation. In that case, we get the result to gray-fuzzy comprehensive evaluation:

$$\tilde{B}_i = \tilde{A}_i \cdot \tilde{R}_i = [(b_{is}, v_{bis})]_n = \left[\left(\sum_{j=1}^k a_{ij} \cdot \mu_{ijs}, \frac{1}{k} \sum_{j=1}^k (1 \wedge (v_{ij} + v_{ijs})) \right) \right]_n \quad (56.1)$$

3. Second grade gray-fuzzy evaluation

The sub-factor u_i is the factor of its upper grade factor set U , so the gray-fuzzy relation between the factor set U and the evaluation set Y is:

$$\tilde{R} = \left[\begin{matrix} \tilde{B}_1 \\ \tilde{B}_2 \\ \tilde{B}_3 \end{matrix} \right]_{3 \times n}^T \quad (56.2)$$

We can use the first grade evaluation method and get the every influenced factor's weight set of the evaluated objects. $\tilde{A}_{\otimes} = [(a_1, v_1), (a_2, v_2), (a_3, v_3)]$, in which $\sum_{i=1}^3 a_i = 1$, and try to calculate the comprehensive evaluation vector of final evaluated object:

$$\tilde{B}_{\otimes} = \tilde{A}_{\otimes} \cdot \tilde{R}_{\otimes} = [(b_s, v_{bs})]_n \tag{56.3}$$

4. Process of the evaluation results

In the gray-fuzzy comprehensive evaluation, we can comprehensively consider the gray character and fuzzy character and transform the evaluation result as:

$$\tilde{B}_{\otimes} = \left[\frac{b_s \times (1 - v_{bs})}{\sum_{s=1}^n b_s \times (1 - v_{bs})} \right]_n \tag{56.4}$$

Then we regulate the comment grade in comment set as standard scores and get the set, then get the evaluation value on organizational efficiency of logistic enterprise:

$$H = \tilde{B} \cdot V^T \tag{56.5}$$

We can make a conclusion on the logistic enterprises' organizational efficiency evaluation according to the value H .

56.3.3 Case Analysis on Logistic Enterprises' Organizational Efficiency Evaluation

In order to further test the evaluation method, we will invite 10 experts on logistics and some top managers in logistic enterprises to be the experts-evaluation group and evaluate the organizational efficiency of one logistic enterprise. Then we can respectively get the weight set of every evaluation index through comparison and get its gray level through every index scoring information given by the experts group, in that case, get the weight set of every degree index.

$$\begin{aligned} \tilde{A}_{\otimes} &= [(0.5, 0.1), (0.4, 0.1), (0.1, 0.3)] \\ \tilde{A}_{1\otimes} &= [(0.4, 0.1), (0.3, 0.1), (0.2, 0.1), (0.1, 0.3)] \\ \tilde{A}_{2\otimes} &= [(0.2, 0.1), (0.3, 0.1), (0.2, 0), (0.3, 0.1)] \\ \tilde{A}_{3\otimes} &= [(0.4, 0.3), (0.6, 0.3)] \end{aligned}$$

According to the evaluation set, the experts group will review and grade on it's every index and get the membership degree of every index and gray level. And then get the gray-fuzzy evaluation matrix of $u_i(i = 1, 2, 3)$ respectively.

$$\tilde{R}_1 = \begin{bmatrix} (0.4, 0.2) & (0.5, 0.3) & (0.1, 0.2) & (0, 0.5) \\ (0.1, 0.2) & (0.1, 0.3) & (0.3, 0.4) & (0.5, 0.2) \\ (0.5, 0.1) & (0.3, 0.1) & (0.2, 0.3) & (0, 0.3) \\ (0, 0.1) & (0.3, 0.3) & (0.6, 0.2) & (0.1, 0.2) \end{bmatrix}$$

$$\tilde{R}_2 = \begin{bmatrix} (0, 0.3) & (0.5, 0.3) & (0.4, 0.2) & (0.1, 0.2) \\ (0, 0.2) & (0.2, 0.1) & (0.6, 0.1) & (0.2, 0.4) \\ (0.8, 0.1) & (0.2, 0.1) & (0, 0.1) & (0, 0.1) \\ (0.2, 0.4) & (0.4, 0.2) & (0.3, 0.1) & (0.1, 0.2) \end{bmatrix}$$

$$\tilde{R}_3 = \begin{bmatrix} (0, 0.3) & (0.2, 0.5) & (0.7, 0.5) & (0.1, 0.3) \\ (0.1, 0.5) & (0.1, 0.3) & (0.6, 0.3) & (0.2, 0.3) \end{bmatrix}$$

Let formula (56.1), finding:

$$\tilde{B}_1 = [(0.3, 0.3) \quad (0.32, 0.4) \quad (0.23, 0.425) \quad (0.16, 0.45)]$$

$$\tilde{B}_2 = [(0.22, 0.325) \quad (0.32, 0.25) \quad (0.35, 0.2) \quad (0.11, 0.3)]$$

$$\tilde{B}_3 = [(0.06, 0.7) \quad (0.14, 0.7) \quad (0.64, 0.7) \quad (0.16, 0.55)]$$

From (56.2, 56.3), we can get comprehensive evaluation vector:

$$\tilde{B} = [(0.244, 0.608) \quad (0.302, 0.617) \quad (0.319, 0.608) \quad (0.14, 0.6)]$$

Let (56.4) transform and get:

$$\tilde{B} = [0.244 \quad 0.295 \quad 0.318 \quad 0.142]$$

And the last evaluation value is: $H = \tilde{B} \cdot V^T = 69.6$, from this we can judge that the comments on this logistic enterprise's organizational efficiency evaluation result is ordinary.

56.4 Conclusion

In this paper, we introduced the gray-fuzzy theory to the evaluation organizational efficiency of logistic enterprises and established a comprehensive evaluation index system. As the same time it quantified the uncertainty, fuzziness, non-adequacy of information in the evaluation on organizational efficiency of logistic enterprise,

etc. Under these bases, make a conclusion on gray-fuzzy comprehensive evaluation and conquer the subjectivity on the process of evaluation. This method is used on evaluating organizational efficiency and insufficiency of logistic enterprises, meanwhile giving the analysis method for reference.

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Chapter 57

Clustering Algorithm Based on Territory Game in Wireless Sensor Networks

Dan Huang, Yong Zhang and Ziwei Zheng

Abstract Clustering technique can efficiently reduce the energy consumption in wireless sensor networks. This paper utilizes evolution game theoretic model to analyze the communication energy optimization considering the impact of the distance from CHs to sink, and proposes a clustering algorithm based on territory game theories, which mitigates the unbalanced energy consumption caused by the asymmetrical distance from CHs to sink. The results show the proposed algorithm has the ability of maintaining energy optimization, while achieving desirable network performances, compared with clustering algorithms.

Keywords Wireless sensor network · Territory game · Energy optimization · Clustering

57.1 Introduction

Recent years have witnessed an increasing interest in using wireless sensor networks (WSNs) [1] in many applications. The energy optimization is critical for the lifetime and the cost of WSNs. Many mechanisms have been proposed to reduce the impact of communication protocols on the overall energy dissipation of WSNs. One of the approaches to extend the lifetime of WSNs is the clustering technique

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[1, 2]. LEACH [2] is one of the most widely cited clustering methods due to its simplicity and effectiveness. LEACH routing protocol has the good adaptability for large-scale wireless sensor network. In LEACH-C [3, 4], BS globally determines cluster head (CH) node and nonCH sensors of each cluster according to each node's current location and energy level. However, clustering technique cannot exhaustively solve the problem of extending the network lifetime. These schemes still suffer from the problems of CHs placement, blind spots, and immature death of CHs due to different deployment environments and uneven sensors distribution.

At present, the major WSNs clustering schemes are based on idealized assumptions of uniform distribution of sensors. However, in a real work environment, these assumptions often take unreasonable. Since sensors are generally deployed in surveillance areas by airplane and cannonball, node's position is affected by many factors, which lead to uneven distribution.

Recently, lots of researchers have started using game theory as a tool to analyze wireless networks [5]. Shen et al. [6] propose a global view of WSNs security approaches based on game theory. In [7], the problem of determining the sleep and wakeup probabilities is formulated as a bargaining game. The Nash equilibrium is used as the solution of this game. Lee et al. [8] discuss the use of Nash bargaining solution (NBS) for analyzing clustering-based sensor network. However, the existing algorithms cannot be directly applied to WSNs deployed in realistic region, because of its different features in terms of node characteristics (low power, high density, and asymmetrical distance to sink), and player preferences (connectivity, reusability, efficiency, and reliability). Moreover, their proposed schemes are not suitable for asymmetrical communication distance caused by the location of sink, especially, long and narrow deployment environment. To solve the asymmetrical communication energy consumption, in this paper, we analyze the evolution game models and propose the energy efficient clustering strategies.

The rest of this paper is organized as follows. The theoretical framework and research hypotheses are presented in Sect. 57.2. Clustering algorithm based on territory game (TG) is provided in Sect. 57.3. Comparisons with some other clustering schemes and the related simulation results are presented in Sect. 57.4. The conclusions are provided in Sect. 57.5.

57.2 Model Framework

The energy consumption in this paper considers only two sections. One is the intracluster communication energy consumption. The other is intercluster communication energy consumption. There are two factors of distance and number of hops that influence communication energy consumption. To obtain the optimal communication energy consumption scheme from source to destination according to the game theory so as to direct the CHs election strategies, we cite the following energy models [9].

Based on the structure and power consumption of each component, the total power consumption for transmitting and for receiving, denoted by P_T and P_R , are specifically given by:

$$P_T(d) = P_{TB} + P_{TRF} + P_A(d) = P_{T0} + P_A(d) \tag{57.1}$$

$$P_R = P_{RB} + P_{RRF} + P_L = P_{R0} \tag{57.2}$$

where $P_{A(d)}$ is the power consumption of the power amplifier which is a function of the transmission range d . Since P_{TB} and P_{TRF} do not depend on the transmission range, the two components can be modeled as a constant P_{T0} . Similarly, the power consumption of the receiving circuitry can be modeled as a constant P_{R0} , since P_{RB} and P_{RRF} are clearly not dependent on transmission range, and P_L is also a constant.

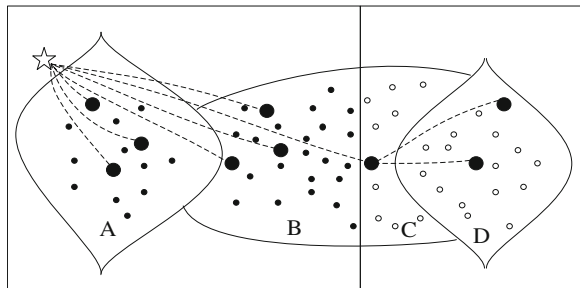
Suppose wireless sensor network is deployed in a region, and the sink locates in one place, as is shown in Fig. 57.1 The asymmetrical communication distance from the sensors and sink will cause the asymmetrical energy consumption. The energy consumption will not be balanced if area A and D adopt the same clustering strategy. In this paper, area A and D are seen as two players in a game. The CH selection strategies of the two areas are adopted, respectively, to optimize the energy consumption.

To optimize intracluster and intercluster communication scheme for energy efficiency, we divide the region into four areas. As shown in Fig. 57.1, the deployment region is divided into A , B , C , and D areas. We use R to denote the distance from source to destination, and R_{smax} to denote the maximum single-hop distance. Clearly, for the case $R > R_{smax}$, a single-hop scheme is not feasible.

After the deployment, the sensors near the sink will have higher probability of becoming CHs. The sensors far to the sink will have lower probability of becoming CHs. In the above 4 areas, the CHs probability adjustment coefficients C_A , C_B , C_C , and C_D are calculated as follows.

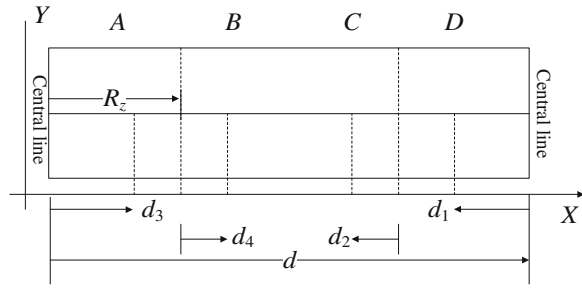
$$C_A = 1 - \left(\frac{d_3}{d}\right)^2, C_B = 1 - 0.5 \cdot \frac{d_4 + R_z}{d} \tag{57.3}$$

Fig. 57.1 WSNs deployment region and region division



○ Sensor far to the sink ● Sensor near to the sink ☆ Sink
● Cluster head

Fig. 57.2 The parameters of clustering strategy



$$C_C = 0.5 + 0.5 \cdot \frac{d_2 + R_z}{d}, \quad C_D = 0.5 + \left(\frac{d_1}{d}\right)^2 \tag{57.4}$$

where R_z is the distance from central line of area A or D to the limit of current area, d_1 is the distance from the sensors in area D to the central line of area D, $d_1 < R_z$, d_2 is the distance from the limit of area D to the sensors in area C. d_3 is the distance from the sensors in area A to the central line in area A. d_4 is the distance from the limit of area A to area B, as shown in Fig. 57.2.

According to the parameter in Fig. 57.2, the adjusted probability of becoming CHs such as P_A, P_B, P_C , and P_D is calculated as $P_i = P \times C_i, i = A, B, C, D$. Applying the above adjusted probability, the objective of the CHs number falling with the distance increase to sink in the area is achieved.

The different CHs probability adjustment coefficients in areas show that the different territories have different importance. To define the limit among areas, we need to solve the two problems. The first one is how to define the limit between A and B or C and D. The second problem is how to define the limit of B and C. To solve the above problems, this paper cites the TG model [10] and proposes a clustering algorithm.

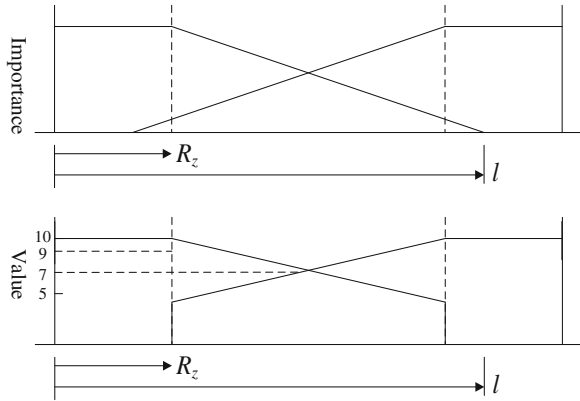
57.3 Clustering Algorithm Based on Territory Game

57.3.1 Analysis of Territory Game Model

This paper will discuss a contest between two areas who have already confirmed the position, in a 2-dimension deployment region, of the ‘central line’ of their proposed territories. First, some assumptions must be made about the value, in offspring sensors terms, of territories of different sizes.

The essential features are as follows. If territory size is less than R_z , it would pay the holder to leave, in which case its expected fitness is R (the fitness if a territory is sought elsewhere) [10]. The area within R_z of the center will be called the ‘central area’ which is no advantage in extending the territory size beyond l . There is a linear increase in value from 5 to 10 between R_z and l . These assumptions are translated into a graph of the ‘importance’ of particular areas in Fig. 57.3.

Fig. 57.3 The value of territory



Individuals are capable of displaying with varying intensity, from zero to some maximum level. If two opponents display with maximum intensity at the same spot, this is treated as a breakdown of communication. Individuals then have two choices:

Retreat to limit of own central area, and then, if necessary, escalate.

Escalate at once without retreating. If two opponents escalate, the cost to both is C . Each has an even chance of ‘winning’. The loser must retreat to a distance l from the winner’s center; if this means retreating into the loser’s central area, the loser must leave altogether.

The TG model defines three possible strategies [10]: (1) Hawk. Display to maximum level up to distance l . Escalate without retreating if necessary. (2) Honest. Behave as Hawk up to distance R_z only. Between R_z and l , display at a level corresponding to the importance of the place (Fig. 57.3). If opponent signals with higher intensity, retreat and if at lower intensity, advance. (3) Bluffer. Behave as Hawk up to distance R_z only. Between R_z and l , display with maximum intensity. If opponent also displays with maximum intensity, retreat to limit of own central area.

Writing H , B , and N for Hawk, Bluffer, and Honest, the payoff matrix is shown in Table 57.1. In this matrix, the entries are the payoffs to the individual adopting the strategy on the left, if his opponent adopts the strategy above.

We can simplify the matrix by recognizing a necessary relationship between R and C . Thus at the limit of the central area, the payoffs for escalating and for leaving must be equal; it would not be worth escalating to win a territory less than R_z , and it would not be worth leaving if it were possible to win a territory larger than R_z . Hence, $1/2 \times 5 + 1/2 \times R-C = R$, or $R = 5-2C$.

Table 57.1 Payoff matrixes for territory game

	H	B	N
H	$1/2*(10 + R)-C$	$1/2*(10 + R)-C$	$1/2*(10 + R)-C$
B	$1/2*(10 + R)-C$	7	5
N	$1/2*(10 + R)-C$	9	7

57.3.2 Territory Game Algorithm

Based on game theoretic analysis of the TG model, we propose a TG algorithm for energy consumption in WSNs. TG algorithm is designed for WSNs, in which the member sensors may have various probability levels to be CH according to the located region.

Algorithm 1 TG for node i

Input: a sensor network $G = (V, E)$ with n LNs randomly deployed in a $L \times L$ (m^2) square region and one BS deployed in $[0, 0]$.

Output: the optimal area division and their limitation.

Initialize central lines of the two central areas: l_{CA} and l_{CB} ;

Create the limit line l_A and l_B whose distance to the nearest central line l_{CA} or l_{CB} is d ;

Set distance d is $1/k$ of the distance between l_{CA} and l_{CB} ; Set m be $1/k$ of n ; Set n_r be the number of joined sensors;

Create area A which is the area between line l_A and l_{CA} ; Create area B which is the area between line l_B and l_{CB} ;

Choose two area heads for central area from elected CHs nearest to l_{CA} or l_{CB} ;

If $n_r < m$ and the node is in area A or B , then accept the node to current central area. End if

If $n_r < m$ and the cluster setup is over, then replace l_A , l_B with the coordinate line of two joined node nearest to l_A or l_B respectively; end if

//Set the area probability of becoming a CH

Repeat

Choose the nearest CH and join the cluster;

If the central area sensor receives the CH advertisement from opposite area which is nearer than current area's CH, and then refuse to join the cluster of opposite area. End if

Update region information upon joined cluster.

Update upon region probability adjustment coefficients according to Eqs. 57.3, 57.4, and check if the remaining energy is more than $1/m$ of total battery capacity
If be satisfied then

Set CH probability by probability adjustment coefficient of the belonged area for next clustering.

Choose the coordinate axis of the node at the limit of the area A and area B as l_C
end if

Until the timer of cluster setup is expired.

Return l_A , l_B , l_C .

57.4 Performance Analysis and Simulation Results

In this section, we evaluate the performance of the proposed TG algorithm in WSNs, and compare the proposed scheme with some other cluster schemes, such as LEACH and LEACH-C. We simulate the algorithm through the J-Sim1.3 patch4 which is a network simulation tool based on components. Setting a wireless sensor network covering $80 \times 300 \text{ m}^2$ region, we deploy 500 sensors randomly in the network. The sink is located in one side of the deployment region serving for receiving fused data from CHs with different locations. The rationality of communication mode of single hop or multihop for the sensors is modeled by a communication energy consumption efficiency waypoint model [9].

First, we studied the power consumption of the proposed TG algorithm. We can obtain territory limit for area A and D according to the proposed algorithm. Figure 57.4 shows the power consumption for different clustering algorithm. If the fitful values of clustering probability adjustment coefficient values are applied to clustering in the corresponding areas, the energy consumption is balanced and efficient. Otherwise, the energy consumption will be unbalanced, and the premature death of sensors far to the sink will occur. From the figure, we can see TG algorithm is better than LEACH and LEACH-C algorithms.

Second, we analyzed the relationship between the ratio of length to breadth in deployment region and the death time of the first node far to sink. Figure 57.5 presents the death time of the first node far to sink under different ratio of length to breadth. From Fig. 57.5, we find that the death time of TG delays with the rising of the ratio of length to breadth compared to LEACH and LEACH-C. It means that the longer and narrower the deployment, the better energy efficiency of TG is. On the other side, it can also be seen that the performance loss of TG is very limited compared to that of LEACH and LEACH-C.

Fig. 57.4 Total power consumption

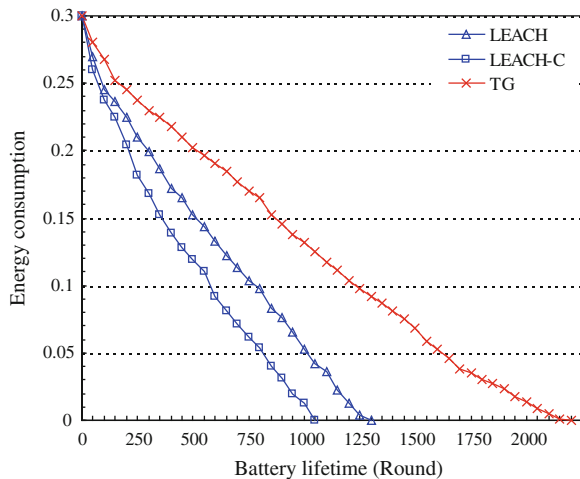
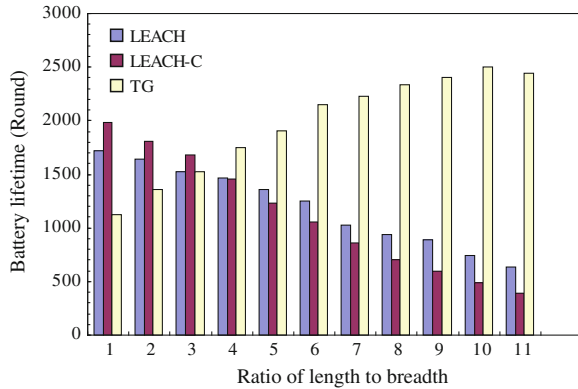


Fig. 57.5 Battery lifetime comparison on different ratio of length to breadth



57.5 Conclusions

Game theory is essential to analyze clustering technique in WSNs. In the present study, the aim is to utilize the game model to set optimal strategy in WSNs. Our study contributes to the clustering literature by integrating TG algorithm into WSNs clustering research, so as to help enhance energy optimization. The contrast experiments are discussed and the results are compared with the optimal scheme. The results show that the proposed algorithm has the ability of maintaining energy optimization, while achieving desirable network performances, compared with clustering algorithms.

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Chapter 58

Optimality Conditions for Non-Smooth Multi Objective Semi-Infinite Programming

Xiaoyan Gao

Abstract The purpose of this paper is to consider a class of non-smooth multi objective semi-infinite programming problem. Based on the concepts of local cone approximation, K -directional derivative and K -subdifferential, a new generalization of convexity, namely generalized uniform K - (F, α, ρ, d) -convexity, is defined for this problem. For such semi-infinite programming problem, 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 Local cone approximation · K -directional derivative · K -subdifferential · Semi-infinite programming · Sufficient optimality condition

58.1 Introduction

In recent years, there has been considerable interest in so-called semi-infinite programming problems—the optimization of an objective function in finitely many variables over a feasible region defined by an infinite number of constraints. 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. To date, many authors investigated the optimality conditions and duality results for semi-infinite programming problems. We can see in [1, 2, 3].

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On the other hand, a large literature was developed around generalized convexity and its applications in mathematical programming. Several authors have extended the basic theoretical results in multi objective programming. The optimality conditions and duality in multi objective programming have not only been used in many theoretical and computational developments in mathematical programming itself but also used in economics, control theory, business problems, and other diverse fields. In particular, Anurag Jayswal [4] obtained the sufficient optimality conditions and duality results under the generalized α - unisex type I function. Optimality conditions and generalized Mond-Weir duality for multi objective programming involving n -set functions which satisfy appropriate generalized university V-type-I conditions were formulated in [5]. Kim and Bae [6] formulated no differentiable multi objective programs involving the support functions of a compact convex set. Also, Bae et al. [7] established duality theorems for no differentiable multi objective programming problems under generalized convexity assumptions. Recently, Kim and Lee [8] introduced the no smooth multi objective programming problems involving local Lipchitz functions and support functions.

In this paper, motivated by the above work, we first define a kind of generalized convex functions about the local cone approximation, K -directional derivative and K -subdifferential. Then, the sufficient optimality conditions are obtained for a class of multi objective semi-infinite programming problem involving the new generalized convexity.

58.2 Definitions and Preliminaries

Let X be a nonempty set of R^n . The epigraph of a real-valued function $f : X \rightarrow R$ is the following subset of $X \times R$:

$$epif = \{(x, r) \in X \times R | f(x) \leq r\}$$

Definition 1 Let $K(\cdot, \cdot)$ be a local cone approximation. Then, $f^k(x; \cdot) : X \times X \rightarrow R \cup \{+\infty\}$ is said to be K -directional derivative at x , where

$$f^k(x; y) = \inf\{\zeta \in R | (y, \zeta) \in K(epif, (x, f(x)))\}.$$

Definition 2 Marco Castellani [9] $f : X \rightarrow R$ is said to be K -sub differentiable, if there exists convex compact set $\partial^K f(x)$, such that

$$f^k(x; y) = \max_{\zeta \in \partial^K f(x)} \langle \zeta, y \rangle, \forall y \in R^n,$$

where, $\partial^K f(x) = \{x^* \in X^* | \langle y, x^* \rangle \leq f^k(x; y), \forall y \in R^n\}$ is K -sub differential of f at x .

Definition 3 Preda [10] a functional $F : X \times X \times R^n \rightarrow R (X \subset R^n)$ is said to be sublinear about the third variable, if for $\forall (x_1, x_2) \in X \times X$, it satisfies

$$F(x_1, x_2; \alpha_1 + \alpha_2) \leq F(x_1, x_2; \alpha_1) + F(x_1, x_2; \alpha_2), \forall \alpha_1, \alpha_2 \in R^n.$$

$$F(x_1, x_2; r\alpha) = rF(x_1, x_2; \alpha), \forall r \in R_+, \alpha \in R^n.$$

We suppose that $X \subset R^n$ is nonempty; $f : X \rightarrow R$ is local Lipchitz function; $F : X \times X \times R^n \rightarrow R$ is sublinear; $\phi : R \rightarrow R$; $b : X \times X \times [0, 1] \rightarrow R_+$, $\lim_{\lambda \rightarrow 0^+} b(x, x_0; \lambda) = b(x, x_0)$; $\alpha : X \times X \rightarrow R_+ \setminus \{0\}$; $d : X \times X \rightarrow R^n$ is a pseudo-metric ton R^n , $\rho \in R$.

Definition 4 f is said to be generalized uniform K — (F, α, ρ, d) —convex at $x_0 \in X$, if for all $x \in X$, there exists the local cone approximation K , such that

$$b(x, x_0)\phi[f(x) - f(x_0)] \geq F(x, x_0, \alpha(x, x_0)\xi) + \rho d^2(x, x_0), \forall \xi \in \partial^K f(x_0).$$

Definition 5 f is said to be strict generalized uniform K — (F, α, ρ, d) —convex at $x_0 \in X$, if for all $x \in X, x \neq x_0$, there exists the local cone approximation K , such that

$$b(x, x_0)\phi[f(x) - f(x_0)] > F(x, x_0, \alpha(x, x_0)\xi) + \rho d^2(x, x_0), \forall \xi \in \partial^K f(x_0).$$

Definition 6 f is said to be generalized uniform K — (F, α, ρ, d) —pseudo convex at $x_0 \in X$, if for all $x \in X$, there exists the local cone approximation K , such that

$$b(x, x_0)\phi[f(x) - f(x_0)] < 0 \Rightarrow F(x, x_0, \alpha(x, x_0)\xi) + \rho d^2(x, x_0) < 0, \forall \xi \in \partial^K f(x_0).$$

Definition 7 f is said to be strict generalized uniform K — (F, α, ρ, d) —pseudo-convex at $x_0 \in X$, if for all $x \in X, x \neq x_0$, there exists local cone approximation K , such that

$$b(x, x_0)\phi[f(x) - f(x_0)] \leq 0 \Rightarrow F(x, x_0, \alpha(x, x_0)\xi) + \rho d^2(x, x_0) < 0, \forall \xi \in \partial^K f(x_0).$$

Definition 8 f is said to be generalized uniform K — (F, α, ρ, d) —quasiconvex at $x_0 \in X$, if for all $x \in X$, there exists local cone approximation K , such that

$$b(x, x_0)\phi[f(x) - f(x_0)] \leq 0 \Rightarrow F(x, x_0, \alpha(x, x_0)\xi) + \rho d^2(x, x_0) \leq 0, \forall \xi \in \partial^K f(x_0).$$

Definition 9 f is said to be generalized uniform K — (F, α, ρ, d) —weak quasi-convex at $x_0 \in X$, if for all $x \in X$, there exists local cone approximation K , such that

$$b(x, x_0)\phi[f(x) - f(x_0)] < 0 \Rightarrow F(x, x_0, \alpha(x, x_0)\xi) + \rho d^2(x, x_0) \leq 0, \forall \xi \in \partial^K f(x_0).$$

58.3 Sufficient Optimality Conditions

In this paper, we consider the following multi objective semi-infinite programming problem:

$$\begin{aligned} \text{(SIVP) minimize } & f(x) = (f_1(x), f_2(x), \dots, f_p(x)), \\ \text{Subject to } & g_t(x) \leq 0, t \in T, x \in X \end{aligned}$$

where $X \subset R^n$ is a nonempty open subset, $f : x \rightarrow R^p, g_t : x \rightarrow R, t \in T$ and T is an infinite compact index set. We put $X^0 = \{x \in X | g_t(x) \leq 0, t \in T\}$ for the feasible set of problem (SIVP). $f_i : x \rightarrow R (i = 1, 2, \dots, p)$ And $g_t : x \rightarrow R (t \in T)$ are local Lipchitz, and K -sub differentiable at $x \in X$. then we define

$$\begin{aligned} \Lambda^+ &= \left\{ \lambda = (\lambda_1, \lambda_2, \dots, \lambda_p)^T | \lambda_i \geq 0, \quad i = 1, 2, \dots, p, \sum_{i=1}^p \lambda_i = 1 \right\}, \\ \Lambda^{++} &= \left\{ \lambda = (\lambda_1, \lambda_2, \dots, \lambda_p)^T | \lambda_i > 0, \quad i = 1, 2, \dots, p, \sum_{i=1}^p \lambda_i = 1 \right\}, \\ T(\bar{x}) &= \{t \in T | g_t(\bar{x}) = 0\}, R_+^{(T)} = \{\mu : T \rightarrow R_+ | t \in T\}, \end{aligned}$$

where $T(\bar{x})$ is active constraint set; $R_+^{(T)}$ denotes that for all $t \in T, \mu_t \geq 0$, and only finitely many are strictly positive.

Theorem 1 Let $x^* \in X$. Assume that for all $x \in X$, there exists $\lambda^* \in \Lambda^+$ and $(\mu_t^*)_{t \in T} \in R_+^{(T)}$, satisfy the following conditions.

$\lambda^{*T} f$ is generalized uniform $K_0 - (F, \alpha, \rho_0, d)$ -convex at x^* with respect to b_0 and ϕ_0 ;

For any $t \in T(x^*), g_t$ is generalized uniform $K_t - (F, \alpha, \rho_t^*, d)$ -convex at x^* with respect to b_1 and ϕ_1 ;

$$\begin{aligned} 0 &\in \partial^{K_0}(\lambda^{*T} f)(x^*) + \sum_{t \in T} \mu_t^* \partial^{K_t} g_t(x^*); \\ \mu_t^* g_t(\bar{x}) &= 0, t \in T; \\ a < 0 &\Rightarrow \phi_0(a) < 0 \text{ and } \phi_0(0) = 0; \\ a \leq 0 &\Rightarrow \phi_1(a) \leq 0; b_0(x, x^*) > 0, b_1(x, x^*) \geq 0; \\ \rho_0 + \sum_{t \in T} \mu_t^* \rho_t^* &\geq 0 \end{aligned}$$

Then x^* is a weak efficient solution of (SIVP).

Proof Suppose that x^* is not weak efficient solution of (SIVP). Then there exists $\bar{x} \in X^0$, such that $f(\bar{x}) < f(x^*)$

Since $\lambda^* \in \Lambda^+$, it follows that $\lambda^{*T}f(\bar{x}) < \lambda^{*T}f(x^*)$

Condition implies $b_0(\bar{x}, x^*)\phi_0[\lambda^{*T}f(\bar{x}) - \lambda^{*T}f(x^*)] < 0$.

Then from this we get

$$F(\bar{x}, x^*; \alpha(\bar{x}, x^*)\zeta) + \rho_0 d^2(\bar{x}, x^*) < 0, \forall \zeta \in \partial^{K_0}(\lambda^{*T}f)(x^*) \quad (58.1)$$

As $t \in T(x^*)$, we have $g_t(\bar{x}) \leq 0 = g_t(x^*)$

By, we obtain $b_1(\bar{x}, x^*)\phi_1[g_t(\bar{x}) - g_t(x^*)] \leq 0$

Then yields

$$F(\bar{x}, x^*; \alpha(\bar{x}, x^*)\zeta_t) + \rho_t^* d^2(\bar{x}, x^*) \leq 0, \forall \zeta_t \in \partial^{K_t}g_t(x^*), t \in T(x^*)$$

From this we have $\mu_t^* \geq 0$, as $t \in T(x^*)$; we let $\mu_t^* = 0$, as $t \in T \setminus T(x^*)$. So it follows that

$$\begin{aligned} & \sum_{t \in T} \mu_t^* F(\bar{x}, x^*; \alpha(\bar{x}, x^*)\zeta_t) + \sum_{t \in T} \mu_t^* \rho_t^* d^2(\bar{x}, x^*) \\ &= \sum_{t \in T} F(\bar{x}, x^*; \alpha(\bar{x}, x^*)\mu_t^* \zeta_t) + \sum_{t \in T} \mu_t^* \rho_t^* d^2(\bar{x}, x^*) \leq 0 \end{aligned} \quad (58.2)$$

Adding theorems (58.1) and (58.2), then by the sub linearity of F and (vi), we have

$$F\left(\bar{x}, x^*; \alpha(\bar{x}, x^*)\left(\zeta + \sum_{t \in T} \mu_t^* \zeta_t\right)\right) < -\left(\rho_0 + \sum_{t \in T} \mu_t^* \rho_t^*\right) d^2(\bar{x}, x^*) \leq 0$$

Finally, we have a contradiction. Hence x^* is a weak efficient solution of (SIVP).

Theorem 2 Let $x^* \in X^0$. Assume that for all $x \in X^0$, there exists $\lambda^* \in \Lambda^+$ and $(\mu_t^*)_{t \in T} \in R_+^{(T)}$, satisfy the following conditions.

- i. $\lambda^{*T}f$ is generalized uniform $K_0 - (F, \alpha, \rho_0, d)$ —pseudo convex at x^* with respect to b_0 and ϕ_0 ;
- ii. For any $t \in T(x^*)$, g_t is generalized uniform $K_t - (F, \alpha, \rho_t^*, d)$ —quasiconvex at x^* with respect to b_1 and ϕ_1 ;
- iii. $0 \in \partial^{K_0}(\lambda^{*T}f)(x^*) + \sum_{t \in T} \mu_t^* \partial^{K_t}g_t(x^*)$;
- iv. $\mu_t^* g_t(x^*) = 0, t \in T$;
- v. $a < 0 \Rightarrow \phi_0(a) < 0$ and $\phi_0(0) = 0$; $a \leq 0 \Rightarrow \phi_1(a) \leq 0$;
 $b_0(x, x^*) > 0, b_1(x, x^*) \geq 0$;
- vi. $\rho_0 + \sum_{t \in T} \mu_t^* \rho_t^* \geq 0$.

Then x^* is a weak efficient solution of (SIVP).

Proof Suppose that x^* is not weak efficient solution of (SIVP). Then there exists $\bar{x} \in X^0$, such that $f(\bar{x}) < f(x^*)$

Since $\lambda^* \in \Lambda^+$, it follows that $\lambda^{*T}f(\bar{x}) < \lambda^{*T}f(x^*)$

By (v), we obtain $b_0(\bar{x}, x^*)\phi_0[\lambda^{*T}f(\bar{x}) - \lambda^{*T}f(x^*)] < 0$

Then (i) yield

$$F(\bar{x}, x^*; \alpha(\bar{x}, x^*)\zeta) + \rho_0 d^2(\bar{x}, x^*) < 0, \forall \zeta \in \partial^{K_0}(\lambda^{*T}f)(x^*) \tag{58.3}$$

As $t \in T(x^*)$, we have $g_t(\bar{x}) \leq 0 = g_t(x^*)$

From (v), we get $b_1(\bar{x}, x^*)\phi_1[g_t(\bar{x}) - g_t(x^*)] \leq 0$

Then (ii) yields

$$F(\bar{x}, x^*; \alpha(\bar{x}, x^*)\zeta_t) + \rho_t^* d^2(\bar{x}, x^*) \leq 0, \forall \zeta_t \in \partial^{K_t}g_t(x^*), t \in T(x^*)$$

From (iv), we have $\mu_t^* \geq 0$, as $t \in T(x^*)$; we let $\mu_t^* = 0$, as $t \in T \setminus T(x^*)$. So it follows that

$$\begin{aligned} & \sum_{t \in T} \mu_t^* F(\bar{x}, x^*; \alpha(\bar{x}, x^*)\zeta_t) + \sum_{t \in T} \mu_t^* \rho_t^* d^2(\bar{x}, x^*) \\ &= \sum_{t \in T} F(\bar{x}, x^*; \alpha(\bar{x}, x^*)\mu_t^* \zeta_t) + \sum_{t \in T} \mu_t^* \rho_t^* d^2(\bar{x}, x^*) \leq 0 \end{aligned} \tag{58.4}$$

Adding (58.3) and (58.4), then by the sub linearity of F and (vi), we get

$$F\left(\bar{x}, x^*; \alpha(\bar{x}, x^*)\left(\zeta + \sum_{t \in T} \mu_t^* \zeta_t\right)\right) < -\left(\rho_0 + \sum_{t \in T} \mu_t^* \rho_t^*\right) d^2(\bar{x}, x^*) \leq 0$$

Finally, we have a contradiction. Hence x^* is a weak efficient solution of (SIVP).

Theorem 3 Let $x^* \in X^0$. Assume that for all $x \in X^0$, there exists $\lambda^* \in \Lambda^+$ and $(\mu_t^*)_{t \in T} \in R_+^{(T)}$, satisfy the following conditions.

- i. $\lambda^{*T}f$ is strict generalized uniform $K_0 - (F, \alpha, \rho_0, d)$ —pseudo convex at x^* with respect to b_0 and ϕ_0 ;
- ii. For any $t \in T(x^*)$, g_t is generalized uniform $K_t - (F, \alpha, \rho_t^*, d)$ —quasiconvex at x^* with respect to b_1 and ϕ_1 ;
- iii. $0 \in \partial^{K_0}(\lambda^{*T}f)(x^*) + \sum_{t \in T} \mu_t^* \partial^{K_t}g_t(x^*)$;
- iv. $\mu_t^* g_t(x^*) = 0, t \in T$;
- v. $a \leq 0 \Rightarrow \phi_0(a) \leq 0$; $a \leq 0 \Rightarrow \phi_1(a) \leq 0$; $b_0(x, x^*) \geq 0, b_1(x, x^*) \geq 0$;
- vi. $\rho_0 + \sum_{t \in T} \mu_t^* \rho_t^* \geq 0$.

Then x^* is a weak efficient solution of (SIVP).

Proof Suppose that x^* is not weak efficient solution of (SIVP). Then there exists $\bar{x} \in X^0$, such that $f(\bar{x}) \leq f(x^*)$

Since $\lambda^* \in \Lambda^+$, it follows that $\lambda^{*T}f(\bar{x}) \leq \lambda^{*T}f(x^*)$

By (v), we obtain $b_0(\bar{x}, x^*)\phi_0[\lambda^{*T}f(\bar{x}) - \lambda^{*T}f(x^*)] \leq 0$

Then (i) yield

$$F(\bar{x}, x^*; \alpha(\bar{x}, x^*)\xi) + \rho_0 d^2(\bar{x}, x^*) < 0, \forall \xi \in \partial^{K_0}(\lambda^{*T}f)(x^*) \tag{58.5}$$

As $t \in T(x^*)$, we have $g_t(\bar{x}) \leq 0 = g_t(x^*)$

Using (v), we get $b_1(\bar{x}, x^*)\phi_1[g_t(\bar{x}) - g_t(x^*)] \leq 0$

Then (ii) yields

$$F(\bar{x}, x^*; \alpha(\bar{x}, x^*)\zeta_t) + \rho_t^* d^2(\bar{x}, x^*) \leq 0, \forall \zeta_t \in \partial^{K_t}g_t(x^*), t \in T(x^*)$$

From (iv), we have $\mu_t^* \geq 0$, as $t \in T(x^*)$; we let $t \in T(x^*)$, as $t \in T \setminus T(x^*)$. So it follows that

$$\begin{aligned} & \sum_{t \in T} \mu_t^* F(\bar{x}, x^*; \alpha(\bar{x}, x^*)\zeta_t) + \sum_{t \in T} \mu_t^* \rho_t^* d^2(\bar{x}, x^*) \\ &= \sum_{t \in T} F(\bar{x}, x^*; \alpha(\bar{x}, x^*)\mu_t^* \zeta_t) + \sum_{t \in T} \mu_t^* \rho_t^* d^2(\bar{x}, x^*) \leq 0 \end{aligned} \tag{58.6}$$

Adding theorem (58.5) and (58.6), then by the sub linearity of F and (vi), we obtain

$$F\left(\bar{x}, x^*; \alpha(\bar{x}, x^*)\left(\xi + \sum_{t \in T} \mu_t^* \zeta_t\right)\right) < -\left(\rho_0 + \sum_{t \in T} \mu_t^* \rho_t^*\right) d^2(\bar{x}, x^*) \leq 0$$

Finally, we have a contradiction. Hence x^* is a weak efficient solution of (SIVP).

Similarly, we can derive the following theorem easily.

Theorem 4 Let $x^* \in X^0$. Assume that for all $x \in X^0$, there exists $\lambda^* \in \Lambda^+$ and $(\mu_t^*)_{t \in T} \in R_+^{(T)}$, satisfy the following conditions.

- i. $\lambda^{*T}f$ is generalized uniform $K_0 - (F, \alpha, \rho_0, d)$ —weak quasiconvex at x^* with respect to b_0 and ϕ_0 ;
- ii. For any $t \in T(x^*)$, g_t is strict generalized uniform $K_t - (F, \alpha, \rho_t^*, d)$ —pseudoconvex at x^* with respect to b_1 and ϕ_1 ;
- iii. $0 \in \partial^{K_0}(\lambda^{*T}f)(x^*) + \sum_{t \in T} \mu_t^* \partial^{K_t}g_t(x^*)$;
- iv. $\mu_t^* g_t(x^*) = 0, t \in T$;
- v. $a < 0 \Rightarrow \phi_0(a) < 0; a \leq 0 \Rightarrow \phi_1(a) \leq 0; b_0(x, x^*) > 0, b_1(x, x^*) \geq 0$;
- vi. $\rho_0 + \sum_{t \in T} \mu_t^* \rho_t^* \geq 0$.

Then x^* is a weak efficient solution of (SIVP).

58.4 Conclusions

Throughout this paper, we have defined a new generalized convex function, extending many well-known classes of generalized convex functions. Furthermore, we have achieved some sufficient optimality conditions for a class of multi objective semi-infinite programming problem. There should be further opportunities for exploiting this structure of the semi-infinite programming problem.

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Part VII
Mathematics and Computation

Chapter 59

Study of Real Estate Bubble Measurement

Ning Zheng, Bo Dong and Rong Rong Shen

Abstract In the modern economic society, the status and function of the real estate industry is very prominent in the national economy. In this paper, it introduces the method of real estate bubble on the basic of the definition of the real estate bubble and the analysis of the bubble's causes. Especially, it describes two real estate bubble methods in detail, which are the standard value of the housing price to income ratio and the real estate price growth rate/GDP growth rate. Furthermore, it does empirical analysis on Beijing's real estate bubble with two kinds of measuring methods. On the basis of the analysis, there are some problems in the process of Beijing's real estate development. Finally, this paper puts forward five policy suggestions to solve the problem of real estate bubble.

Keywords Real estate bubble · Housing price to income ratio · The real estate price growth rate/GDP growth rate

59.1 The Definition of Real Estate Bubble

In the modern economic society, the status and function of real estate industry is very prominent in the national economy [1, 2]. The real estate industry is not only a basic and leading industry but also a high degree of industrial association and a strong pillar industry; thus, the real estate industry's sustainable development plays a decisive role on economy [3–6]. Our country's real estate starts late; however, it has been developed at a high speed. As the pillar industry in national economy,

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real estate industry's healthy development must guide and influence the development of related industries directly or indirectly [7]. Therefore, the sustained and healthy development of the real estate industry is not only the requirement of real estate market itself, but also the need of sustainable development of macro economy; moreover, it is in need of protecting the interests of the masses.

59.1.1 The Definition of Real Estate Bubble

Charles P Kindle Berger described “bubble” in the “The New Palgrave Economics Dictionary” as “The bubble can be less strictly defined as: an asset or a series of asset prices is sharply rising in a continuous process, and the initial price increase leads to people doing prediction of further price rise, thus attracting new buyers—these persons are generally speculators profited with the business of assets, in fact they are not pay attention to the assets usage and profit ability [8, 9]. Accordingly, it often appears expected reverse and price slump, resulting in financial crisis generally.” Therefore, real estate bubble is continuously in sharp rise of real estate price divorced from the market foundation owing to realty speculation. From the market perspective, real estate bubble is a kind of phenomenon of price, which means speculative capitals continually increase, brings on the phenomenon of realty price far higher than the corresponding entity value (production and circulation etc.) within a certain range [10].

59.1.2 The Causes of Real Estate Bubble

First, this paper refers to the special composition of real estate price.

Theoretically speaking, the real estate price is capitalization of the rent which means the real estate price is equal to the rent or the interest rate. In other words, the real estate price is capitalization of the future income and it depends upon three factors: the estimate of earnings in the future, the final value of assets' assessment, and with what kind of discount rate converting rental income into real value. Developers sometimes use this method when pricing. For example, a rental property for 20,000 Yuan, the bank's interest rate of 5 %, the property here is priced at:

- Estate price = rent/interest rate
- $P = 20,000/5 \%$
- $P = 400,000$

Therefore, the real estate price is determined by three artificial elements, the future return rate, the final value, and the interest rate. Obviously, if people can make a prediction on the basis of the objective reality, the real estate price reflected will not only be true, and also be confirm to the entity economy.

However, the price of realty is easy to deviate from the true values due to the limited rationality and the information asymmetry of persons. Hence, the realty assets have virtual capital character which is the root of real estate industry's bubble.

Second, it is the special relationship between supply and demand.

The supply of real estate is lack of elasticity in short term as the specific characteristics of the commodity. Therefore, in a highly speculative realty market, speculative demand curve is the irregular changes curve. It is still in the normal situation when the price rises in small scale. However, the price increases faster and the needs grow more when the price changes greatly; while the price drops, the demand goes down substantially. Obviously, if the growth in demand is supported by economic growth, besides the demand is conform to the entity economy and purchasing power, the realty industry's development can be promoted undoubtedly. However, it will lead to false boom of market if the false needs are resulted in irrational speculation caused by high interest of realty industry.

Finally, it is the special relationship between real estate industry and the financial industry.

Real estate business activities are in need of financial industry, in other words, both the developers and buyers need a lot of money. Factors prove that the support the financial industry provides to the real estate industry not only can shorten the time to raise fund of realty, but also can reduce cost greatly. Consequently, realty industry can get rapid development with the support of financial industry. On one hand, the realty loans are always one of the most important fields for financial investment as the high interest rate and creditor's rights reliability of realty industry, real estate industry becomes one of the most critical source of profit for financial industry. The financial industry and real estate industry increasingly demonstrate mutual infiltration and integration due to the collective gain, and they present the situation of prosperity, loss, or both.

59.2 The Real Estate Bubble Measurement

59.2.1 Housing Price to Income Ratio

In the early 1990s, when World Bank China Bureau chief economist, Heifer. End did research with domestic housing system reform, he put forward an "ideal" experienced proportion, believing that the housing price should be 3–6 times of annual household income for residents. If monthly payment of housing loan's principal and interest accounted for less than 25 %, think about housing loans factor. Later, many domestic scholars took this ratio as the standard to measure if there be bubble. The housing price to income ratio of 3–6 times is mainly deduced on the basis of United States and part of western developed countries' experienced data. However, various countries have different national conditions, thus the value

of 3–6 times may not be suitable to all countries in the world, so it should not be called international practice. Here, it analyzes the reasonable house price to income ratio with a simple model to determine the suitable value. Obviously model can provide more persuasive value basis relative to the general international experience data or the special cases. There is one point to emphasize, the “housing price” referred in the “housing price to income ratio” in this paper is the real estate’s actual transaction average price in a period.

Supposing residential price is P yuan, annual family income is Y yuan, housing loan interest of bank is r , repayment time limit is n year, the proportion of the first payment is a , the annual percentage of loan repayment accounts for household income is K , and housing price to income ratio is R . Getting the following formulas combined with the geometric series formula:

$$(1 - a)P = kY \frac{(1 + r)^n - 1}{r(1 + r)^n} \quad (59.1)$$

Calculating (59.1)

$$\frac{P}{Y} = \frac{k}{1 - a} \cdot \frac{(1 + r)^n - 1}{r(1 + r)^n} \quad (59.2)$$

Thus, the housing price to income ratio is

$$R = \frac{k}{1 - a} \cdot \frac{(1 + r)^n - 1}{r(1 + r)^n} \quad (59.3)$$

59.2.2 The Real Estate Price Growth Rate/GDP Growth Rate

This index is designed based on the definition of real estate bubble. GDP growth rate represents the development of entitative economy, and measuring the dynamic index about real estate relative to economic entities’ economic growth speed to detect the real estate economic bubble trend. It shows that the bigger the index value is, the higher real estate growth rate more than native estimative economy, and the bigger the possibility of real estate bubble formation is. There is burst possibility of real estate bubble crisis if the index continued to rise during a specific period. This index has no comparable advantage in the item of data availability, thus the housing price and GDP growth rate are easily obtained.

However, there are apparent defects in this index. The GDP growth rate is the ratio of one year’s constant gross domestic product value divided by the constant gross domestic product value of last year, and then subtracting one. GDP shows residents’ final consumption goods and services of the actual growth rate expressed in currency. Obviously, it is not scientific to contrast the real estate price growth rate including price element with the GDP growth rate eliminating the

price factor. In addition, it is not suitable to compare the price increase to GDP growth rate. On account of the population element, which means if the GDP growth is offset by population growth, the GDP will not change and people's standard of living does not improve. It means that at the same time of price growth, the income level of residents does not increase correspondingly, and the real estate market appears bubble if the situation exists in long term.

59.3 The Empirical Analysis of the Real Estate Bubble in Beijing

59.3.1 *The Housing Price to Income Ratio's Standard Value Analysis*

Considering the marriage age of youth is mostly between 25 and 30 years old, however, the retirement age is 60 years old commonly, therefore, the bank mortgage loans is generally not more than 30 years. Hence, the loan period limit set here is for 30 years. At the same time, family consumption includes the basic necessities of life and educational expenses of children. In USA, living approximately accounts for 20–30 % in the total consumption, relatively Japanese residential loan repayment amount accounts for the proportion of family income in 20–25 %. According to the Beijing statistical information data online, over the years, Beijing residential expenses accounts for 6–15 % in the total consumption expenditure. Moreover, the living expenditure proportion is rising as the price increases faster than the income increase rate in recent years. In a word, in the process to determine the upper limit of k , determining k is 25 %. It is around 5 % of housing reserve fund loan interest rate in Beijing, the commercial loan rate of purchasing is 7–8 %, and the domestic commercial banks provide mortgage rate is between 6 and 7 %. Therefore, we take the loan interest rate of 5–9 % to calculate (Tables 59.1 and 59.2).

According to the calculation result when the first payment rate is 30 %, the longest loan period is 30 years, the interest rate is 5 %, and the biggest housing price to income ratio is 5.49 times, which is smaller than 6 times. Hence, if the first payment is 20 or 30 %, the interest rate is 6–7 %, and the loan period is between 20 and 30 years, and the reasonable housing price to income ratio is 3–5 times.

Table 59.1 Housing price to income ratio when the first payment rate is 20 %

Years period	5 %	6 %	7 %	8 %	9 %
10	2.41	2.3	2.19	2.10	2.01
20	3.89	3.58	3.31	3.07	2.85
30	4.8	4.3	3.88	3.52	3.21

Table 59.2 Housing price to income ratio when the first payment rate is 30 %

Years period	5 %	6 %	7 %	8 %	9 %
10	2.76	2.63	2.51	2.4	2.29
20	4.45	4.10	3.78	3.51	3.26
30	5.49	4.92	4.43	4.02	3.67

59.3.2 The Real Estate Price Growth Rate/GDP Growth Rate Analysis

According to the above introduction, this index reflects the degree of deviation on the real estate industry and the entity economy. Therefore, it can be used as the indicator of the real estate bubble. However, there is no strict standard about the index critical value among the world. Generally, when the price rise is two times of the GDP increases, it is not normal price and there are large bubbles in the realty price. Like Japan for example, when the average indicator reached 3.3, there was serious bubble in the real estate industry between 1987 and 1990. When it refers to Hong Kong, this average indicator was 2.4 in 1986–1996, and the index reached 5.0 when the property market increased to peak in August of 1997. In the following is the change diagram of this index in Beijing (Fig. 59.1).

Form the figure, it shows that the index value exceeds 2 only in 2005. When it comes to the value of 1.5–2.0, they are in 2006 and 2010, and there may be a slight bubble during these 2 years. In addition, the index value is almost in the range of -1 to 1. According to the index, the growth of real estate is supported by the growth of entity economy,; thus, there is no bubble phenomenon. It is worth to pay attention to the rapid growth of this index in 2003–2005, and the phenomenon shows that the real estate investment growth rate rise faster in the few years. The curve indicates that the index value reaches the top in 2005, and then has relatively substantially drops in 2006; however, this index is still at a higher level from 2006 to 2008. The change shows the macrocontrol policies play important role, but there may be some slight bubble (Fig. 59.2).

Fig. 59.1 Speculative demand curve

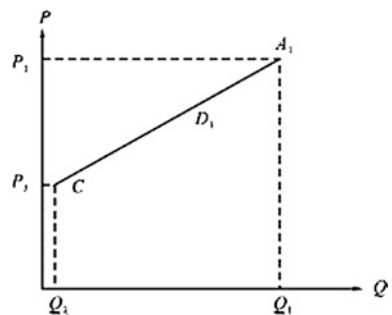
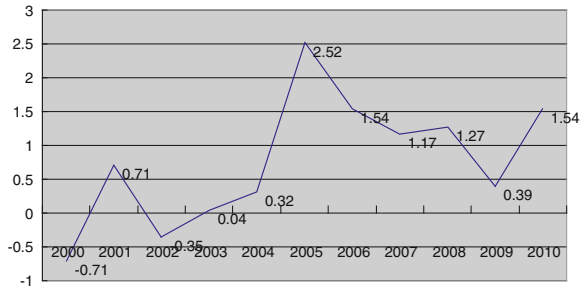


Fig. 59.2 The real estate price growth rate/GDP growth rate in Beijing (Source Beijing statistical information database)



59.4 Some Suggestion About Real Estate Bubble Management Policy in China

59.4.1 Perfecting Residential Security System

One of the most important institutional reasons of urban real estate bubble is obviously insufficient of residential security system. In recent years, China insists to deepen reform, and continually to eliminate institutional and policy obstacles influenced the residential housing consumption. Besides, taking “speeding up and perfecting the housing security system suitable our national conditions” as an important guiding ideology for the real estate market development, and making a serious of achievements. Nevertheless, our government still has a long way to go on the item of building housing security system compared with western developed countries, and it need to pay unremitting efforts. In addition, it also needs long-term planning and thinking of construction and needs some strong measures on administrative system to prevent remaining stagnant because of various reasons. Therefore, it is suggests that the government takes establish and perfecting housing security system as some mechanisms’ critical task. At the same time, on the financial, it should provide measures of annual improvement to support the residents’ housing security.

59.4.2 Positively Developing the Rental Market

“Everyone buys a house” is not suitable to the social economic development level and the income consumption level of residents in the present years in our country, and it is not realistic. Moreover, in a fairly long term, even some first-tier cities like Beijing, it is not possible to realize the “everyone buys a house” target. Obviously, it is an objective fact, and it will lead to real estate bubble if people blindly pursuing “everyone buys a house” object as the unrealistic demand expansion. On the other hand, “everybody has appropriate house” is residents’ living need, and it is also an important aspect of realizing comprehensive and

comparatively well-off life; therefore, it needs to form a housing surplus “gradient market”, which including new commodity housing, second-hand housing, rental housing, and low rent housing etc. According to the experience of metropolis, residents living in metropolis commonly own rental housing, in other words, the housing rental market is the biggest housing supply sources. However, the present urban housing rental market develops flow in our country, thus developing rental market positively should be an important long-term policy of the government.

59.4.3 Strengthening the Financial Supervision

The goal of financial supervision is to make moderate credit total amount, reasonable structure, and ensure the financial institutions operating in accordance with the law through a variety of means, and preventing excessive moral risk to reduce systematic risk to the minimum. The reason of real estate bubble appearance reflects the importance and urgency to strengthen financial institutions’ supervision system reform, establish a set of perfect financial supervision system, and establish an independent and efficient financial supervision system.

59.4.4 Pushing Forward the Real Estate Tax Reform Actively and Steadily, and Perfecting the Related Land Policy

Tax is the main source of government revenues, and it is also an important tool of income distribution. Therefore, tax should follow efficiency principle, fair principle, and stability principle. In the real estate market, tax revenue is the government regulation system’s important constituent, with the help of tax relief, government perfects its economic decision making according to the behavioral conditions change when the market subject behavior occurs, and promoting the optimal allocation of resources and market benign operation.

It is a wide range of taxes for our country’s present real estate tax, low gravity, and mainly be concentrated on the development tacks, but the maintain and circulation tacks are lighter. Therefore, our country must not to move or retreat to advance the real estate tax reform, at the same time it should give full consideration to variety of contradictions in the actual situation and the reform process. Our country collects experience through the pilot approach, and creates foundation conditions for continuous reformation and then gradually extended.

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Chapter 60

Measuring Energy Consumption and Carbon Dioxide Emissions of Star-Rated Hotels

Zi Tang

Abstract The measurement of energy consumption and carbon dioxide emission is an important project for promoting the development of building low-carbon hotels in China. Heilongjiang province in China was taken as an example to measure the direct results of energy consumption and carbon dioxide emission of star-rated hotels by using the methods of documentation and mathematical statistics. The results show that the energy consumption of star-rated hotels in Heilongjiang province increased from 0.49 PJ in 1998 to 1.88 PJ in 2009, the carbon dioxide emission of star-rated hotels increased from 7.85×10^4 t in 1998 to 29.81×10^4 t in 2009. The three-star hotels were the largest energy consumer and carbon dioxide dischargers, followed by the two-star grade. The study of estimation for tourist hotels in China is discussed in detail in this paper.

Keywords Energy consumption · Carbon dioxide emission · Star-rated hotels · Heilongjiang province

60.1 Introduction

Human society and sustainable economic development are faced with severe challenges because of the energy crisis and greenhouse gas emissions [1]. The relevant international organizations and scholars have focused on the impact of tourism on climate and the environment with the growing the tourism industry [2, 3]. A research by the World Tourism Organization shows that tourism

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accounted for 5 % of the world's total greenhouse gas emissions in 2005 [4]. According to the World Tourism Organization, China will become the world's largest tourist destination and the world's fourth largest tourist source country in 2020. In 2009, the State Council clearly demanded to promote the tourism industry energy saving and to reduce water and electricity consumption of star-rated hotels and A-rated scenic area by 20 % within 5 years [5]. As a province with abundant tourism resources, the tourism development of Heilongjiang is so rapid that there has been a lot of energy consumption and CO₂ emissions in recent years. It has attracted widespread attention of the hotel industry, one of the three pillars of the tourism industry, consumed a large number of energy and materials, and discharged much waste. The purpose of this chapter is to provide a reference on energy conservation and carbon reduction of tourist hotels for Heilongjiang. To achieve this, star-rated hotels of Heilongjiang were used as models and the current situation of energy consumption and carbon dioxide emissions was calculated.

60.2 Method and Data

60.2.1 Method

There is no available systemic method to estimate tourism energy consumption and carbon dioxide emissions currently [6]. Tourism elements include six parts, e.g., food, hotel, transport, traveling, shopping, and recreation, all of which consume energies and produce carbon emissions directly or indirectly. Hence it is impossible to calculate tourism consumption precisely, instead it can only be estimated. In this chapter, the energy consumption of tourist hotels is calculated using the following formula [6, 7]:

$$Q_e = S_e \times P \quad (60.1)$$

where Q_e indicates the energy consumption of tourist hotels; S_e stands for the energy consumption per unit; and P is the scale of tourist hotels.

The carbon dioxide emissions are calculated as [6, 7]:

$$Q_c = S_c \times Q_e \times \frac{1}{1000} \div \frac{12}{44} \quad (60.2)$$

where Q_c indicates the carbon dioxide emissions of tourist hotels; S_c stands for the carbon dioxide emission per unit; and Q_e is the energy consumption of the tourist hotels; 1/1,000 is the unit conversion coefficient; 12/44 is the conversion coefficients of carbon content in CO₂.

60.2.2 Data Sources

In this paper, most statistical data come from major statistical yearbooks published by the National Bureau of Statistics State of China and other statistical bulletins, and the remaining are quoted from the available domestic and foreign research results.

60.3 Results and Discussion

60.3.1 Energy Consumption

The energy consumption of tourism hotels largely involves consumptions in water, gas, and electricity. These consumptions per year can be transformed into energy consumption by a certain conversion ratio. However, there are very large differences between different countries or areas, as shown in Table 60.1.

For the purpose of the following calculations, this paper sets up $S_e = 163$ MJ per bed night to compute the hotels' energy consumption in Heilongjiang province, from the average of energy consumption per unit from the above domestic and foreign scholars. The reasons are as follows. First, most hotels in Heilongjiang province are less sensitive to "green" consciousness and there is tremendous prodigal consumption, so their actual energy consumption may be higher. Second, Heilongjiang province is located in northeast China and its latitude is high, where the heating time reaches to 6 months in winter.

Based on the above analysis, energy consumption from 1998 to 2009 of star-rated hotels in Heilongjiang estimated with formula (1) is shown in Table 60.2. In view of four-star and five-star hotels having existed since 2000 in Heilongjiang, energy consumption of different grade hotels in 2000 and 2009 shown in Table 60.3 were estimated separately.

It can be seen from Table 60.2 that the energy consumption of star-rated hotels increased from 0.49 PJ in 1998 to 1.88 PJ in 2009 with an average annual growth of 23.33 %, and the multiple is 3.84 times. From 1998 to 2001, energy consumption

Table 60.1 The energy consumption per bed night of hotels in some countries/areas

MJ/bed night	Region/reference year	Source
200	Germany, 1982	[8]
87	Cyprus, 2001	[9]
155	New Zealand, 1998–2000	[10]
256	Zanzibar, average hotels, 1999	[11]
130	Global, 2000	[12]
155	Taiwan, 2006	[6]
155	China, 2001–1008	[7]

Table 60.2 The energy consumption of star-rated hotels from 1998 to 2009 in Heilongjiang province

Year	Bed number	Occupancy rate (%)	Bed nights (million) ^a	Energy consumption (PJ)
1998	21,990	37.83	3.04	0.49
1999	24,575	48.72	4.37	0.71
2000	31,882	51.09	5.95	0.97
2001	34,693	32.43	4.11	0.67
2002	37,998	54.66	7.58	1.24
2003	36,127	51.74	6.82	1.11
2004	40,077	57.38	8.39	1.37
2005	44,761	56.52	9.23	1.51
2006	46,903	59.06	10.11	1.65
2007	48,662	55.49	9.86	1.61
2008	51,360	56.85	10.66	1.74
2009	53,811	58.73	11.54	1.88

^a Bed nights = the number of nights × occupancy rate × 365

Table 60.3 The energy consumption of different star-rated hotels in 2000 and 2009 in Heilongjiang province

Constitute	2000			2009		
	Bed nights (million)	Energy consumption (PJ)	Proportion (%)	Bed nights (million)	Energy consumption (PJ)	Proportion (%)
One-star	0.86	0.14	14.41	0.28	0.05	2.43
Two-star	2.26	0.37	38.06	3.46	0.56	29.98
Three-star	2.33	0.38	39.10	5.00	0.81	43.29
Four-star	0.45	0.07	7.53	2.27	0.37	19.63
Five-star	0.12	0.02	1.95	0.49	0.08	4.22
Total		0.97	100.00		1.88	100.00

A Bed nights = the number of nights × occupancy rate × 365

was at a lower level, but it was higher in 2002–2009, which was adapted to the scale of hotels.

It can be seen from Table 60.3 that energy consumption is not the same for different grade hotels. The three-star hotel's energy consumption was 0.38 PJ in 2000 and 0.81 PJ in 2009, accounting for 39.10 and 43.29 % of the total energy consumption, respectively, which was the largest and showing an increasing trend. The following is the one of two-star hotels, which was 0.37 PJ in 2000 and 0.56 PJ in 2009, accounting for 38.06 and 29.98 % of the total energy consumption, respectively. Five-star hotel's energy consumption was the smallest in 2000, which was 0.02 PJ, accounting for 1.95 %; however, one-star hotel's energy consumption was the smallest in 2009, which was 0.05 PJ, accounting for 2.43 %.

60.3.2 Carbon Dioxide Emission

Based on an emission factor of 43.2 go/MJ for the 1990 world electricity generation mix [12], this paper sets up $S_c = 43.2$ go/MJ to estimate the hotels' carbon dioxide emission in Heilongjiang province combined with Tables 60.2 and 60.3 by formula (2). The results are shown in Tables 60.4 and 60.5.

It can be seen from Table 60.4 that the carbon dioxide emission of star-rated hotels in Heilongjiang province increased from 7.85×10^4 t in 1998 to 29.81×10^4 t in 2009, and the multiple is 3.80 times. It can be seen from Table 60.5 that carbon dioxide emission is not the same for different grade hotels. Three-star hotels' carbon dioxide emission was the largest and showed the increasing trend, from 6.01×10^4 t in 2000 to 12.91×10^4 t in 2009, respectively. This was followed by one and two-star hotels, which was 5.85×10^4 t in 2000 and 8.94×10^4 t in 2009, respectively, showing a downward trend. Closely related to the increase in five-star hotels, and the reduction in one-star hotels, five-star hotel's carbon dioxide emission was the smallest in 2000, which was 0.30×10^4 t, but one-star hotel's carbon dioxide emission was the smallest in 2009, which was 0.72×10^4 t.

Table 60.4 CO₂ emissions of star-rated hotels from 1998 to 2009 in Heilongjiang province

Years	Bed nights (million)	Energy consumption (PJ)	CO ₂ emission (10 ⁴ t)
1998	3.04	0.49	7.85
1999	4.37	0.71	11.29
2000	5.95	0.97	15.36
2001	4.11	0.67	10.61
2002	7.58	1.24	19.59
2003	6.82	1.11	17.63
2004	8.39	1.37	21.69
2005	9.23	1.51	23.86
2006	10.11	1.65	26.13
2007	9.86	1.61	25.47
2008	10.66	1.74	27.54
2009	11.54	1.88	29.81

Table 60.5 The CO₂ emissions of different star-rated hotels from 2000 to 2009 in Heilongjiang province

	2000			2009		
	Bed nights (million)	CO ₂ emission (10 ⁴ t)	Proportion (%)	Bed nights (million)	CO ₂ emission (10 ⁴ t)	Proportion (%)
One-star	0.86	2.22	14.41	0.28	0.72	2.43
Two-star	2.26	5.85	38.06	3.46	8.94	29.98
Three-star	2.33	6.01	39.10	5.00	12.91	43.29
Four-star	0.45	1.16	7.53	2.27	5.85	19.63
Five-star	0.12	0.30	1.95	0.49	1.26	4.22
Total		15.36	100.00		29.81	100.00

60.4 Conclusions

The energy consumption of star-rated hotels in Heilongjiang province increased from 0.49 PJ in 1998 to 1.88 PJ in 2009, the carbon dioxide emission of star-rated hotels increased from 7.85×10^4 t in 1998 to 29.81×10^4 t in 2009. The three-star hotels were the largest energy consumer and carbon dioxide dischargers, followed by the two-star grade.

With the development of the tourism industry, the number of tourist hotels, rooms, and beds increases every year, which leads to the yearly increase in energy consumption and carbon dioxide emission. The three-star and two-star hotels are the main constituents of energy consumption and carbon dioxide emission, and they are important fields in energy saving and emission reduction.

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Chapter 61

Study on Initial Speed of Methane Emission Computation

Zhou Zhang and Min Zhou

Abstract To study the initial speed of methane emission computation is very important. It means that the coal which contains gas is completely exposed to the air. The gas from the adsorption state transforms into the free state. The index reflects that the speed of the coal seam gas spread is concerned with the gas of the coal content, pore structure, and surface properties of the pore. State regulations provide that the initial speed of methane emission is an important index for coal seam outburst identification and forecast. However, the test method of the initial speed of methane emission is not perfect. The result is varied because the laboratory and the operating personnel are different. In addition to the above factors, it is concerned with the temperature and radiation pressure. This paper mainly studies the relationship of the initial speed of methane emission with the temperature and radiation pressure and investigates the previous research and experimental methods to determine whether they can be improved with a mathematical formula.

Keywords Initial speed of methane emission · Temperature · Radiation pressure

61.1 Introduction

The initial speed of methane emission means the coal which contains gas completely exposed to environmental conditions, the gas from the adsorption state into the free state of speed. The ability of radiation gas and the occurrence of outburst have a direct relationship [1, 2].

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Table 61.1 Outburst of dangers of prediction of individual target

Coal seam outburst dangerous	Damage of coal	Coefficient of solid coal	Initial speed of methane emission	Gas pressure
Outburst dangerous	III, IV, V	≥ 10	≤ 0.5	≥ 74 MPa

Currently, our country evaluates coal outburst ability with the initial speed of methane emission, and combines with the coefficient of solid coal f , forms a new composite index $K = BP/f$. It is widely used in regional prediction, and makes a very good effect. “Coal And Gas Outburst Mine Identification of Norms” (in 2006) and “Coal And Gas Outburst Prevention Rules” (in 2009), the two national level norms show the importance of a single target method in coal and gas outburst dangers of identification and prediction (Table 61.1).

State regulations provide that the initial speed of methane emission is one of the important indexes which concern coal seam outburst identification and forecast. Hence, the effect of the BP is not only affirmative, but also of legal significance. However, the test method of the initial speed of methane emission is not perfect. The result is varied because the laboratory and operating personnel are different. This paper mainly studies the relationship of initial speed of methane emission to the temperature and radiation pressure [3, 4].

61.2 The Test Method of the Initial Speed of Methane Emission

According to “Coal And Gas Outburst Mine Identification of Norms” (in 2006), the test method of the initial speed of methane emission is as follows [5].

61.2.1 Instrument Utensils and Equipment

An initial speed of methane emission locator; B the vacuum pump; C methane bottle (concentration is more than 95 %); D the points sieve (aperture 0.2–0.25 mm each one); E the scales (maximum weighing 200 g, feeling 0.1 g); F small hammer; G funnel [6].

61.2.2 Sample Preparation

A sample of coal with label, indicate the sampling sites, horizon, the sampling time, and so on [7].

61.2.3 Testing Steps

The two samples are loaded into a sample bottle. To start the vacuum pump takes off the air 1.5 h. To start the vacuum pump to take off the gas, make U tube at both mercury face equation.

61.2.4 Computation of the Initial Speed of Methane Emission

The formula of the initial speed of methane emission is

$$\Delta p = p_2 - p_1$$

The same coal of two sample *BP* value measured the difference should not be more than one, otherwise need to redo.

61.3 Problems

61.3.1 The Influence of Temperature

The influence of temperature on the initial speed of methane emission mainly has two sides, first, the gas in fixed volume by temperature itself changes due to the impact pressure change in p_1 and p_2 ; second, the ability of coal itself for adsorption and desorption gas effected by temperature; hence the room temperature during the process of test is not to be considered. The overall coal gas is different, the p_1 and p_2 changes cause *BP* changes [8, 9].

61.3.2 Radiation Pressure

The initial speed of the methane emission test process, when gas of adsorption diffuses to vacuum space, and the vacuum of space volume and pressure, is variable. It is the variable space and variable pressure process; air pressure is 101.3 kPa, radiation space is the vacuum, and this is not consistent with the environment of the actual outburst atmosphere. It cannot reflect the actual speed for coal sample, and there is no clear physical significance [10].

61.4 Solution

61.4.1 Temperature Analysis

Analysis of the influence to the fixed space and temperature only considers gas pressure and temperature relations as in formula (61.1), which can get under the formulas on temperature with p_1 and p_2 as formulas (61.2) and (61.3):

$$\frac{p_1}{p_2} = \frac{T'_1}{T'_2} \tag{61.1}$$

$$p'_1 = \frac{p_1(T + \Delta T)}{T} \tag{61.2}$$

$$p'_2 = \frac{p_2(T + \Delta T)}{T} \tag{61.3}$$

Formula T —the temperature before the change in gas temperature.

ΔT —two-test temperature difference.

p'_1 —the gas pressure before temperature change 10s.

p'_2 —the gas pressure after temperature change 60s.

Coal is a porous media, has a developed pore system, and is a natural adsorbent. The gas is mainly adsorbed on coal rock micropores. The gas molecular ability of adsorbed pores increases and overcomes gravity because of the temperature and pressure changes, and breaks away from the inner surface of the coal into the free phase. Experiments show that, this kind of coal and rock adsorption and desorption phenomenon is a physical phenomenon; its characteristic basically is in accord with Langmuir’s isotherm equation. The quadratic function can be expressed as formula (61.4):

$$a = c_1 + c_2T - c_3T^2 \tag{61.4}$$

The gas adsorption balance is achieved when the test on initial speed of methane emission can be regarded approximately when atmospheric pressure reaches the maximum value of adsorption quantity; the equation for adsorption quantity and temperature can be shown as formula (61.5):

$$W = c'_1 + c'_2(T + \Delta T) - c'_3(T + \Delta T)^2 \tag{61.5}$$

Formula W —adsorption gas quantity.

BP —two-test temperature difference.

T —the temperature.

$c_1 c_2 c_3 c'_1 c'_2 c'_3$ — the constant

Because gas by adsorption state to the free state transformation the space is vacuum state the adsorption gas quantity is in close relation with p_1 and p_2 . Also, in p_1 , p_2 and two-test temperature difference there exist a quadratic function relation, as formulas (61.6) and (61.7).

$$\Delta p' = \Delta p + a\Delta T - b\Delta T^2 + \frac{\Delta T}{T} \Delta p \quad (61.6)$$

So also

$$\Delta p' = \Delta p + a'\Delta T - b\Delta T^2 \quad (61.7)$$

61.4.2 Radiation Pressure

At present, in our country the initial speed of methane emission of the industry standard air pressure is 101.3 kPa and radiation pressure is 0. This means that atmospheric pressure radiates to vacuum space. However, in the actual outburst process, it means high pressure gas to the atmosphere of mining space radiation. Hence, to test process the initial speed of methane emission, radiation space pressure is set to atmospheric pressure and air pressure is set to a minimum outburst pressure 0.74 Mpa, making the test environment and actual outburst remain consistent; this is of explicit index physical significance.

Through more than to mining coal samples experimental analysis of the initial speed of methane emission, found at it following formula (61.8):

$$V = D_1 t^{-a} \quad (61.8)$$

Formula V —radiation time.

D_1 —the initial speed of methane emission at 1s.

t —time.

a —attenuation coefficient

61.5 Conclusions

The above analysis draws the following conclusions: the room temperature change affects the initial speed of methane emission BP In this kind of situation the room temperature rises and the initial speed of methane emission BP becomes lower. In the measurement of BP we should maintain the room environmental temperature, prevent room temperature changes from affecting the accuracy of BP , and especially avoid severe winter room temperature changes that can be dangerous.

“Coal And Gas Outburst Mine Identification of Norms” (in 2006) and “Coal And Gas Outburst Prevention Rules” (in 2009), the two national level norms show the importance of the initial speed of methane emission. Its critical value is 10. When $BP \geq 10$, the coal seam has outburst danger; when $BP < 10$, the coal seam has not the outburst danger. Now Gui Zhou, chong qing, fu Shun, temperature and air pressure each are not identical, if the critical value is 10, it will produce deviation, which is of inconvenience to outburst work. Thus the use of indicators should be based on the local temperature and atmospheric pressure to do appropriate adjustments.

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Chapter 62

Discrete Construction of Network Verona Diagram for Lines

Qing hong Zhang, Yi li Tan and Xin Liu

Abstract A new kind of extended Network Verona Diagram is proposed to deal with the condition that generators are Lines. In a network, it is difficult to construct a Network Verona Diagram for Lines because of the complicated conditions. In this paper, a practical discrete construct algorithm is proposed by locating special points and computing the shortest path between generators and points in a network. The application example shows that the algorithm is both simple and useful, and is of high potential value in practice.

Keywords Network verona diagram · Discrete · Network verona diagram for lines

62.1 Introduction

As a branch of Computational Geometry, the Verona diagram has been developed on account of the development of theory and the need of application. We have already noted that the concept of the Verona diagram is used extensively in a variety of disciplines and has independent roots in many of them. Verona diagrams have appeared in meteorology, biology, and so on [1–3]. The Network Verona Diagram is an important concept and it is useful to investigate dominance regions in a grid street system or a radial-circular street system. In many actual conditions however [4, 5] I, the generators we considered, such as railway or seismic belt, etc., are not points but figures. For that reason, a new kind of extended Network

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Verona Diagram is proposed to deal with the condition when generators are Lines. We use a practical discrete algorithm to construct Network Verona Diagram for Lines by locating special points and computing the shortest path between generators and points in a network. Finally, we offer a specific example, which has proved to be satisfactory by experiment.

62.2 Definitions

62.2.1 Definition 1 (A Planar Ordinary Verona Diagram)

Given a finite number of distinct points in the Euclidean plane [6] $P = \{p_1, p_2, \dots, p_n\} \subset R^2$, where $2 < n < + \infty, x_i \neq x_j$, for $i \neq j, i, j \in I_n$.

We call the region given by

$$V(p_i) = \{x \mid \|x - x_i\| \leq \|x - x_j\| \text{ for } j \neq i, j \in I_n\} \tag{62.1}$$

The planar ordinary Verona polygon associated with p_i , and the set given by

$$V = \{V(p_1), V(p_2), \dots, V(p_n)\} \tag{62.2}$$

The planar ordinary generated by p (or the Verona diagram of p). We call p_i of $V(p_i)$ the generator point or generator of the Verona, and the set.

$P = \{p_1, p_2, \dots, p_n\}$ The generator set of the Verona diagram (in the literature, a generator point is sometimes referred to as a site), as shown in Fig. 62.1.

62.2.2 Definition 2 (Network Verona Diagram)

A Network Verona Diagram is a special kind of Verona diagram constructed on spatial networks [7, 8]. The decomposition is based on the connection between the discrete objects rather than the Euclidean distance. In the Network Verona Diagram, the Verona polygon changes to a set of road segments termed Network

Fig. 62.1 Planar ordinary Verona diagram with 13 points in the plane, which are generators

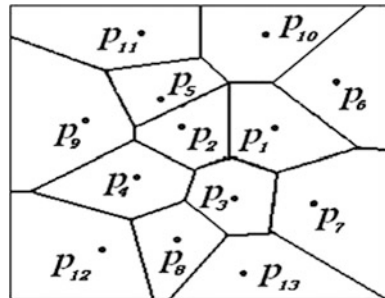
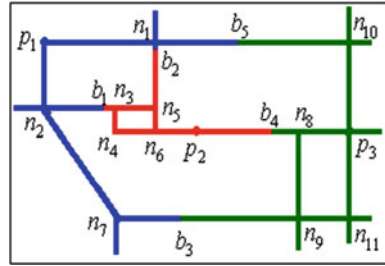


Fig. 62.2 Network Verona Diagram



Verona polygon, and the edges of the polygons also shrink to some midpoints, termed border points, of the road network connection between two objects of interest (Fig. 62.2). An order-2 Verona diagram in which the region with symbol $\{i, j\}$ indicates the order-2 Verona polygon of $\{p_i, p_j\}$.

Figure 62.2 shows an example of Network Verona Diagram. Besides the objects of interest (p), a Network Verona Diagram also includes some road network intersections (n) and border points (b). According to the properties of a Verona diagram, the border points to a pair of adjacent objects are equidistant, e.g., $d(b_7, p_1) = d(b_7, p_3)$

62.2.3 Definition 3 (Verona Diagram for a Set of Points and Straight Line Segments)

We assume that a generator L_i is a point, a straight line segment, or a chain of straight line segments [8–10]. We also assume that a straight line segment L_i contains both end points under these assumptions the shortest distance between p and a straight line segment L_i , i.e.,

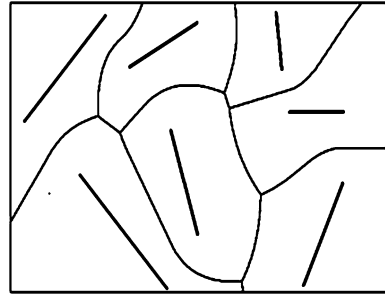
$$d_s(p, L_i) = \begin{cases} \|x - x_{i1}\| \\ \|x - x_{i2}\| \\ \left\| \left(x - x_{i1} \right) - \frac{(x - x_{i1})^T (x_{i2} - x_{i1})}{\|x_{i2} - x_{i1}\|} (x_{i2} - x_{i1}) \right\| \end{cases} \quad (62.3)$$

where x_{i1} and x_{i2} are the end points of L_i ,

$$\text{And } R_{i1} = \{x | (x_{i2} - x_{i1})^T (x - x_{i1}) < 0\}, R_{i2} = \{x | (x_{i1} - x_{i2})^T (x - x_{i2}) < 0\}$$

(A line Verona diagram generated by a set comprises seven straight lines (Fig. 62.3).

Fig. 62.3 A line Verona diagram



62.3 Network Verona Diagram for Lines and Construction

62.3.1 Definition 4 (Network Verona Diagram for Lines)

A Network Verona Diagram for Lines is also a special kind of Verona diagram constructed on spatial networks. In the Network Verona Diagram for Lines, generator points are straight line segments instead of crisp points. We use network distance between a point and a line in place of Euclidean distance. Here, the distance between a point and a line in network is the difference in Euclidean space because the shortest distance between a point and a straight line segment appears only at the points and endpoints of straight lines or nodes of network. The distance between a point and a line in a network, in a sense, is the shortest distance between a point and one of two endpoints of the straight line.

Figure 62.4 shows an example of Network Verona Diagram for Lines. The set of generators is $\{L_1, L_2, L_3\}$ which is denoted by full lines. The dotted lines are the Network Verona Diagram for Lines region generated by the generator which has the similar color.

62.3.2 Outline of Discrete Algorithm

Suppose that there are n generators (section of lines) in the Euclidean plane, and we have to construct a Network Verona Diagram for Lines. First, we assign

Fig. 62.4 Network Verona Diagram for lines

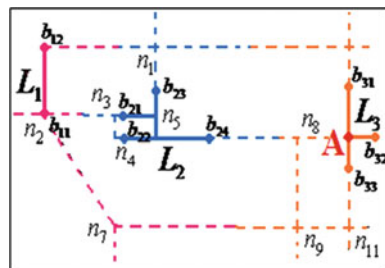
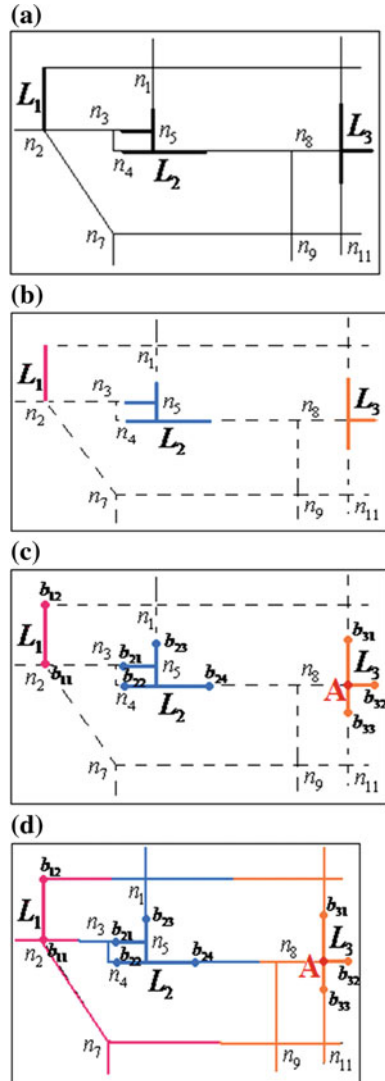


Fig. 62. 5 Discrete production process of a power network diagram with three generator points, **a** L_1, L_2, L_3 are three generators, **b** assigns different colors for different generator points, **c** takes generator points as the center and draws circles, **d** Network Verona Diagram for Lines



different colors for different generators, and black color for the network. Then we take generator points as the centre and draw circles, spreading out from the different points according to the different directions of the network. Unlike the discrete algorithm of planar ordinary Verona diagram, we only need to consider four points around generator point: the upper, lower, the left, and the right, and only need to consider those points on road segments. That is to say, we only assign color for a point with black color. This will greatly improve the efficiency of construction. The procedure ends when all points with black color on screen are marked color. Thus, we get the Network Verona Diagram for Lines.

62.4 Practical Application

Now we take three generators as examples, and construct Network Verona Diagram for Lines using discrete algorithm. L_1, L_2, L_3 are three generators.

Figure 62.5b–d shows us the generation of process. First, we assign different colors for different generators (pink for L_1 , blue for L_2 , yellow for L_3), and black for network. Here, the network is represented as dotted lines. Then

Special points are marked off, which is shown as in Fig. 62.5a. (b_{ij} is the j the endpoint of the generator L_i , A is the point of intersection of generator and network).

Then take generator points as the center and draw circles, spreading out from the different points according to the different directions of the network. (See Fig. 62.5d.) Finally, we get the Network Verona Diagram for Lines (Fig. 62.5d).

62.5 Conclusions

The Network Verona Diagram for Lines is useful when we deal with the condition when generators are Lines. In a network, it is difficult to construct a Network Verona Diagram for Lines. The discrete construction of Network Verona Diagram for Lines need not consider the situation of network distribution. Thus, it has a unique advantage in the construction of Network Verona Diagram for Lines, and the example proves that it is of high potential value in practice.

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Chapter 63

Financial Risk Early Warning Model

Hong Wang, Jun Zheng, Lu Yang Gao and Hui Wang

Abstract With college expansion, merging schools, and building university towns, the situation has worsened so much that university funds cannot make ends meet. Analyzing the causes of financial risk using the method of discriminate analysis, establishing early warning model, and taking effective preventive measures have become the most important financial tasks in the university. The author believes that to strengthen the university financial risk, early warning and prevention is a prerequisite to ensure the comprehensive strength, financial operating performance, and financial development potential of university financial, conducive to improving and strengthening the macro-financial management. It is also very necessary and effective to ensure a healthy teaching order and orderly development. For the development of education and financial balance, it plays a very important role. Especially with the reform and development of education in China, the number of colleges and universities have continued to increase, and the financial management of universities faces a complex situation.

Keywords University financial · Risk · Warning · The method of discriminate analysis

63.1 Introduction

With an increasing number of China's education reforms and development of institutions of higher learning, school expansion, colleges and universities within the professional setting, enrollment plan, graduation assignments, and logistics management have undergone profound changes [1–3]. The process of running the

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economic behavior tends to be diversified; the financial management of the school is facing a more complex situation [4]. Colleges and universities as independent non-profit organizations, under the national macro-control, for the community, engaging in all financial activities, have a certain autonomy in raising funds for schools and using the funds for education [5, 6]. The university financial management has changed from no risk management under conditions of planned economy to risk management in market economy conditions. Practice has proved that the reform in the university management system provides the conditions to raise funds through various channels for colleges, promoting the development of higher education [7, 8]. However, for colleges and universities as non-profit institutions, in many cases the income of the school organization is difficult to offset increasing expenditures. Therefore, there is a sudden increase in financial risks. How to understand and actively prevent financial risks to ensure the university health, stability, sustainable development is an urgent need for study and to solve the problem..

63.2 Concepts and Features of University Financial Risk

The theory community of financial risk still lacks a unified and clear definition. Generally, we believe that financial risk refers to uncertainty of the economic activity subject to using monetary funds to repay maturing debts. Higher financial risk is the risk of colleges and universities in the development process, where the likelihood and consequences of some adverse events caused by the funds movement or loss occurs. Colleges and universities have a similar place in the financial risks faced by non-profit institutions. Objectivity and randomness of both the existence of financial risk, but also the existence of college finances have their own unique characteristics: first, there is a strong policy in financing; second, expenses are not compensatory; third, the products are not profitable; fourth, lack of regenerative capacity in capital flow.

Therefore, analysis of financial risks cannot be applied; reflecting the enterprise financial risk indicators, we must select the characteristics evaluation to reflect colleges and universities risk.

With regard to the actual situation of the college financial activities and financial management, there are three aspects in the campaign funds of colleges and universities, financing activities, investing activities, and daily operational activities.

63.3 Types and Causes of University Financial Risks

63.3.1 Financing for Liabilities Risk

The risk of liability refers to colleges and universities having over-debt or bad debt from banks and other financial institutions, which form the possibility of adverse

outcomes because of the impact on education and teaching and personnel stability. The so-called over-debt means the loan amount over the repayment ability of the borrowing behavior. Bad debt refers to borrowing behavior to maintain the daily operation of the borrowing behavior.

With expanding enrolment from 1999, the rapid development of colleges and universities and the number of students has doubled, and huge construction investment for the new campus, especially since 2001 “Silver school cooperation” in the National University being implemented quickly, has made the size of loans in colleges and universities to constantly expand. The Ministry of Education, “2006 Social Situation Analysis and Prediction,” Social Blue Book has said, China’s college and university bank loans in 2006 totals about 200 billion, for general institutions liabilities are 1–2 million, and Individual institutions’ liabilities are up to more than 10 billion. Excessive debt has significantly increased the payment of interest, the gradual deterioration of the financial structure, and the university’s credit rating and social influence has decreased. There is a serious impact on the university’s own stability and development. The reasons lie in the following areas:

1. The lack of risk awareness and sense of responsibility. With the reform of the university management system, colleges and universities have more independent powers, but this also carries risks for the university. However, many university managers are not fully aware of this, on the one hand, and many universities still are strongly dependent on government funds for school loans. The government “pay” idea which is still prevalent passes the risk of the loans on to the Government. The principals of some colleges and universities, in order to implement the tenure system, can easily form a short-term behavior for the poor sense of responsibility for repayment.
2. The lack of effective lending behavior or a restrictive mechanism. For a long time the management of higher education in China has been a higher administrative department-based longitudinal management for colleges and universities which is also the subsidiary body of higher authorities. Although the education department is in charge of the overall macro-control of the financial operations of the university, it lacks effective regulatory measures. In July 2004 the Ministries of Education and Finance jointly issued the “Opinions on Further Improvement of the economic responsibility system, strengthen the management of bank loans, and effectively guard against financial risks”, and developed a “Colleges and universities bank line of credit control and risk assessment control model” and other rules and regulations. However, only to a certain degree has this standardized the management of subordinate loan institutions; loan management of provincial institutions still lack stringent requirements and effective supervision. At the same time, the education authorities still lack effective management of college loans assessment and monitoring. In addition, there is a lack of a clear system for the accountability of university administrators.

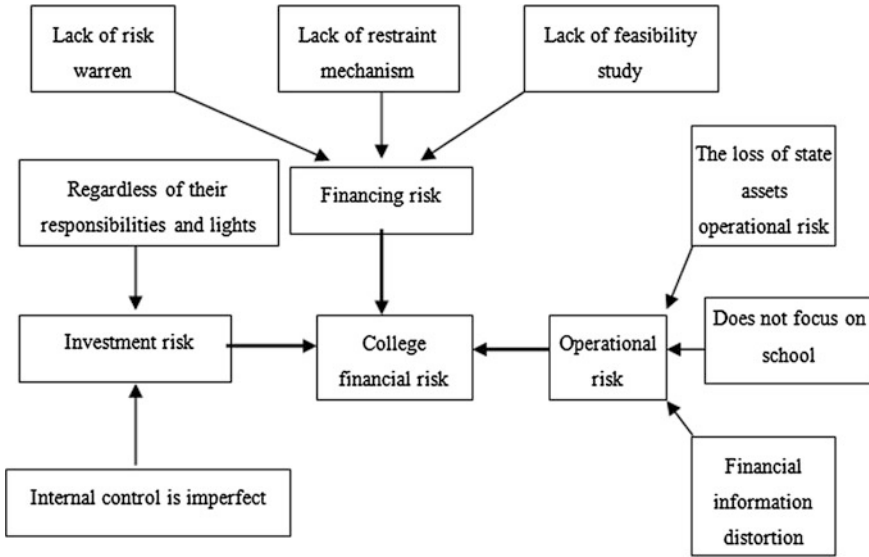


Fig. 63.1 Types of university financial risks

3. There is a lack of a scientifically feasible study on loan programs for colleges and universities debt investment for school expansion and improving the operating efficiency. Huge amounts of loan funds are generally used for infrastructure construction purposes. However, universities often lack rigorous scientific proof at the school level and scale of development, its own conditions for running and long-term economic environment changes. Overestimation of repayment capacity and unrealistic repayment plans result in blind decision-making investments and constitute debt risks (Fig. 63.1).

63.3.2 Investment Risk

College investment, including inward investment and foreign investment, is the risk of investment in gold caused by the policy mistakes of the investment projects that are unable to be recycled or that are investment failures. “The university financial system” allows universities to use monetary funds, material objects, and intangible assets to invest in the run industry and other units. Although this can lead to appreciation in universities’ idle capital, there is also the possibility of loss of university resources due to poor decisions or moral hazards.

College inward investment is mainly used to run industry. Schools as major investors are the primary responsibility for the development of school-run

industries. At the same time, they should bear the financial risk of the investment share of school-run industry. Thus, it affects the financial position of the university and forms the university financial risk. The main reasons for the risk are: (1) unclear property rights; regardless of responsibility, most universities-run industries are responsible for the appointment of the company personnel, from investment decisions to the operating means to intervene. Although the person responsible is a legal personality, for various reasons he cannot bear the corresponding civil liability. The run industry's financial risk is often borne by the colleges and universities. (2) Due to the absence of owners and being unregulated, the school-enterprise accounting system is not perfect, inadequate internal controls, audit and supervision are not in place; the operator has no strong sense of responsibility, resulting in poor management and industry-run financial risks.

Foreign investment, mainly universities directly involved in investment in social projects, is divided into investment and financial investment (production).

63.3.3 Operational Risk

Operational risk in colleges and universities in the process of running is due to poor operation and management causing imbalance in the financial situation. The main reasons for operational risk are:

1. The risk of loss of state assets, as the consciousness of property rights, poor daily management resulting in unclear family property, so that blind investment, redundant construction, formation of loss of state assets result in great waste;
2. Developing cost for students' estimation not allowed, poor awareness of school effectiveness, which results in more enrollments and greater deficit.
3. Socialization of logistics reform is not complete, schools still need to continue investment, bring financial burden onto the school.
4. Management of teaching quality risk, in the enrollment of the environment, schools' teaching hardware and software are poor, a lot of work lack performance management mechanisms, resulting in teaching quality decline, student employment difficulties, lead to decreased school reputation, lack of students, resulting in the school economic decline, or are even forced to close.
5. The risk of financial information distortion. Due to the lack of current university financial accounting system, financial management system needs further improvement resulting in the university financial information cannot totally reflect the real financial situation that may result in wrong decisions, resulting in financial risk.

63.4 Model Building of University Financial Risk Prevention and Early Warning

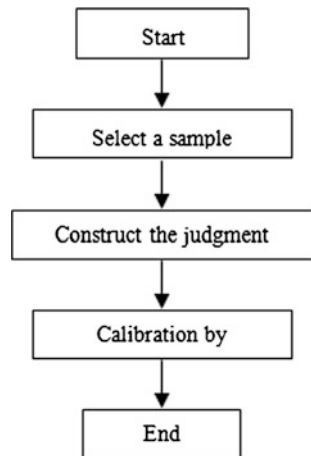
In the process of forecasting risk, the most important thing is the choice prediction model. The following focuses on the economic forecasts commonly used in discriminate analysis method, stepwise regression analysis model, partial least squares regression analysis model, BP neural network model and combination forecasting model, but also has its own advantages and disadvantages, there not one by one introduction. Using discriminate analysis method to establish a flow figure of the prediction model as in Fig. 63.2.

63.4.1 Discriminate Analysis Method

Discriminate analysis based on the nature of the known things (independent variable), to establish the function of a linear combination of independent variables that is discriminate function. On this basis, to judge unknown category of new things and it is classified a known category. Discriminate analysis should make use of some technology to create a function expression, and accordingly classified and discriminate analysis to new things. The discriminate analysis has two overall discriminate points and more overall discriminate. Two overall discriminate analyses are to discrimination a sample belongs to which of the known population. More overall discriminate analysis is to distinguish a sample should belong to which of the multiple population.

Mathematical description of discriminate analysis is: there are k overall G_1, G_2, \dots and G_k , and the corresponding distribution function $F_1(x), F_2(x), \dots, F_k(x)$, for each function are m -dimensional the distribution function, each function is m -

Fig. 63.2 The prediction model



dimensional distribution function, newly observing the number features of the new sample x , and judging whether this sample from which overall. Using discriminate function group expression as:

$$\begin{cases} c_{i1} = a_{01} + a_{11}x_{i1} + \dots + a_{m1}x_{im} \\ c_{i2} = a_{02} + a_{12}x_{i1} + \dots + a_{m2}x_{im} \\ \dots \\ c_{in} = a_{0n} + a_{1n}x_{i1} + \dots + a_{mn}x_{im} \end{cases} \quad (63.1)$$

The formula: n number of discriminate function, its value is which is smaller between a known number of categories or groups -1 and the numbers of independent variables.

63.4.2 Multiple Discriminate Analysis Method Introduced

Research in the field of social, economic, management, people often make a judgment on the attribution of a particular object of study. In economics, for example, per capita income, per capita consumption level, per capita housing area and other indicators to determine the type of a country's level of economic development; in archeology, archaeologists uncovered human skulls width and other characteristics to determine whether it is male or female. Examples of this abound, which are related to the multiple discriminate analysis.

Multiple discriminate analysis (MDA), a branch of multivariate statistical mathematics, it is known classification of measured data, the minimum false positive rate when the observed sample classification according to the criterion of discriminate function model to derive the discriminate function, and differentiate the samples of unknown classification should be what kind of a statistical method. The use of the more common methods include: the distance criterion, Bayesian discriminate method, Fisher Discriminate method. These methods are widely used in the field of marine science, medicine and artificial intelligence. In effect, the prestigious Z-Score scoring model is to use this method. Because the purpose of this study as well as my level of restrictions, this article select Fisher discriminate method for multi-overall discriminate analysis to carry out research on college financial risk early warning model. Fisher discriminate function expression:

Discriminate function as follows:

$$F(x) = x'(w_1 + w_2) - 1(x_1 - x_2) \quad (63.2)$$

The basic ideas of multiple overall Fisher discriminate:

To k overall number $G_1, G_2 \dots$ and G_k , we assume that they have the same covariance matrix sigma, $\mu_1, \mu_2 \dots$ and μ_k , respectively for the mean of overall G_1 ,

$G_2 \dots$ and G_k , everyone in general contain p samples, any given sample point x , to distinguish x belongs to which a general, so that the linear discriminate function of x :

$$F(x) = b^T x = b_1 x_1 + b_2 x_2 + \dots + b_p x_p \quad (63.3)$$

Fisher discriminate method is to find a linear function $F(x)$ by p variables, each an overall function of the sample point value as close as possible, try to alienate the function value between the other overall. The same with the two general situations, we need to calculate b , making the

$$\Delta(b) = \frac{b^T B b}{b^T \sum b} \quad (63.4)$$

Reaches a maximum:

The main advantage of the Fisher discriminate is on require of the overall distribution types, only requires the second-order matrix exists on the overall distribution of types. The disadvantage is that due to the variable between the correlation and multiple linear function variables may be multicollinearity, leading all the discriminate function generated by the relatively high discrimination efficiency may not necessarily low false positive rate. Only in sample of a multivariate normal distribution, and covariance and the mean vectors, covariance, a priori probability, the cost of misclassification is known, the rate of Fisher discriminate function expectations misjudge may minimize.

63.4.3 Combination Forecasting Model

In predicting the actual economic problems, people usually cannot determine in advance which forecasting method is the best. Because the applicable conditions to each prediction method are different, prediction is difficult to accurately determine the applicable conditions. Each forecasting method has its unique information characteristics from different angles to reflect the future circumstances. Giving up a forecasting method most likely to make valuable economic information resources cannot be fully utilized. From predict reliability and risk points of view, using only a single prediction model to predict the complex economic system is not feasible, as much as possible with useful information that Bates and Granger proposed for the theory of combination forecasting. A combination forecasting model is different from the above kinds of models; it is not based on historical data modeling, but in making appropriate combinations of the different prediction models, we get a better combined predictive value than any one of the independent predictive values. Combination forecasting model for a class is a prediction method for a combination of weight coefficient, such as the optimal combination forecasting method and variable weight combination forecasting method. The characteristics of these methods is that the combination forecasting model is a linear relationship. A classic nonlinear combination forecasting method is using the artificial network.

63.5 Conclusions

The above-mentioned economic forecasting model in practical applications is for both the difference and intrinsic link, such as the application of any model to predict the need for variable filter needing to predict the results of the correlation coefficient, mean absolute error, average relative error, the prediction model fitted values, and the correlation calculation test. In practical applications, we should select the appropriate model according to the characteristics of the practical problems to predict.

Overall, there are many methods to guard against financial risks; it is not possible to use each method together. In real life, during the estimation and prevention of financial risk, we more rely on the professional judgment of financial managers and accountants. Their smell of risk awareness and risk-sensitive sense plays an enormous impact to discover and estimate the potential risk. Therefore, in the whole process of risk prevention, we should always carry out a “people-oriented” thinking, pay attention to cultivating risks awareness of the university financial officers and thus better analyze and prevent financial risks. From this perspective, the university financial staff continues to improve the financial security awareness and strengthens the sense of responsibility ownership, which is the most important task of financial management.

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Chapter 64

Threshold Calculation and Prediction Methods of Slope Deformation

Chao Chen, De Qing Gan and Zhong Jian Yang

Abstract The exploitation deformation of the slope directly affects the mining production safety and the safety of miners. To determine and predict the slope deformation threshold, the slope deformation and failure law, being influenced by mining activities, is studied using numerical simulation based on finite element strength reduction method and warning threshold of the slope deformation is determined. According to nonintermittent characteristics of mine deformation monitoring, nonintermittent GM (1, 1) model has been adopted to predict the exact value of warning threshold of the slope deformation.

Keywords Threshold predict · Finite element reduction method · Nonintermittent GM (1, 1) model

64.1 Strength Reduction Method

64.1.1 Basic Principle of Finite Element Reduction Method

The first step in application of finite element reduction method is that the strength reduction factor is determined and c and φ of the rock strength indicators are adjusted. Main content of the second step is that stress field, strain field, and displacement field are determined according to finite element numerical method, distribution characteristics of stress field, strain field, and displacement field are analyzed, and then as well as some of the finite element calculation mathematical

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characteristics were discussed [1]. The last, increases the reduction factor, until the program just does not converge until, when the reduction factor is the stability factor.

64.1.2 Strength Reduction of Stability Assessment Criterion

So far the criterion of slope instability is mainly based on the following two comments:

It is according to the convergence of the finite element to judge whether or not the state of instability. First, the nonlinear iteration-time is given as the restrictive condition [2]. When the unbalanced strength is not meeting with the convergence conditions, the slope with a specific reduction factor is instable or failure. And now, the nonlinear iteration-time may be of any value. Some people think that iteration may number more than 500 times, and some think more than 1,000 times [3]. So many scholars believe finite element calculation convergence as the basis for the slope instability option is bigger.

It is according to the connection of displacement and reduction factors of the slope to judge whether or not the state of instability. Sienkiewicz, to propose firstly using the reduction method as slope instability criterion, believes that it is the biggest node displacement as the criterion of slope instability [4]. Before the destruction of the slope instability, reduction factor and the maximum displacement of a node of the rock should be in correspondence to each other. Method B is more explicit physical meaning in the two methods.

64.2 Interval GM (1, 1) Model

It is prerequisite for the Grey forecasting that the model sequence must meet the time interval (distance interval) conditions. And in contrast, there is often a lot of noninterval sequence in the field of practical engineering and technical data for fitting and prediction [5]. So it is very important to predict the modeling for the interval using GM (1, 1) model [6]. The interval sequence modeling also needs many sequence prerequisites that the original situation in the sequence has the trend of negative, monotonicity, and concave or has trend of the negative, monotonicity, and sink [7].

A $I^{(0)}$ for equally spaced sequence

$$I^{(0)} = \left(I^{(0)}(t_1), I^{(0)}(t_2) \dots I^{(0)}(t_n) \right) \quad (64.1)$$

Type, $\Delta t_k = t_k - t_{k-1} \neq \text{const}, k = 2, 3, \dots, n$

So the gap of the type is defined accordingly as follows:

$$l^{(0)}(t_k) + az^{(1)}(t_k) = b \quad (64.2)$$

$$l^{(1)}(t_k) = \sum_{m=1}^k x(0)(t_m) \Delta t_m, \quad z^{(1)}(t_k) = 0.5x^{(1)}(t_k) + 0.5x^{(1)}(t_{k-1}) \quad (64.3)$$

Its primary parameters bag $p_{(1)} = (a, b)$ have matrix as follows in the least square rule:

$$p_1 = [a, b]^T = (B^T B)^{-1} B^T y_N \quad (64.4)$$

$$B = \begin{bmatrix} -z^{(1)}(t_2) & 1 \\ -z^{(1)}(t_3) & 1 \\ \vdots & \vdots \\ -z^{(1)}(t_n) & 1 \end{bmatrix}, \quad y_N = \begin{bmatrix} l^{(0)}(t_2) \\ l^{(0)}(t_3) \\ \vdots \\ l^{(0)}(t_4) \end{bmatrix} \quad (64.5)$$

Alb for the expression

$$a = \frac{CD - (n-1)E}{(n-1)F - C^2} \quad (64.6)$$

$$b = \frac{DF - CE}{(n-1)F - C^2}$$

C, D, E, F as secondary parameters, it is

$$C = \sum_{k=2}^n z^{(1)}(t_k), \quad D = \sum_{k=2}^n l^{(0)}(t_k), \quad E = \sum_{k=2}^n z^{(1)}(t_k)l^{(0)}(t_k), \quad F = [z^{(1)}(t_k)]^2$$

The gap of the reactive

$$\hat{l}(t_k) = \left(l^{(0)}(t_1) - \frac{b}{a} \right) e^{-a(t_k-t_1)} + \frac{b}{a} \quad (64.7)$$

$$\hat{l}^{(0)}(t_k) = \frac{\hat{l}(t_k) - \hat{l}^{(1)}(t_{k-1})}{\Delta t_k} \quad (64.8)$$

64.3 Calculation Model of Slope

Elastic-plastic model is used as the calculating model, and four nodes unit is applied. It is divided into 2,313 nodes and 2,076 units and the bottom slope body as a fixed constraint, or so boundary as level constraints, the other as a free constraint. The slope is only considered self-respect and no external load [8].

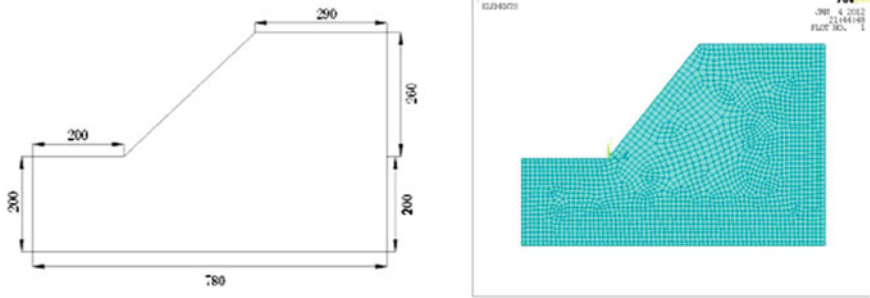


Fig. 64.1 Plate slope design schemes and slope model meshes

The grid schematic diagram is shown in Fig. 64.1. Convergence criteria are displacement and strength and at the same time convergence, strength, and displacement allow limitations of 0.005 and 0.05, respectively, maximum iterating times for 100 times.

64.4 Slope Deformation Law and Threshold Confirmed

64.4.1 Law of Slope Deformation Analysis

From the displacement of the slope cloud in Fig. 64.2, it is seen that displacement is becoming smaller from the top to the slope toe, and the actual observation data of change law is consistent, and raw displacement also produces change as the reduction of the coefficient increases; when reduction coefficient is 1.6, mutational displacements occur, until the slope gets totally destroyed.

64.4.2 Slope Instability Criterion Analysis

A. The first criteria, is the convergence criteria. It is used a symbol as no convergence displacement as overall destruction slope.

Based on ANSYS own D-P standard, the internal friction angle of rock mass and stick together strength reduction are calculated according to the principle of finite element reduction, and then gradually reduction coefficient is increased until slope destruction [9].

The initial reduction coefficient is 1. The material properties in the model are defined and calculated. The calculation convergence explains slope stability. Also, reduction coefficient increases gradually according to calculated unit of 0.1. When reduction coefficient is 1.6, the slope is believed to converge, and when reduction coefficient is 1.7, the displacement convergence slope fails, and then in value

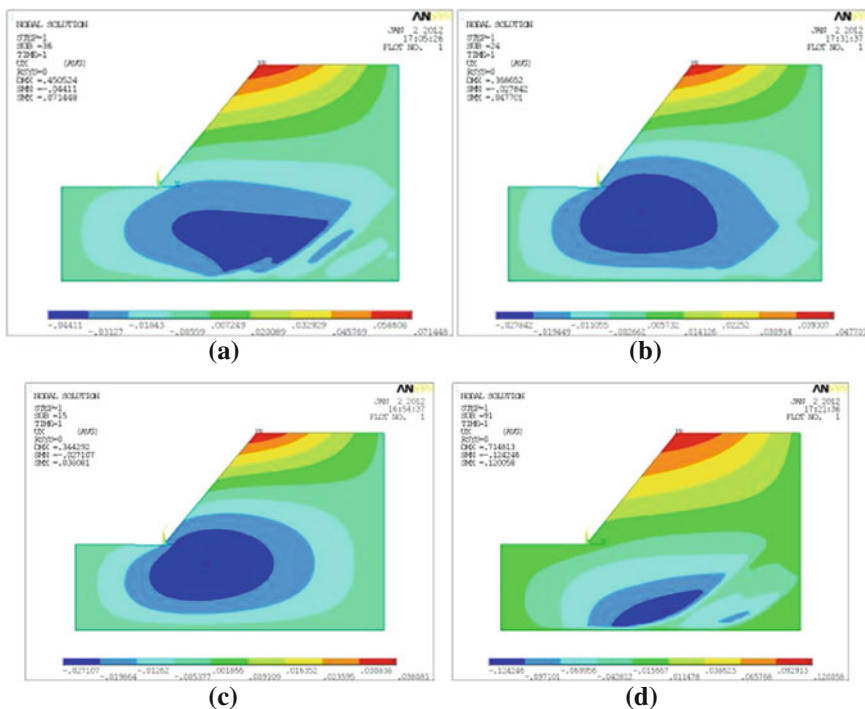


Fig. 64.2 X-direction displacement contours to the different reduction factors. **a** $F = 1.0$. **b** $F = 1.3$. **c** $F = 1.6$. **d** $F = 1.7$

between 1.6 and 1.7, found that when reduction coefficient is 1.65 and are already not convergence, therefore, the slope safety coefficient is 1.65.

B. Another criterion, mutation some criterion [10]. Mine slope has the sign of damage for X direction displacement mutations, when reduction coefficient is 1.6, the slope displacement occurred at slope into mutations buckling critical state [11].

It is based on the maximum displacement change point, top point, slope toe point, and slope at any point within the experimental analysis as a point, respectively. Data is shown in Table 64.1.

On the analysis of the data in the table, establishment of reduction coefficient for the abscissa denotes to each point X direction displacement value for Y-coordinate of drawings, analysis with the destruction of the slope displacement variation process.

Then conclusion is determined.

With the reduction factor increases the displacement of each point are changed as the similar trend line [11]. The relationship of the reduction factors and the largest displacement are implied in Figs. 64.3 and 64.4. When reduction factor increases to 1.6, displacement suddenly increases severely, and the slope is

Table 64.1 Different reduction coefficients corresponding to each point X direction displacement

Reduction coefficient t	Maximum displacement (mm)	Top displacement (mm)	Slope toe displacement (mm)	Slope at any point (mm)
1.0	38.081	30.838	19.864	23.595
1.2	38.081	30.838	19.864	23.595
1.3	47.701	39.307	19.449	30.914
1.4	56.286	46.809	19.535	37.331
1.5	66.697	54.621	17.848	42.545
1.6	71.448	58.608	18.434	45.769
1.65	92.393	71.718	18.837	63.665
1.7	120.058	92.913	19.634	65.768

Fig. 64.3 Maximal displacement point deformation

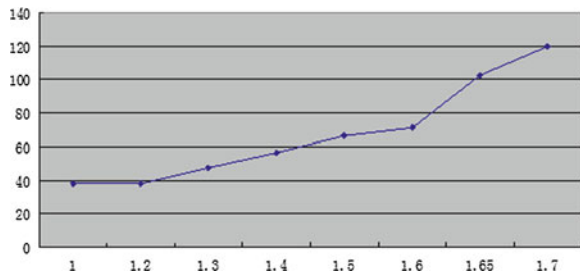
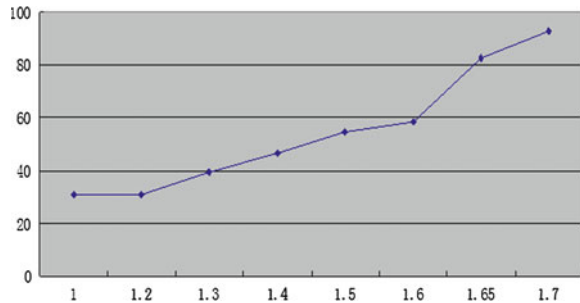


Fig. 64.4 Top point displacement curve



buckling critical state, slope already destroyed, so safety coefficient is 1.6. It did not appear abrupt change point in the Figs. 64.5 and 64.6. When the reduction factor increases, displacement value does not have a lot of changes; the maximum displacement point mutations appear, slope toe point displacement is still not significant change. The point is not that slope toe a special case points, with the second point no criterion, is that the second criterion limitations: select one or more points as a special point, through these point mutations to judge whether there is instability or not [12]. It is because of the difficulty of narratology and uncertainty, many scholars often with the maximum displacement point as the most reliable criterion point.

Fig. 64.5 Slope toe point displacement curve

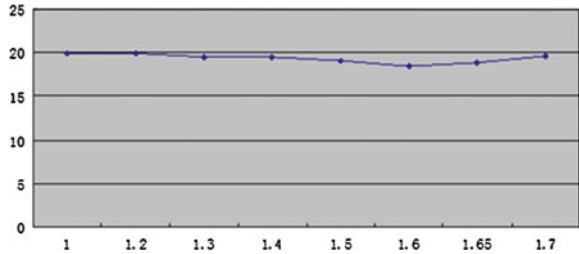
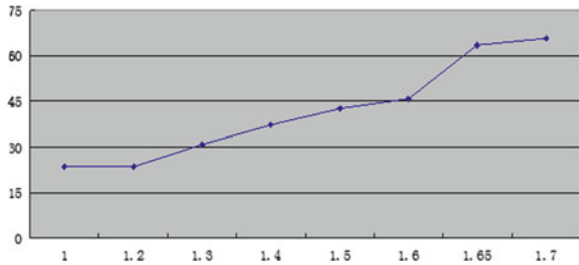


Fig. 64.6 Any point displacement curve



64.4.3 Determination of Slope Threshold

When four selection points in reduction coefficient is 1.6 and displacement mutations occurred, reduction factor 1.6 is actually a turning point. After the reduction factor of 1.6, the displacement mutations happen because it entered the second phase of the rock mass elastic-plastic. When slope undergoes greater elastic-plastic changes, displacement continues to produce relatively small changes until the slope elastoplasticity is completely destroyed. Reduction factor of 1.6 corresponding to the maximum displacement values can be seen as an early warning value, although not a real elastoplastic destruction point, the slope is near the state of destruction.

Combined with the above instability criterion and the displacement of the slope of the corresponding point mutations, the maximum displacement value can be seen as slope deformation of the threshold.

64.5 Xing Shan Iron Mine Slope Threshold Prediction Based on Gray Theory

Slope deformation value is determined by receiving different times of the amount of displacement. According to the Xing Shan slope observational data, a gray model is established to describe the process of gray Xing Shan slope deformation predicting.

Table 64.2 Displacement prediction table of E direction of G2 point

Periods	Time (days)	E measured (m)	Predicted (mm)	Accumulative deformation value (mm)	Predicted accumulated deformation (mm)
10	58	503641.4337		13.5	
11	69	503641.4351	503641.4339	14.9	13.7
12	81	503641.4368	503641.4358	16.6	15.6
13	92	503641.4387	503641.4381	18.5	17.9
14	113	503641.4420	503641.4419	21.8	21.9
15	139	503641.4453	503641.4464	25.1	26.2
16	196	503641.4518	503641.4539	31.6	33.7
17	254	503641.4590	503641.4575	38.8	37.3
18	296	503641.4545	503641.4527	44.3	41.5
19	345		503641.4585		47.3
20	390		503641.4633		52.1
21	451		503641.4698		58.6

With 10–18 issues of the monitoring data, gray prediction model is constructed. Displacement larger G2, for example, after the slope threshold to predict the direction of the *E*, G2 is at the top of the hill region. As Table 64.2, when the maximum point of the mutation point displacement values reached 71.448 mm, corresponding displacement of the top of the hill point is 58.608 mm. The top of the deformation warning is 58.608 mm, the following use of noninterval GM (1, 1) series model to predict the deformation threshold G2 instead of the value of slope failure warning. So the interval GM (1, 1) model of the G2 point sequence deformation threshold prediction replaced slope failure warning value.

Take the interval GM (1, 1) model also is the sequence's length sequence for nine prediction model of predicted.

It is predicted that the slope of the three stages in future, respectively, is 58, 100 and 164 days. In the practical slope engineering of the data to 19, the open pit has closed down. The prediction data of slope deformation are researched and analyzed from Table 64.2, which is gradually increasing process, the actual displacement cumulative value reached 44.3 mm, and prediction of 41.5 mm. Though there is 2.8 mm error, it has been more approaches to the real value. This can explain why the interval GM (1, 1) can be used to predict the middle slope; this reduction coefficient method combined with the safety factor of the evaluation can think not only the temporarily slope safety production but also the consistent development status; when 164 days or so, deformation cumulative has reached closer to 58.608 mm warning point.

64.6 Conclusion

The judgment of stability factor, both criterions are almost in consistent, but there is a tiny gap. Mutations' corresponding to the reduction factor are not necessarily precisely the final reduction factors, and not every point can be used as a mutation criterion point, generally the maximum displacement point is more reliable. Mutation point in the form is not the same displacement or abruptly or suddenly smaller, but in either case, the mutation point corresponds to the maximum displacement as a deformation threshold of reliability, but also gives forecasting more physical meaning.

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Chapter 65

Shanghai World Expo Influential Quantitative Assessment Model

Ran-Wang Jin, Jun-Guo Ya, Jie-Geng Shu and Juan Zhao Tong

Abstract To assess the influence of tourism on the Shanghai World Expo, this paper selected evaluation quota, used Excel software to draw data charts and set up the appropriate function model according to the background theory of trendline data interpolation. It used the Matlab software to get fitting curve and to determine the relevant parameters established for the background trendline model of the Shanghai tourism and the tourism development of Expo influence and background values for comparison of the World Expo; finally it shows the model solving, analysis, and evaluation.

Keywords World expo · Tourism · Background trend line model · Curve fitting

65.1 Introduction

The 2010 Shanghai World Expo was successfully held in China. It had a positive role to accelerate the building and construction of the international metropolis of international economic, financial, trade, and shipping center. The World Expo is organized by countries and cities having an impact on Fair Economy. The Expo

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economy has an economic activity; in order to study it, it cannot be separated from the costs and benefits of the Expo; but how to reduce costs, improve efficiency, expand the positive impact of the Expo on the economy, and reduce its negative effects to achieve an organized sustainable urban economy development needs to be studied and so are of important practical significance.

65.2 Model and Solution

65.2.1 Model Assumptions and Symbols Provisions

The data are true reflections of the situation of tourism in Shanghai [1]; the development of tourism reflects the factors selected which are reasonable; the bottom trendline established from other factors under the influence of the growth of tourism is correctly reflected [2, 3]; The World Expo impact on the tourism industry is limited to economic incremental impact on tourist arrivals and tourism receipts; ignoring all types of emergencies without considering the various types of systematic errors.

Y_0 : The starting point of straight line interpolation; Y_n : The end point of straight line interpolation; Y_i : The data of i year; i : i year; Y'_i : The data of i year by the interpolation values; R^2 : Goodness of fit; gr : The number of domestic Shanghai Tourism; gs : Domestic income; jw : The number of outbound tourism; wh : Tourism foreign exchange earnings.

65.2.2 Model Establish and Solution

65.2.2.1 Data Collection and Processing

Using Excel and Matlab software to predict and compare with each other to prove the background trendline, and then stripping out the impact of the Shanghai World Expo. Determining impact indicators: the number of domestic tourism, domestic tourism revenue, tourist arrivals, and foreign exchange earnings. Analysis period: 1998–2009.

Data interpolation (interpolation of the values called for the interpolated), making the background trendline the most realistic; using the Matlab software statistical analysis tools, linear model, Gaussian model, the triangle model to fit the various indicators, to determine the relevant parameters, the trend of the indicators model equation to calculate the years of background values [4].

According to the Shanghai Statistical Yearbook a related data using the Excel mathematical software for data processing, the Chart Statistics is given in Table 65.1:

Table 65.1 Shanghai tourism data

Years	Domestic tourist arrivals (million)	Internal revenue (million)	International tourist arrivals (million)	Tourism foreign exchange earnings (US \$) (100 million US \$)
1998	7,098	646	152.7	12.45
1999	7,498	719.33	165.68	13.64
2000	7,848	775	181.4	16.13
2001	8,254	805.78	204.26	18.25
2002	8,761	993.82	272.53	22.75
2003	7,603	1,465	319.87	20.53
2004	8,505	1,430	491.92	30.89
2005	9,012	1,452	571.35	36.08
2006	9,684	1,466	605.67	39.61
2007	10,210	1611.3	665.59	47.37
2008	11,000	1612.41	640.57	50.27
2009	12,361	1620.35	639.92	47.96

Table 65.2 Shanghai tourism interpolated data

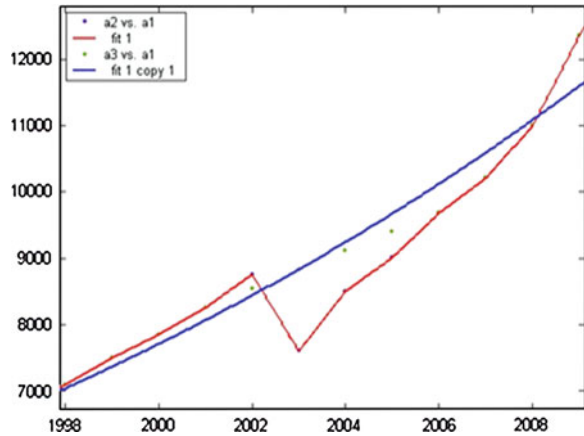
Years	Domestic tourist arrivals (million)	Internal revenue (million)	International tourist arrivals (million)	Tourism foreign exchange earnings(US \$) (100 million US \$)
1998	7,098	646	152.7	12.45
1999	7,498	719.33	165.68	13.64
2000	7,848	775	181.4	16.13
2001	8,254	805.78	204.26	18.25
2002	8,540	1,010	300.15	22.75
2003	8,826	1221.9266	395.95	27.183
2004	9,112	1,430	491.92	31.6163
2005	9,398	1,452	571.35	36.08
2006	9,684	1,466	605.67	39.61
2007	10,210	1611.3	617.0867	47.37
2008	11,000	1612.41	628.5034	50.27
2009	12,361	1620.35	639.92	47.96

Using $d = \frac{Y_n - Y_0}{T_n - T_0}$, $Y'_i = Y_i + d(Y_i - Y_0)$, by interpolation of the data in Table 65.1, get data of Table 65.2.

65.2.2.2 Establish Model of Background Trend Line

Using interpolated data, make a trendline charts with Matlab software to fit, find the most reasonable background trendline; curve fitting based on least squares method to determine the specific parameters to determine the equation [5–7].

Fig. 65.1 Domestic tourist arrivals



65.2.2.3 Model of Domestic Shanghai Tourist Arrivals

Traffic is the first indicator of the level of tourism development, and the proportion of domestic tourism accounts to be very large, up to ten times. Shanghai reception of domestic tourist arrivals in 1998 amounted to 70.98 million people, grew to 123.61 million passengers in 2009, an increase of 1.714 times in the past 12 years, average annual growth rate of 0.0618. Using Excel software the domestic traffic statistics is shown in Fig. 65.1, the Power model of the dynamic changes in the equation of the bottom line about the number of domestic tourists:

$$gr = 2.806 \times 10^{(-297)} \times t^{91.01}$$

65.2.2.4 Domestic Revenue Model

Using Excel Software statistics, domestic income is presented in Fig. 65.2. Using the Gaussian model, the equation at bottom of the internal revenue’s dynamic changes presented:

$$gs = 1633 \times e^{-((i-2009)/10.52)^2}$$

Similarly, we obtain the number of outside travel and tourism foreign exchange earnings’ curve in Figs. 65.3 and 65.4, and their corresponding dynamic changes in the bottom-line equation:

$$jw = 644 \times e^{-((i-2008)/7.34)^2}$$

$$wh = 53.88 \times e^{-((i-2012)/10.57)^2}$$

Fig. 65.2 Domestic revenue

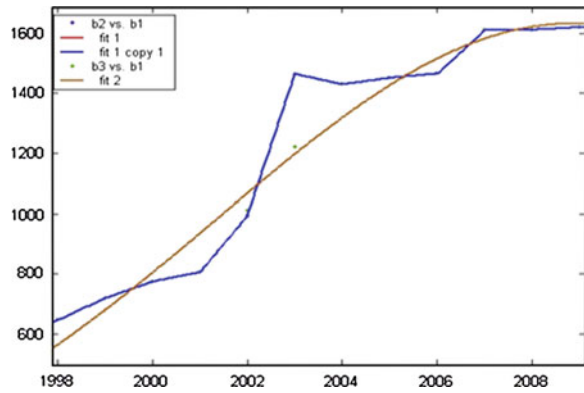


Fig. 65.3 The number of outside tourism

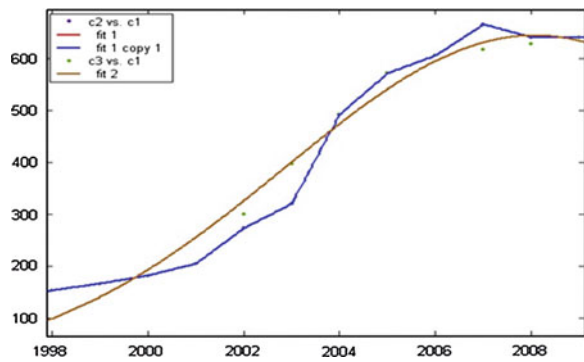
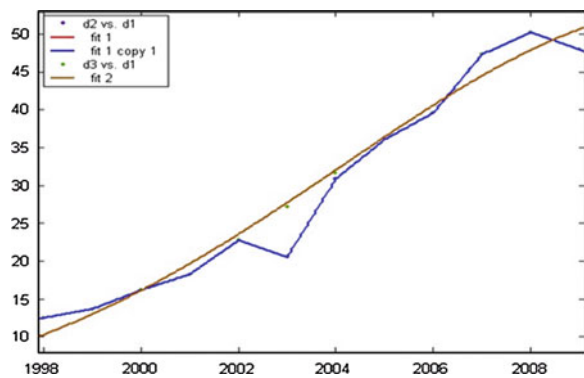


Fig. 65.4 Tourism foreign exchange earnings



65.2.3 Model Analysis

65.2.3.1 The Background Value Prediction

2010–2013 Shanghai tourism Expo under the influence of estimates based on the model equation is solved, the results are shown in Table 65.3.

Expo's official website predicted the four indicator values for 2010 to be 180 million people, 293 billion, 700 million people, and 5.9 billion US\$ as the predictive value of the background and the increase in 2010 to be 52.5, 80.8, 17.1, 13.5 % points. It can be seen that the Expo had a significant impact on tourism; especially domestic tourism revenue has been improved rapidly.

Analysis to know the number of domestic tourists and foreign exchange earnings rose slightly, domestic tourism revenues and tourist arrivals declined slightly, these results may be based on the impact of financial crisis, but reflect the natural tendency of the bottom trendline in the nonmajor event under the influence of law in terms of major events, the nature of an ultraconventional, special factors, the more prominent of the particularities of such a major event for the World Expo. Thus, the bottom trendline model is appropriate to analyze Expo tourism.

Based on 1998–2002 data to estimate the background, no Expo was under the influence of background values in 2003–2009 (Table 65.4).

65.2.3.2 Expo Influential Comparison of the Data Analysis

Using Excel illustration tools, the actual data and value data in the background histogram is obtained [8, 9], see Figs. 65.5–65.8.

Figure 65.5 shows that due to SARS and other reasons, the Expo does not have the number of domestic tourists in 2002–2009 predicts the impact.

Figure 65.6 shows that Internal Revenue, the SARS impact, is with a slow reaction zone, but the actual value is still greater than the background value, indicating the impact of the Expo on domestic income to be greater than the negative impact of SARS as the World Expo national income great. Analysis of the 2008 and 2009 data to know the positive impact of the Expo is less than the negative impact of the financial crisis. Floating value is less than the difference

Table 65.3 The value table under the influence of the World Expo Shanghai tourism

Years	The number of domestic passengers	Internal revenue (million)	International tourist arrivals (million)	Tourism foreign exchange earnings (US\$)
2010	11,800	1,620	597.918	51.9851
2011	12,300	1,580	544.9245	53.3999
2012	12,900	1,510	478.5297	53.88
2013	13,500	1,410	404.9108	53.3999

Table 65.4 The value table without the Expo influence of Shanghai tourism

Years	Domestic tourist arrivals (million)	Domestic income (million)	International tourist arrivals (million)	Foreign exchange earnings (US\$)
2002	8,761	993.82	272.53	22.75
2003	9,213	1065.31	296.35	24.86
2004	9,597	1197.42	361.56	27.61
2005	10,360	1298.82	446.25	30.59
2006	10,783	1423.25	512.98	33.56
2007	11,206	1516.46	586.21	36.82
2008	11,654	1629.36	675.81	39.16
2009	12,506	1713.49	754.09	43.13

Fig. 65.5 The number of domestic passengers

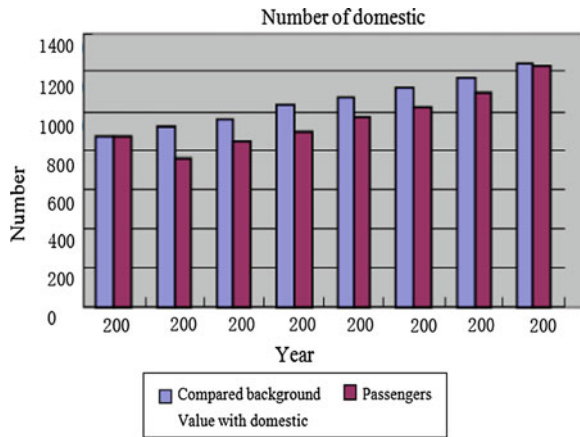
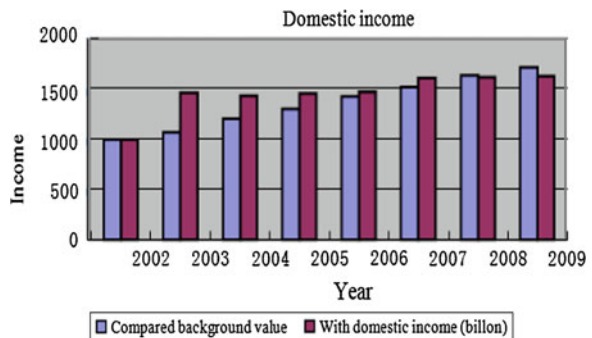


Fig. 65.6 Internal revenue comparison chart



between the SARS and World Expo period; the World Expo national income does have a positive impact.

Figure 65.7 shows that apart from the 2003 foreign exchange earnings, real income is greater than the predictive value of the background, description of the

Fig. 65.7 Foreign exchange earnings comparison chart

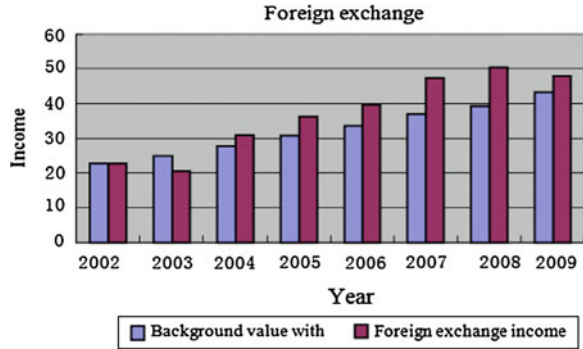
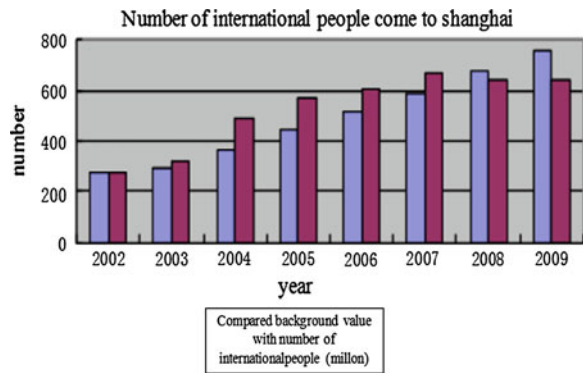


Fig. 65.8 Number of international people to Shanghai



preparations for the World Expo put a great impact on the foreign exchange earnings for the 2009 financial crisis, only to reduce it to microsmall.

Similarly, Fig. 65.8 shows that the Expo has a huge impact on the tourism industry during the financial crisis, may be due to the exchange rate impact, the impact on the tourism industry was slightly cool [10].

65.2.4 Model Results and Evaluation

65.2.4.1 Analysis of the Results

This paper used Matlab software to get fitted curve equations and graphs and in accordance with equations effective estimate income of 2010–2013, see Table 65.3; Factors broadly in line with the Gauss curve and by the chart comparison of Expo under the influence of the actual data, you can visually see the effect or value of the World Expo on various factors in different years. It can be seen that in the Expo the same factors affect the value of the different years and different values of the same year [11].

65.2.4.2 Model Evaluation and Improvement

The model obtained is due to the impact of the Expo, the absolute value of the growth of tourism. Since the 2008 economic crisis the Expo's impact on tourism is weaken, so the model could be improved. For 2008 and 2009 years, according to the relevant data and indicators to determine the impact of the economic crisis, per capita income, quantitative analysis came to tourism industry (select the same indicators); the negative effect to the Expo is the value of the special period of the financial crisis impact on tourism.

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Chapter 66

Analysis and Application of New Shares Based on Decision Tree

Xiu Yan Chang, Xin Yi Zhao and Bao Xing Yue

Abstract The decision tree is a method building on the foundation of information theory, carrying on the classified mining to the data. Its basic thought is to build a decision tree through a batch of known training data, and then to predict data making use of the decision tree. This paper presents the expressing method of decision tree and the algorithm of ID3. The investment method of new shares is proposed by the decision tree. The paper gives a verification implement with some examples. The results indicate that the ID3 algorithm can efficiently be helpful for stocks investment.

Keywords Decision tree · New shares · Entropy

66.1 Introduction

The decision tree is a problem-solving method through graph that lists the steps and conditions and the results of all steps. Making permutation of the instances from the root node to a leaf to classify instances, the leaf node is the category of instance [1–3]. Each node describes a test of certain attributes of instance, and each subsequent branch corresponds to a possible value of that attribute [4, 5]. The origin of the concept of the decision tree is the concept learning system, then to ID3 (Iterative Dichotomies 3) Samples is of the same class C?

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66.2 ID3 Algorithm

ID3 algorithm is a classical learning algorithm of decision tree, proposed in 1979 by Quinlan [6, 7]. The basic idea of the ID3 algorithm is to make the information entropy measure for attribute selection of nodes [8]. Priority select attribute having the maximum information each time can make entropy into the smallest. To build a decision tree that entropy declines the fastest; the entropy is 0 at the leaf nodes. At this point, the instance which each node corresponds to the consent-rated belongs to the same kind.

How to determine which property is the best? Using a statistical property called information gain, select the one having the largest gain (information is the most useful for classification) [9–11]. To define the gain, first with the help of a concept of information theory, entropy can measure the amount of information of attribute.

Known to have C results in the training set S

$$\text{Entropy}(S) = \sum -p(I) \log_2 p(I) \tag{66.1}$$

where, $p(I)$ belongs to S ratio of class I .

If all S belong to the same kind, entropy is 0 (data classification is completed). Entropy range is 0 (classification completed) to 1 (completely random).

Notes: S is not only attribute but also the entire sample set (this may be a bit confusing in the beginning).

$$\text{Entropy}(S, A) = \sum (|V_s|/|S|) * \text{Entropy}(S_v) \tag{66.2}$$

V_s . Equals attribute A has a subset S of values V ;

$|V_s|$ Equals number of elements in $|V_s|$;

$|S|$ Equals number of elements in S .

Gain (S, A) is the information gain attribute on set S , defined as:

$$\text{Gain}(S, A) = \text{Entropy}(S) - \text{Entropy}(S, A) \tag{66.3}$$

Gain (S, A) refers to the reduction in entropy after the value of attribute A . The greater Gain (S, A) is, the more information selected test attribute A provides for classification.

The classical ID3 algorithm given by Quinlan is as follows:

Algorithm: Generate decision tree (samples, attribute list) // to produce a decision tree by the training set given. Samples are training set and each attribute is discrete values; attribute list is a collection of candidate attributes (Fig. 66.1).

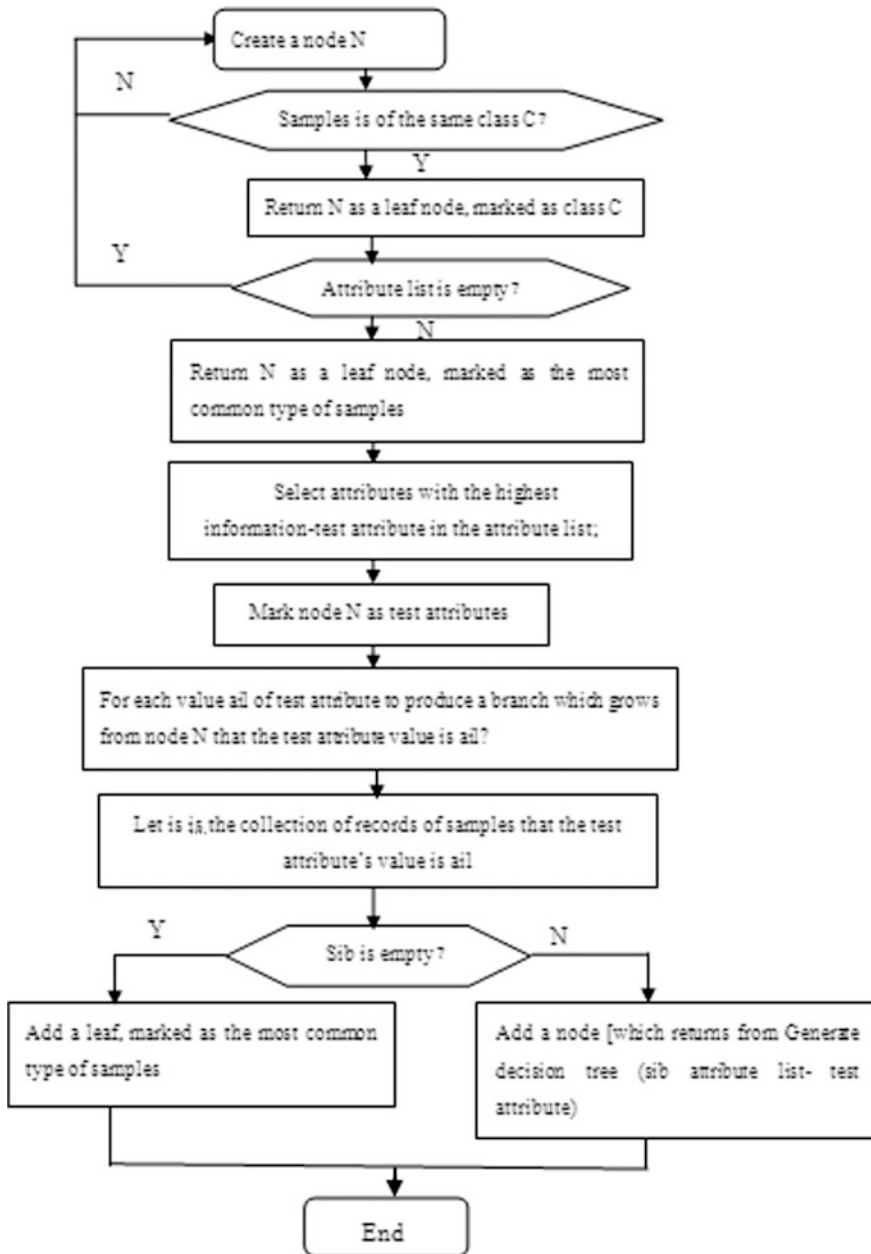


Fig. 66.1 Algorithm of generate decision tree

66.3 Applications

This paper shares the new shares as a analysis unit, taking the four important factors that affect new shares (company industry, competitive position, composite index, main capital) as test attributes of Training Set in the use of the decision tree.

Screening of new shares is the process of decision tree, the stock price movements are influenced by many factors; company industry, competitive position, and composite index and main capital concerned are the typical aspects.

New share data in Table 66.1 select 14 new shares listed in July and August in 2008. Industries include machinery, pharmaceutical, chemical, commercial, building materials, energy, information, transportation and so on, both traditional industries and sunrise industries. Besides, there is not only leading enterprises like China Southern Railway (CSR) and Westone with high competitive position, but also general enterprise like Rainbow Fine Chemical.

The decision-making process is as follows:

Step One: Calculate the entropy of decision attributes

There are 14 records for decision attributes investment, 8 records can be invested and 6 cannot. So the calculation of entropy is:

$$\text{Entropy (event)} = -(8/14) * \log_2(8/14) - (6/14) * \log_2 (6/14) = 0.985$$

Step Two: Calculate the entropy of condition attributes.

There are four condition attributes; company industry, competitive position, composite index, and funds degree of concern.

Table 66.1 Sample of new share data

New share	Company industry	Competitive position	Composite index	Funds amount
Westona	Advanced	Strong	Weak	General
Fu Chun Jiang	Advanced	General	Weak	General
Di long new material	General	General	Weak	Few
New pharmaceutical	Advanced	Strong	Strong	General
Talk Web information	Advanced	Strong	Strong	More
Xi yi industry	Poor	Weak	Weak	Few
Haiku heavy industry	Advanced	Strong	Strong	General
Rainbow fine chemical	Poor	Weak	Strong	Few
Yan tai spandex	General	Strong	Strong	Few
Shanghai RAAS	Advanced	Strong	Strong	More
Better life	General	General	Strong	More
Rustic if liter	Advanced	Strong	Strong	Few
CSR	Advanced	Strong	Strong	More
Hua dong automation	Poor	Weak	Weak	Few

1. The entropy of index

Consists of two processes: First calculate the entropy of attribute values that is strong and weak of the index

$$\text{Entropy } (S_{\text{weak}}) = -(5/5) * \log_2(5/5) = 0$$

$$\text{Entropy } (S_{\text{strong}}) = -(1/9) * \log_2(1/9) - (8/9) * \log_2(8/9) = 0.503.$$

Then calculate the entropy of attribute

$$\text{Entropy } (S_{\text{index}}) = (5/14) * \text{Entropy } (S_{\text{weak}}) + (9/14) * \text{Entropy } (S_{\text{strong}}) = (5/14) * 0 + (9/14) * 0.503 = 0.323$$

2. The entropy of company industry

There are three attribute values: advanced, general, and poor. The entropies are as follows:

$$\text{Entropy } (S_{\text{advanced}}) = -(2/8) * \log_2(2/8) - (6/8) * \log_2(6/8) = 0.811$$

Entropy (Spoor) = -(3/3) * log₂(3/3) = 0 (If entropy is 0, this data classification is completed, there is no need for sub-going)

$$\text{Entropy } (S_{\text{general}}) = -(2/3) * \log_2(2/3) - (1/3) * \log_2(1/3) = 0.918$$

Thus the entropy of company status is as follows:

$$\begin{aligned} \text{Entropy } (S, \text{ company industry}) &= (8/14) * \text{Entropy } (S_{\text{advanced}}) + (3/14) * \\ \text{Entropy } (S_{\text{poor}}) &+ (3/14) * \text{Entropy } (S_{\text{general}}) = (8/14) * 0.971 + (3/14) * \\ 0 &+ (3/14) * 0.918 = 0.700 \end{aligned}$$

3. The entropy of competitive position

There are three attribute values, strong, general, and weak. The entropies are as follows:

$$\text{Entropy } (S_{\text{strong}}) = -(7/8) * \log_2(7/8) - (1/8) * \log_2(1/8) = 0.544$$

$$\text{Entropy } (S_{\text{general}}) = -(1/3) * \log_2(1/3) - (2/3) * \log_2(2/3) = 0.918$$

$$\text{Entropy } (S_{\text{weak}}) = -(3/3) * \log_2(3/3) = 0$$

Thus the entropy of competitive position is as follows:

$$\begin{aligned} \text{Entropy } (S, \text{ competitive position}) &= (8/14) * \text{Entropy } (S_{\text{strong}}) + (3/14) * \\ \text{Entropy } (S_{\text{general}}) &+ (3/14) * \text{Entropy } (S_{\text{weak}}) = (8/14) * 0.544 + (3/14) * \\ 0.918 &+ (3/14) * 0 = 0.508. \end{aligned}$$

4. The entropy of the main funds concern

There are three attribute values: more, general, and few. The entropies are as follows:

$$\text{Entropy } (S_{\text{more}}) = -(4/4) * \log_2(4/4) = 0$$

$$\text{Entropy } (S_{\text{general}}) = -(2/4) * \log_2(2/4) - (2/4) * \log_2(2/4) = 1$$

$$\text{Entropy } (S_{\text{few}}) = -(2/6) * \log_2(2/6) - (4/6) * \log_2(4/6) = 0.918$$

Thus the entropy of main funds concern is as follows:

$$\text{Entropy } (S, \text{ the main funds}) = (4/14) * \text{Entropy } (S_{\text{more}}) + (2/14) * \text{Entropy } (S_{\text{general}}) + (6/14) * \text{Entropy } (S_{\text{few}}) = (4/14) * 0 + (4/14) * 1 + (6/14) * 0.918 = 0.679$$

The third step: Calculate the gain of condition attributes.

$$\text{Gain } (S, \text{ company industry}) = \text{Entropy } (\text{investment}) - \text{Entropy } (S, \text{ company industry}) = 0.985 - 0.700 = 0.285$$

$$\text{Gain } (S, \text{ competitive position}) = \text{Entropy } (\text{investment}) - \text{Entropy } (S, \text{ competitive position}) = 0.985 - 0.508 = 0.477$$

$$\text{Gain } (S, \text{ composite index}) = \text{Entropy } (\text{investment}) - \text{Entropy } (S, \text{ composite index}) = 0.985 - 0.503 = 0.482$$

$$\text{Gain } (S, \text{ main funds}) = \text{Entropy } (\text{investment}) - \text{Entropy } (S, \text{ main funds}) = 0.985 - 0.679 = 0.306.$$

Composite index of condition attributes have great gain, so it is used to decide the root node of decision tree.

Branch note selection is as follows:

Because there are two types of composite index, there are two branches of root node (strong, weak). As the weak entropy is 0, do not consider it. Consider the strong index conditions. Next, select the advanced branch nodes. In the strong index branch nodes, what attributes should we test? Because we have used composite index as root node already, we can only use the remaining three variables: competitive position, the main funds concern or company industry.

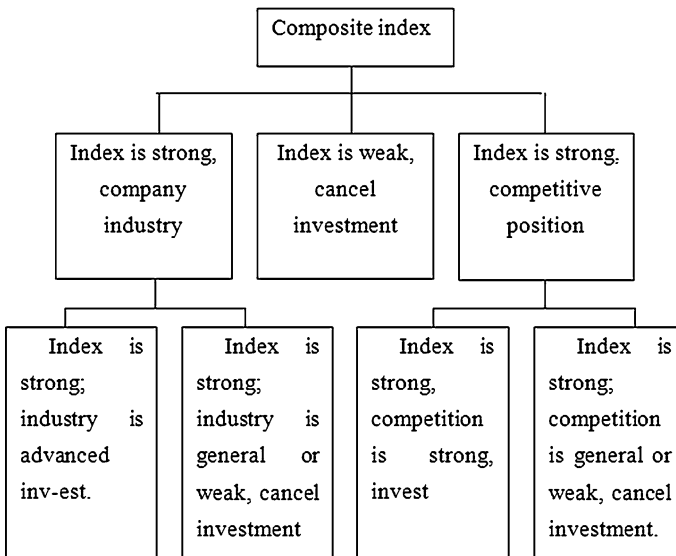


Fig. 66.2 Final decision tree generated

Conclusions obtained from Fig. 66.2 are a strong case in the index, regardless of whether this is the main financial concern, as long as the company industry is good or of clear competitive advantage, invest and should get a better benefit.

Decision tree can also be expressed by rule formula.

66.4 Conclusion

The decision tree method is simple and honest thinking. It establishes the prediction model intuitive, is easy to accept, and the acquired knowledge is described as clear and explicit rules. Practice has proved that analysis and application of new shares based on decision tree can provide help for investors. By this method, investors can obtain better profits from the stock market. In practice, according to the existing model it can improve the accuracy of investment, but the capital markets have become more complex and need to constantly explore new algorithms. Therefore, exploring new algorithms is the next research focus.

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Chapter 67

Supermarket Application Based on Queueing Theory

Tongjuan Zhao and Chunhui He

Abstract In order to better reduce the operation cost of Beidaihe small supermarket, especially the reasonable arrangement of the cashier of a number, we can use the queueing theory to solve this question. Queueing theory is the theory of random service system, based on the service object and the arrival of business hours of the statistical study, draws some quantitative indices (waiting time, queue length, busy period length) statistical regularity. Supermarket operators in order to facilitate the purchase installed large number of tourists pay POS machine, to reduce the customer waiting time. Introduction of excess POS will increase the cost of the supermarket operators. Use queue theory by comparing the calculated cash and credit card payment waiting time. With the results of guided supermarket operator reasonable arrangement of POS machine number.

Keywords Queueing theory · Utilization rate

67.1 Introduction

Queueing theory (queueing theory), or the theory of random service system, is based on the service object and the arrival of business hours of the statistical study; the quantitative index (waiting time, queue length, busy period length) statistical regularity, then according to these rules to improve the service system structure or organization is service object, makes the service system that cannot only meet the

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needs of the service object, and can make the body of the economic cost or certain indices [1]. Queueing system comprises three components: input process, queueing rules, and service agencies. A queueing system can be described as: customer service to seek, if there are customer arrivals, not immediately enter the service, need to wait, accept service, after leaving the system [2, 3].

In people's daily life, especially in modern urban life, queueing phenomenon is everywhere. For example, go to a hospital or the railway station service window, often had to wait in line, the plane circled in the air, not landing, the aircraft in the waiting "queue", all according to a certain order and pattern of landing.

The finite sex of resource and demand randomness is queueing phenomenon based. Increased resources, such as increasing the service window, setting more runways, site equipment capacity, can reduce customer queueing phenomenon, even may not line up. But when fewer customers, inevitable meeting causes resources unused, results equivalent to resources in "queuing" waiting for customers to visit [4]. Therefore, to increase the service mechanism, can certainly reduce queueing phenomenon, but increase the cost of service; conversely, reduce service agencies, although increased service utilization rate, reduce the cost, but increases the customer waiting time. This is contradictory. Queueing theory is the use of probability theory and stochastic process theory, study the queue within the system services and customer demands, so that the required quality of service standards fully meet the conditions, the most economic service fee. Below in a supermarket checkout set for example to explain the use of queueing theory can reduce the cost of operator [5].

With the development of society and economy, people's leisure time increasing, more and more people choose to travel on holidays. Beidaihe is a permanent population of more than six small towns. But every year 6–10 month reception of tourists at home and abroad the population of this city a few times. Many visitors choose to go to the supermarket to buy items. In such a short time rapid population increase, will bring a lot of profit to the supermarket, there are also many problems to be solved urgently. The small quantity of cashiers, little number of service personnel, queueing phenomenon is serious, raising the tourists' voices of discontent. Tourists often do not carry too much cash, and use bank card payment. Following the use of queueing theory to discuss the payment in cash and credit card payment in which two ways is faster having shorter customer waiting time [6, 7].

67.2 Queueing Model

In three letters of the symbol A/B/C queueing system. Where A represents the customer arrival time distribution, B distribution business hours, and C service agencies in the service station number. Queueing system index [8]:

1. captain L_s , total number of customers in the system;
2. rows of captain L_q , the number of customers in the queue;

3. length of stay W_s customers in the system of residence time;
4. the W_q —customer waiting time in the queue waiting time;

Our customer to get to the supermarket, shopping, waiting for the payment as a queueing system. In this system, mainly on the following index:

1. within the system (including customer value is service and customers waiting in line mean);
2. the customer within the system, the average length of stay;
3. within the system average number of customers waiting in line;
4. average customer waiting time.

This index can reflect the supermarket checkout set is reasonable. Using the lambda per unit of time the average number of customers for each service station, μ said the average service rate (waiter service capacity) [9]. $\rho = \frac{\lambda}{\mu}$ Service strength. W_s said the customer in the system of average length of stay (including queue waiting time and service time), W_q said customers waiting for the mean time, by the following formula:

In a single team under the condition of single service desk:

$$W_s = \frac{1}{\mu - \lambda} \quad W_q = \frac{\rho}{\mu - \lambda} \tag{67.1}$$

Many teams to service desk can be considered as a single team single service station. In a single team K service case:

$$W_s = \frac{(k\rho)^k \rho}{k!(1 - \rho)^2 \lambda} P_0 + \frac{1}{\mu} W_q = \frac{(k\rho)^k \rho}{k!(1 - \rho)^2 \lambda} P_0 \tag{67.2}$$

$$\rho_1 = \frac{\lambda}{\mu}, \rho = \frac{\lambda}{n\mu} \tag{67.3}$$

$$P_0 = \left[\sum_{n=0}^{k-1} \frac{1}{n!} \left(\frac{\lambda}{\mu}\right)^n + \frac{1}{k!(1 - \rho)} \left(\frac{\lambda}{\mu}\right)^k \right]^{-1} \tag{67.4}$$

67.3 Example Analysis

The queueing theory of M/M/1 and M/M/C model, the analysis supermarket cashier service system. In the afternoon and evening, the supermarket is very busy, we discuss only those busy periods (the rest of the time to visit).

If customer according to Poisson flow reaches the cashier and sales for customer service time is exponential distribution [10]. The supermarket is equipped with three cash desks, cashier and each customer can use bank card

payment, due to the use of bank card payment process is more complex, the salesperson needs more business hours. According to a period of observation: 0.5 min on average for every customer who arrives at the cashier for payment, which on average out of every five customers one customer requires the use of the bank card payment, the others use cash payment. If the customer using the bank card payment, takes sales average business time for 1.5 min; if the customer use cash payment, takes sales average business time for 0.75 min, so the total average business time for $1.5 \times 1/5 + 0.75 \times 4/5 = 0.9$ min [11, 12].

If the three register can use bank card payment, then each customer can choose cash desk. According to the customer arrival intensity $\lambda = 60/0.5 = 120$ (person/h), the average service rate $\mu = 60/0.9 = 66.67$ (person/h), so $\rho_1 = \frac{\lambda}{\mu} = \frac{96}{80} = 1.2$, $\rho = \frac{\lambda}{2\mu} = \frac{96}{2 \times 80} = 0.6$, Using M/M/C the model, can obtain the following result:

$$p_0 = \left[\sum_{k=0}^{n-1} \frac{\rho_1^k}{k!} + \frac{\rho_1^n}{n!} * \frac{1}{1-\rho} \right]^{-1} = 0.25.$$

$$L_q = \frac{\rho_1^{n+1}}{(n-1)!(n-\rho_1)^2} p_0 = 0.54 \tag{67.5}$$

$$L_s = \rho_1 = 1.2, L_s = L_q + L_s = 0.55 + 1.2 = 1.75 \tag{67.6}$$

$$W_q = \frac{L_q}{\lambda} = \frac{0.55}{120} = 0.00833 \text{ (h)} \tag{67.7}$$

$$W_s = \frac{L_s}{\lambda} = \frac{1.75}{120} = 0.01458 \text{ (h)} \tag{67.8}$$

If you specify a register can use bank card payment, the other two cashiers can only use cash payment. For can use bank card payment collection platform using M/M/1 model, in which the customer arrival intensity $\lambda = 120/5 = 24$ (person/h), average service rate $\mu = 60/1.5 = 40$ (person/h), you can get the following result:

$$L_s = \frac{\lambda}{\mu - \lambda} = \frac{24}{40 - 24} = 1.5 \tag{67.9}$$

$$L_q = \frac{\lambda^2}{\mu(\mu - \lambda)} = 0.9 \tag{67.10}$$

$$W_q = \frac{L_q}{\lambda} = \frac{0.9}{24} = 0.0375 \tag{67.11}$$

The other two can only use cash payment cash desk using M/M/2 model, in which the customer arrival intensity. The other two can only use cash payment cash desk using M/M/2 model, in which the customer arrival intensity $\lambda = 120 \times 0.8 = 96$ (person/h), average service rate $\mu = 60 \div 0.75 = 80$ (person/h),

$$\rho_1 = \frac{\lambda}{\mu} = \frac{96}{80} = 1.2, \rho = \frac{\lambda}{2\mu} = \frac{96}{2 \times 80} = 0.6 \quad (67.12)$$

$$p_0 = \left(\sum_{k=0}^{n-1} \frac{\rho_1^k}{k!} + \frac{\rho_1^n}{n!} * \frac{1}{1-\rho} \right)^{-1} = 0.25 \quad (67.13)$$

$$L_q = \frac{\rho_1^{n+1}}{(n-1)!(n-\rho_1)^2} p_0 = 0.54 \quad (67.14)$$

$$L_F = \rho_1 = 1.2, L_s = L_q + L_F = 0.54 + 1.2 = 1.74 \quad (67.15)$$

$$W_q = \frac{L_q}{\lambda} = \frac{0.54}{96} = 0.005625 \text{ (h)} \quad (67.16)$$

$$W_s = \frac{L_s}{\lambda} = \frac{1.74}{96} = 0.018125 \text{ (h)} \quad (67.17)$$

67.4 Supermarket Checkout Optimization Design

As consumers, supermarket checkout needs to be better and more convenient, and supermarket operators, increase the cashier to increase investment. Thus, it should be a reasonable planning the cashier number, so that neither the cashier number caused by excessive waste of resources, also not because of the small number of checkout and cause severe queueing phenomenon. Therefore, the supermarket cash register management and optimal design.

1. Pairs of supermarket layout planning, for customers to create a warm, convenient shopping environment. Give the customer in the shortest possible time to buy what good they want to buy, improve the unit time import and supermarket traffic, thereby saving customers time, also make the supermarket increased customer flow, so that the supermarket management efficiency is improved. For the large-scale supermarket in the proper position to increase sales to a very good method. For the first time to the customer, shopping guide will greatly reduce the number of their aimless sojourn time. Checkout management is also very important, try to make the waiting customers in line in order to avoid excessive crowded and confused situation.
2. To strengthen training, improve the basic quality. The cashier is host of the supermarket. Can be said to be a supermarket cashier's window, and the quality of service quality directly affect the image of the supermarket. If the supermarket is located in the community, customers have been old customers, they know which cashier is of relatively fast speed, good service attitude, may be in his/her channel customers will be queueing more, thus leading to other cashiers become temporarily idle resources. This is not conducive to the supermarket management.

3. As a single team server queueing rules, improve work efficiency.

In the supermarket queueing system, input process obeys the Poisson distribution, from the theory, using a single team server queueing rules than the team service of high efficiency.

4. Integrity management. In the current market economy condition, who occupies the consumer's purchase confidence is who has the market. Therefore, the supermarket operators have to integrity management, so that consumers in supermarket consumption, without any menace from the "rear". Enable consumers to believe that he selected the supermarket can be long-term cooperation.

67.5 Summary

To the supermarket, shopping has become a common way of consumption and the check-out line payment is a common phenomenon. Credit card consumption has become a new fashion. Supermarkets introduced POS engine to meet the part of people's consumption pattern, but each cashier that limits customer's card use will affect the cash rate, leading to severe queueing phenomenon; and will increase the supermarket's management cost. Through the examples, the contrast can be illustrated, in resource configuration, using the queueing theory combined with the customer's arrival records obtained relevant data, to make the qualitative, quantitative and quantitative index, forecast, analysis and evaluation, through optimizing design, the supermarket can properly install some POS machine to achieve the desired customer intention. Both reduce customer waiting time, and do not waste the supermarket's manpower and material resources, in order to obtain the maximum economic benefit.

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Chapter 68

Study of Determining Satisfaction Weight Based on KPCA

Xinghuo Wan, Wenyi Zhang and Shuming Guan

Abstract Satisfaction evaluation research in qualitative index weights reflecting the index relative to the satisfaction degree of importance, to a great extent determines the index system reflecting the satisfaction of objective truth. This paper is based on the kernel principal component analysis (KPCA) with satisfaction index weights determined by PCA analysis method, which was improved is to overcome the index nonlinear problem. The empirical research shows that using KPCA obtains satisfaction weight better than the PCA method.

Keywords Satisfaction · Weight · KPCA

68.1 Introduction

The customer is the life of an enterprise; providing high-quality service to customers should be the immediate goal is to attract new users, create business income, and the deeper purpose should be to keep old customers and improve their loyalty. Thus the enterprise makes cost minimization, income maximization, and profit maximization. To improve customer loyalty, we first need to understand the existing customer service satisfaction, find out the gap, and further improve customer satisfaction level; thus the latest enterprises pay more and more attention to customer's satisfaction [1]. The satisfaction index system is the customer satisfaction measurement basis, and the rationality of the design directly affects the satisfaction of the results of the study. This is the most important element in the

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study of satisfaction of a link. In the process of building satisfaction index, the understanding in the industry is different, the researchers of mastery of index system structure is also different. As the structure of the index system are fuzzy conditions, can the principal component analysis or kernel principal component analysis (KPCA) to each index determine the weight [2]?

The nuclear method of principal component analysis (KPCA) actually applied to nuclear method for the analysis of the main points, is that the original data system information lost under the principle of minimum, in all variables related research, and on the basis of the information will more variable compression can reflect the original problem for several characteristics of the variables index, and based on the characteristics of information system index comprehensive analysis, can effectively deal with the nonlinear relationship between variables to solve many of the comprehensive evaluation index providing a very good method. The basic idea is: use a nonlinear mapping ϕ to input data $x_k (k = 1, 2, \dots, l)$ (l is the number of input data) is mapped to a feature space F , linear PCA in the feature space F .

According to Tangshan mobile customers using KPCA on the weights of customer satisfaction the specific content includes the mobile customer satisfaction evaluation index system, and on this basis to design questionnaire. Using PCA, KPCA determines the weight of each index, and the results were analyzed and compared, describing the kernel principal component in the study of satisfaction weights of superiority [3]. Aiming at the existing problems puts forward the improvement proposal.

68.2 Weights of Customer Satisfaction

This article in view of the Tangshan mobile company customer uses KPCA for customer satisfaction determining weight problems for which the concrete content includes: moving forward customer satisfaction evaluation index system based on this questionnaire. Using PCA respectively, KPCA confirms the index weight and the analysis of the results is that the kernel principal component in the study of problems determining weight satisfaction superiority. Aiming at the problems put forward the improvement suggests that to evaluate customer satisfaction first, it should be able to offer a direct measurement of the index system. A complete customer satisfaction index system is required including the evaluation index, and the index of evaluation according to the index system in which the importance of the different degree of each index determines the overall satisfaction effect weight [4].

The index weight on the one hand states the index in the same position as the evaluation index level, and on the other hand reflects the index variation on the evaluation results changing the size of the role. A scientific and reasonable evaluation index weight system should be able to accurately reflect the evaluation index (be evaluated object's properties) relative to the important evaluation target

degree [5]. Evaluation index weight reflects the assessment index relative to the importance of the satisfaction degree to a great degree the index system reflects the authenticity of customer satisfaction.

The understanding of the industry being different, the researchers of mastery of index system structure is also different, and different indexes in the index system must be reflected in the influence of customers on product quality and service quality evaluation of the importance of factors. Thus customer satisfaction index system of determining weight is satisfaction in the design of key steps, as an objective that can reflect the customer satisfaction plays a crucial role.

68.3 Kappa-Based Mobile Client Satisfaction Model

68.3.1 Principles Established by the Indicator System

The customer satisfaction index system has more than one invisible variable (customer expectations, customer perception, customer satisfaction, etc.), as some of the fuzziness is not easy for direct evaluation [5, 6]. Customer satisfaction assessment systems to a great extent determine the validity and reliability of the assessment result. Thus we have to analyze these invisible variables, and a set of evaluation index system directly. Usually, we need to follow the following principles [7, 8].

First, the representative principles among the indexes are connected to each other, and sometimes the response characteristics of the overlap are alternative. While establishing customer satisfaction index system, a strong representative index should be chosen.

Second, controllable principles Evaluation index in the enterprise must be within the scope of control. Customer satisfaction assessment will surely make customers generate new expectations, and thus promote the enterprise to take improvement measures [9]. But if the enterprise in a certain area takes measures to improve conditions the evaluation index should avoid such.

Third, the feasibility of principle establishment of index system should be in accord with the objective reality. The evaluation index should be of statistics, calculation, and analysis.

Fourth, the scientific principle customer satisfaction index system must be complete. Each index should have a certain logical relationship; Index to and evaluation objects and adapt to target.

68.3.1.1 Establishment of the Customer Satisfaction Index System

Tangshan mobile company customer satisfaction based on determining weight model framework, customer satisfaction evaluation index system using hierarchical structure set assessment index, divided into two levels. Customer

Table 68.1 Satisfaction index systems

One class index	Level 2 index
Company image	The extent of the customer x_1
	Improve service quality level x_2
	Service image and brand of social acceptance degree x_3
	The total consumption of the monthly customers x_4
Service quality	The reliability of the service to customer feedback x_5
	The price of service customer feedback x_6
	On the different service channels customer evaluation x_7
	Different services to the customers' comments x_8
Customer satisfaction	The potential customer input x_9
	Overall assessment x_{10}
Customer complaints	Meet customer expectation level x_{11}
	This year the number customer complaints x_{12}
Customer loyalty	This year the number customer claim x_{13}
	Recommend Tangshan mobile company will x_{14}
	Go to the possibility of other communications company x_{15}
	The development of the company level of confidence x_{16}

satisfaction image of determining weight model, service quality, customer satisfaction, customer complaint and customer loyalty five structure variables for one class index, namely the first level: according to the characteristics of the mobile company, five hidden variables can be launched for specific factors index, namely to explain structure variables of the points factor, that is, the second level. The index system structure is given in Table 68.1.

68.3.1.2 Quantified

Customer satisfaction index based on design related issues. Questionnaire kinds of questions, including the scoring title and fill in the blank (the questionnaire see Appendix I). Fill in the blank to write their own on the line after the title, in order to make recommendations for improvement to the mobile company scoring title according to the investigator's own subjective satisfaction rate, 10-point scale, and score range 1–10 points for each question. Specific quantified as follows in Table 68.2.

68.3.2 Sample Selection

The main objective of the survey is the study of Tangshan Mobile customer satisfaction the right weight. The survey method used is simple random sampling. The time of the survey is set for two weeks Random distribution of 500 questionnaires, 458 valid questionnaires [10].

Table 68.2 Quantified criteria

Score	Customer satisfaction
10	Completely satisfied
9	Extremely satisfied
8	Very satisfied
7	Satisfied
6	Relatively satisfied
5	Not completely satisfied
4	Not satisfied
3	Disappointed
2	Very disappointed
1	Completely disappointed

68.3.3 Use of PCA to Analyze

Using the principal component analysis method to do research on satisfaction weight (use SPSS 18.0 to complete its calculations on the computer), specific results is as follows:

The first principal component:

$$\begin{aligned}
 F_1(p) = & 0.050x_1 - 0.018x_2 + 0.151x_3 + 0.167x_4 - 0.056x_5 - 0.063x_6 \\
 & + 0.154x_7 + 0.041x_8 + 0.304x_9 - 0.001x_{10} - 0.214x_{11} + 0.204x_{12} \\
 & + 0.256x_{13} + 0.070x_{14} - 0.012x_{15} - 0.144x_{16}
 \end{aligned} \tag{68.1}$$

The second principal component:

$$\begin{aligned}
 F_2(p) = & 0.240x_1 - 0.90x_2 + 0.056x_3 - 0.170x_4 - 0.171x_5 - 0.024x_6 \\
 & + 0.416x_7 + 0.388x_8 + 0.154x_9 + 0.220x_{10} - 0.151x_{11} - 0.079x_{12} \\
 & + 0.123x_{13} + 0.044x_{14} + 0.095x_{15} + 0.119x_{16}
 \end{aligned} \tag{68.2}$$

The third principal components:

$$\begin{aligned}
 F_3(p) = & -0.066x_1 + 0.387x_2 + 0.354x_3 + 0.052x_4 + 0.472x_5 \\
 & - 0.109x_6 + 0.041x_7 - 0.112x_8 + 0.080x_9 + 0.129x_{10} + 0.076x_{11} \\
 & + 0.108x_{12} + 0.007x_{13} + 0.216x_{14} + 0.032x_{15} - 0.176x_{16}
 \end{aligned} \tag{68.3}$$

The fourth principal components:

$$\begin{aligned}
 F_4(p) = & 0.219x_1 - 0.116x_2 - 0.036x_3 + 0.048x_4 - 0.003x_5 + 0.272x_6 \\
 & + 0.83x_7 - 0.304x_8 - 0.083x_9 - 0.149x_{10} + 0.064x_{11} + 0.010x_{12} \\
 & + 0.089x_{13} + 0.293x_{14} - 0.411x_{15} + 0.220x_{16}
 \end{aligned} \tag{68.4}$$

The first principal component F_1 of each index of the corresponding coefficient on the first principal component F_1 corresponding to the contribution rate, plus second (three or four) principal component $F_2(F_3, F_4)$ of each index the corresponding coefficient multiplied by second (three or four) principal component $F_2(F_3, F_4)$ the corresponding contribution rate, then divided by the extracted four main component four contribution rate and, can get the PCA mobile customer satisfaction formula:

$$\begin{aligned}
 F(p) &= \frac{(4.737F_1(p) + 1.977F_2(p) + 1.410F_3(p) + 1.319F_4(p))}{(4.737 + 1.977 + 1.410 + 1.319)} \\
 &= 0.096x_1 + 0.014x_2 + 0.135x_3 + 0.063x_4 + 0.006x_5 + 0.015x_6 \\
 &\quad + 0.182x_7 + 0.043x_8 + 0.185x_9 + 0.044x_{10} + 0.119x_{11} + 0.103x_{12} \\
 &\quad + 0.168x_{13} + 0.118x_{14} + 0.039x_{15} + 0.043x_{16} \tag{68.5}
 \end{aligned}$$

In the model every index corresponding to the factor is the weight of each index.

68.3.4 The Use of KPCA for Analysis

When the use of KPCA, the choice of the Gaussian kernel function, namely:

$$K(x, z) = \exp\left(\frac{\|x - z\|^2}{2\sigma^2}\right), \sigma > 0 \tag{68.6}$$

Using KPCA method to do research on satisfaction weight (using Matlab 7.1 done on the computer and the calculation process), the results are as follows:

The first principal component:

$$\begin{aligned}
 F_1(kp) &= 0.181x_1 + 0.151x_2 + 0.160x_3 + 0.197x_4 + 0.180x_5 + 0.077x_6 \\
 &\quad - 0.435x_7 + 0.080x_8 - 0.466x_9 + 0.027x_{10} + 0.198x_{11} + 0.097x_{12} \\
 &\quad - 0.441x_{13} - 0.354x_{14} + 0.162x_{15} + 0.185x_{16} \tag{68.7}
 \end{aligned}$$

The second principal component:

$$\begin{aligned}
 F_2(kp) &= 0.450x_1 - 0.381x_2 + 0.173x_3 + 0.332x_4 - 0.155x_5 - 0.331x_6 \\
 &\quad + 0.039x_7 - 0.307x_8 + 0.058x_9 - 0.069x_{10} + 0.305x_{11} - 0.018x_{12} \\
 &\quad + 0.057x_{13} + 0.013x_{14} - 0.369x_{15} + 0.204x_{16} \tag{68.8}
 \end{aligned}$$

The third principal components:

$$\begin{aligned}
 F_3(kp) = & -0.151x_1 - 0.252x_2 + 0.243x_3 - 0.045x_4 - 0.259x_5 \\
 & + 0.119x_6 - 0.055x_7 + 0.104x_8 - 0.083x_9 + 0.596x_{10} - 0.008x_{11} \\
 & + 0.469x_{12} - 0.080x_{13} - 0.019x_{14} - 0.274x_{15} - 0.304x_{16} \quad (68.9)
 \end{aligned}$$

Indicators corresponding to each of the first principal component F_1 factor multiplied by the first principal component F_1 corresponding to the contribution rate, coupled with the second principal component $F_2(F_3)$ in each of the indicators corresponding coefficient multiplied by the second (three) principal component $F_2(F_3)$ corresponding to the contribution rate, divided by three of the contribution rate of three main components of the extracted and can get the KPCA mobile customer satisfaction formula:

$$\begin{aligned}
 F(kp) &= \frac{(2.473F_1(kp) + 1.307F_2(kp) + 1.185F_3(kp))}{(2.473 + 1.307 + 1.185)} \\
 &= 0.172x_1 + 0.085x_2 + 0.184x_3 + 0.175x_4 + 0.013x_5 + 0.021x_6 \\
 &\quad + 0.219x_7 + 0.016x_8 + 0.237x_9 + 0.138x_{10} + 0.177x_{11} + 0.156x_{12} \\
 &\quad + 0.224x_{13} + 0.178x_{14} + 0.082x_{15} + 0.073x_{16} \quad (68.10)
 \end{aligned}$$

In the model every index corresponding to the factor is the weight of each index.

68.4 Kappa and Pac Mobile Customer Satisfaction Analysis

68.4.1 Based on the KPCA and PCA Satisfaction Formula

PCA method, KPCA method corresponding to the weight of index contrast following Table 68.3:

Data from the questionnaire in a random sample of 50 customer data, respectively, with identical weights, PCA method, KPCA method to calculate satisfaction value, Table 68.4 is a representative sample of 10 customer satisfaction value.

68.4.2 The Results of Analysis of Different Methods

When using the PCA method, 10 customer satisfaction value intervals were calculated: [9.897, 16.074], the interval length: $16.074 - 9.897 = 6.177$; 10 customer

Table 68.3 Two kinds of methods derived from the weight

Index	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
PCA	0.096	0.014	0.135	0.063	0.006	0.015	0.182	0.043
KPCA	0.172	0.085	0.184	0.175	0.013	0.021	0.219	0.016
Index	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}
PCA	0.185	0.044	0.119	0.103	0.168	0.118	0.039	0.043
KPCA	0.237	0.138	0.177	0.156	0.224	0.178	0.082	0.073

Table 68.4 Mobile client satisfaction value

Customer	1	2	3	4	5
PCA	16.074	15.526	13.592	10.488	10.561
KPCA	32.190	29.700	26.061	21.085	18.903
Customer	6	7	8	9	10
PCA	10.108	11.731	12.063	10.492	9.897
KPCA	17.905	23.540	23.640	17.373	18.908

satisfaction, value range when the use of KPCA method, are calculated as follows: [17.373, 32.190], the interval length: $32.190 - 17.373 = 14.817$.

As can be seen, the weight for the calculation of equal satisfaction value interval length is smaller, and it is not easy to distinguish between the different customer satisfaction, which is not conducive to the moving company to make decisions; in the PCA method the results are better than the previous method, but the extent is limited; the KPCA method results the best, where the interval length is large, the customer difference is more obvious, and moving company can make various improvements according to different customer advisory; the mobile customer satisfaction improvement is of great help.

Take customer four and customer eight for example, from the raw data of the two customers. You can see, “On the different service channels customer evaluation $\times 7$ ”, customer four for its score is four, which means “not satisfied”, customer eight for its score is eight, which means “very satisfied”.

When using the PCA method, two customer satisfaction value differences are 1.575, two customers are not classified as a category, which is consistent with the original data to reflect the situation. When using KPCA, the worthy satisfaction difference is 2.555; this method calculates the satisfaction value most fitting to the original data, and can best reflect the original data.

From the above analysis we can see that the KPCA method, to determine the weight of customer satisfaction in reflecting the situation, is the most fitting to the original data, and can reflect the difference between customers [11].

In this paper, aiming at the satisfaction weight issues, through the design of questionnaire, data collection, using principal component analysis (PCA) method,

on the basis of in-depth, using KPCA method, identify the satisfaction index. By using PCA and KPCA methods to get satisfaction weight, the analysis shows the superiority of KPCA.

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Chapter 69

A Special Class of Matrix in Three-Dimensional Combinatorial Matrix Class

Junna Jiang, Bing Han and Hong Wang

Abstract Two-dimensional combinatorial matrix class was found by Richard A Brandi in his book *Combinatorial Matrix Class* in 2006. In this book, he gave us the definition of this matrix, proves its existent theory, and analyzes its construction. In this paper, we define the three-dimensional combinatorial matrix (TDCM) class $A(R, S, T)$ basic of two-dimensional combinatorial matrix class. Then we discuss the existence and construction of this matrix, and built a special class of Matrix in TDCM.

Keywords Combinatorial matrix class · Three-dimensional matrix · $(0, 1)$ Matrix

69.1 Introduction

The combination matrix to rise in a nearly 20 years, and the rapidly developing branch of mathematics, matrix theory, and linear algebra to prove that the combination of theorem and the combination of structure analysis and description, but also the combinatorial theory of thinking and argumentation methods used to accurate analysis of the matrix and reveal the inherent combination of the nature of the array. Therefore, traffic jams are a hot urban traffic management and the core issues [1, 2].

In 2006 Brandi published *Combinatorial Matrix Class* who first proposed the concept of the composite matrix class; given the necessary and sufficient conditions of such a matrix exists; analysis of structural features, such as the rank of the

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matrix, trace, corresponding to the determinant volume and type of value; some combination of parameters and linear algebra parameters in the matrix class. Also defines a real symmetric matrix class and Tournament matrices and conditions for the existence, basic structure, and a special matrix discussed in detail [3, 4].

In this paper we define three-dimensional combinatorial matrix (TDCM) class $A(R, S, T)$ basic of two-dimensional combinatorial matrix class, and discusses a special class of Matrix in TDCM.

69.2 Three-Dimensional (0, 1) Combinatorial Matrix Class

69.2.1 The Definition of TDCM

The definition of three-dimensional combinatorial matrix class (TDCM) class $A(R, S, T)$:

Let m, n, p is positive integer, $R = (r_{ki})_{p \times m}, S = (s_{kj})_{n \times p}, T = (t_{ij})_{m \times n}$ nonnegative integer matrix, $A(R, S, T)$ is the set of three-dimensional $m \times n \times p$ order (0, 1) matrix satisfies the following conditions.

$$\sum_{j=1}^n a_{ijk} = r_{ik} \quad \begin{matrix} i = 0, 1, 2 \dots p - 1 \\ k = 0, 1, 2 \dots m - 1 \end{matrix} \tag{69.1}$$

$$\sum_{i=1}^m a_{ijk} = s_{jk} \quad \begin{matrix} j = 0, 1, 2 \dots n - 1 \\ k = 0, 1, 2 \dots p - 1 \end{matrix} \tag{69.2}$$

$$\sum_{k=1}^p a_{ijk} = t_{ij} \quad \begin{matrix} i = 0, 1, 2 \dots m - 1 \\ j = 0, 1, 2 \dots n - 1 \end{matrix} \tag{69.3}$$

Then named $A(R, S, T)$ TDCM.

The necessary conditions of TDCM:

If $A(R, S, T)$ is unempty, the $\sum_{k=0}^{p-1} \sum_{i=0}^{m-1} r_{ki} = \sum_{k=0}^{p-1} \sum_{j=0}^{n-1} s_{kj} = \sum_{i=0}^{m-1} \sum_{j=0}^{n-1} t_{ki}$, that is the elements sum of R, S, T is equal.

In proving the existence of necessary and sufficient theorem of $A(R, S, T)$ using the method of constructive [5].

First of all, we introduce the memorization relations of matrix. Get four of lemma about the relations of $R S T$, and then, respectively, for $R S T$ is nonnegative integer m -order matrix and $R S$ is $m \times p$ -order T is m -order nonnegative integer the case, structure to meet the conditions of three-dimensional (0, 1) matrix $A(R, S, T)$. Finally by the introduction of these two special cases we get the existence theorem [6].

69.2.2 The Existence Theorem of PCA

Theorem 1 Let m is positive integer, $R = (r_{ki})_{m \times m}$, $S = (s_{kj})_{m \times m}$, $T = (t_{ij})_{m \times m}$ is nonnegative integer matrix, and $r_{ki} \leq m, s_{kj} \leq m, t_{ij} \leq m \ i = 0, 1, \dots, m - 1 \ j = 0, 1, \dots, m - 1 \ k = 0, 1, \dots, m - 1$, then the sufficient and necessary conditions of unkmptly $A(R, S, T)$ is $S \prec R^* \quad R^T \prec T^* \quad S^T \prec \bar{T}$.

Theorem 2 Let m, p ($m \leq p$) is positive integer, $R = (r_{ki})_{p \times m}$, $S = (s_{kj})_{p \times m}$, $T = (t_{ij})_{m \times m}$ is non negative integer matrix, and $r_{ki} \leq m, s_{kj} \leq m, t_{ij} \leq m \ i = 0, 1, \dots, m - 1 \ j = 0, 1, \dots, m - 1 \ k = 0, 1, \dots, m - 1$ then the sufficient and necessary conditions of unkmptly $A(R, S, T)$ is $S \prec R^* \quad R^T \prec T^* \quad S^T \prec \bar{T}$

Theorem 3 Let m, n, p is positive integer, $R = (r_{ki})_{p \times m}$, $S = (s_{kj})_{p \times n}$, $T = (t_{ij})_{m \times n}$ is nonnegative integer matrix, and $r_{ki} \leq \max\{n, p\}, s_{kj} \leq \max\{m, p\}, t_{ij} \leq \max\{n, m\} \ i = 0, 1, \dots, m - 1 \ j = 0, 1, \dots, n - 1 \ k = 0, 1, \dots, p - 1$, then the sufficient and necessary conditions of unkmptly $A(R, S, T)$ is $S \prec R^* \quad R^T \prec T^* \quad S^T \prec \bar{T}$

69.3 A Special Matrix in Three-Dimensional Matrix

Now we structure a special matrix in three-dimensional matrix, this construction method allows us to easily find the matrix to meet the conditions [7].

Taking the first matrix of longitudinal direction of $\bar{A}(R, n, p)$, note as $A(i, j, 1)$ and $\bar{A}(R, n, p)$ as \tilde{A}_{mn1} . Take the first matrix of row direction of \tilde{A}_{mn1} , note as $B(1, j, k)$, the first column of $B(1, j, k)$ is the same as the first row of $A(i, j, 1)$. Note this column as α_1 , and the location of 1 to remember as $i_1, i_2, \dots, i_{r_{11}}$. Note the row sum vector of $B(1, j, k)$ as $t' = (t'_1, t'_2, \dots, t'_n)$, and then discuss:

If t' is decreasing vector, decline the first column α_1 in $B(1, j, k)$, and let t'' is the first row vector after the elements format 1 in location $i_1, i_2, \dots, i_{r_{11}}$ of T . We can construct a matrix belonging to $A(t'', r'_1)$, where r'_1 is the first column of R which decline the first element, fill a column vector α_1 , let it be $B(1, j, k)$, then $B(1, j, k)$ belong to $A(t_1, r_1^T)$;

If t' is nondecreasing vector, that is, there are two rows i, j ($n \geq i > j \geq 1$) satisfy that $t'_i > t'_j$, that means when we construct $A(i, j, 1)$, removing 1 to this position is wrong, at this time, for r_1, s_1 is non-decreasing vector, we can find out a 2×2 order matrix $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$ in $A(i, j, 1)$, then change the position of 1 but cannot change the quality of belonging to $A(r_1, s_1)$ [8]. Repeat until t' is decreasing vector. Then go to.

Note the matrix as \tilde{A}_{1n1} , then after $\min\{m, p\}$ time at least, we get $\min\{m, p\}$ matrix $A(i, j, 1), B(1, j, k), A(i, j, 2), B(2, j, k)$, combining those matrix, we can get a $m \times n \times p$ -order three-dimension matrix $\bar{A} \in A(R, S, T)$.

Second is the interchange, that is, we get one matrix in $A(R, S, T)$ from the other one, as long as we use limited step interchange, this quantity let us get any matrix in $A(R, S, T)$ from one matrix [9]. Let $A = [a_{ijk}] \in A(R, S, T)$, $C = [c_{ijk}]$ is minimum balance of matrix, satisfy $A + C \in A(R, S, T)$. Let $4k$ numbers of nonzero elements in the matrix C , and then $A + C$ can be got by $k - 1$ times interchange from A .

Example Known $R = \begin{pmatrix} 2 & 1 & 1 \\ 1 & 1 & 1 \\ 2 & 2 & 1 \end{pmatrix}, S = \begin{pmatrix} 2 & 2 & 0 \\ 1 & 1 & 1 \\ 3 & 1 & 1 \end{pmatrix}, T = \begin{pmatrix} 2 & 2 & 1 \\ 2 & 1 & 1 \\ 2 & 1 & 0 \end{pmatrix}$, then $\bar{A}(R, 3, 3)$.

In the longitudinal direction of the three matrices were

$$\bar{A}(i, j, 1) = \begin{pmatrix} 1 & 1 & 0 \\ 1 & 0 & 0 \\ 1 & 0 & 0 \end{pmatrix}, \bar{A}(i, j, 2) = \begin{pmatrix} 1 & 0 & 0 \\ 1 & 0 & 0 \\ 1 & 0 & 0 \end{pmatrix}, \bar{A}(i, j, 3) = \begin{pmatrix} 1 & 1 & 0 \\ 1 & 1 & 0 \\ 1 & 0 & 0 \end{pmatrix},$$

In the column direction of the three matrices were

$$\bar{B}(1, j, k) = \begin{pmatrix} 1 & 1 & 1 \\ 1 & 0 & 1 \\ 0 & 0 & 0 \end{pmatrix}, \bar{B}(2, j, k) = \begin{pmatrix} 1 & 1 & 1 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{pmatrix}, \bar{B}(3, j, k) = \begin{pmatrix} 1 & 1 & 1 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}$$

First step: Transform $\bar{A}(i, j, 1) = \begin{pmatrix} 1 & 1 & 0 \\ 1 & 0 & 0 \\ 1 & 0 & 0 \end{pmatrix} \rightarrow A(i, j, 1) = \begin{pmatrix} 1 & 1 & 0 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{pmatrix}$ in

this process the first row does not change, remove the first column $\bar{B}(1, j, k)$ turn

into $B(1, j, k) = \begin{pmatrix} 0 & 1 \\ 0 & 1 \\ 1 & 0 \end{pmatrix}$. This time $\bar{A}(i, j, 1) = \begin{pmatrix} 1 & 1 & 0 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{pmatrix}, \bar{A}(i, j, 2) =$

$$\begin{pmatrix} 1 & 0 & 0 \\ 1 & 0 & 0 \\ 1 & 0 & 0 \end{pmatrix} \rightarrow \begin{pmatrix} 0 & 0 & 1 \\ 1 & 0 & 0 \\ 1 & 0 & 0 \end{pmatrix}, \bar{A}(i, j, 3) \text{ remains unchanged.}$$

$$\bar{B}(1, j, k) = \begin{pmatrix} 1 & 0 & 1 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{pmatrix}, \bar{B}(2, j, k) \rightarrow \begin{pmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 0 & 0 & 0 \end{pmatrix} \bar{B}(3, j, k) \text{ remains unchanged.}$$

Remove $\bar{A}(i, j, 1) \bar{B}(1, j, k)$ get three-dimension $2 \times 3 \times 2$ matrix is $R_1 = \begin{pmatrix} 1 & 1 \\ 2 & 1 \end{pmatrix}, \bar{A}(R_1, 3, 2)$. The matrices in the longitudinal direction are

$$\bar{A}_1(i, j, 1) = \begin{pmatrix} 1 & 0 & 0 \\ 1 & 0 & 0 \end{pmatrix}, \bar{A}_2(i, j, 2) = \begin{pmatrix} 1 & 1 & 0 \\ 1 & 0 & 0 \end{pmatrix}.$$

The matrices in the row direction are $\bar{B}(1,j,k) = \begin{pmatrix} 1 & 1 \\ 0 & 1 \\ 0 & 0 \end{pmatrix}$, $\bar{B}(2,j,k) =$

$$\begin{pmatrix} 1 & 1 \\ 0 & 0 \\ 0 & 0 \end{pmatrix} S \rightarrow \begin{pmatrix} 1 & 1 & 0 \\ 2 & 0 & 1 \end{pmatrix}, T \rightarrow \begin{pmatrix} 2 & 0 & 1 \\ 1 & 1 & 0 \end{pmatrix}$$

Second step: Transform $\bar{A}_1(i,j,1) = \begin{pmatrix} 1 & 0 & 0 \\ 1 & 0 & 0 \end{pmatrix} \rightarrow A_1(i,j,1) =$

$$\begin{pmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \end{pmatrix}, \text{ this time the row direction of matrices was } \bar{B}(1,j,k) = \begin{pmatrix} 1 & 1 \\ 0 & 1 \\ 0 & 0 \end{pmatrix} \rightarrow$$

$$\begin{pmatrix} 0 & 1 \\ 1 & 1 \\ 0 & 0 \end{pmatrix}, \text{ Line sum vectors are nondecreasing, in } A_1(i,j,1) = \begin{pmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \end{pmatrix} \text{ we}$$

got a two-dimension matrix $\left(\begin{array}{cc|c} 0 & 1 & 0 \\ 1 & 0 & 0 \end{array} \right)$ change the position of 1, then

$$A_1(i,j,1) = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \end{pmatrix}, \bar{B}(1,j,k) = \begin{pmatrix} 1 & 1 \\ 0 & 1 \\ 0 & 0 \end{pmatrix}, \text{ this time line sum vectors are}$$

decreasing, $\bar{B}(1,j,k)$ removes the first volume and turn into $B_1(1,j,k) = \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix}$.

Remove $\bar{A}(i,j,1)$ $\bar{B}(1,j,k)$ and we get the three-dimension matrix $\bar{A}(R_2, 3, 1) = (1, 0, 0)$ $R_2 = (1)$, this time $S = (1, 0, 0), T = (1, 0, 0)$. $\bar{A}(R_2, 3, 1) = (1, 0, 0)$ Is that satisfying the condition, noted $A_2(i,j,1)$?

Now we get a three-dimensional matrix

$$A(i,j,1) = \begin{pmatrix} 1 & 1 & 0 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{pmatrix} \quad B(1,j,k) = \begin{pmatrix} 0 & 1 \\ 0 & 1 \\ 1 & 0 \end{pmatrix} \quad A_1(i,j,1) = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \end{pmatrix}$$

$$B_1(1,j,k) = \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix} \quad A_2(i,j,1) = (1, 0, 0)$$

Assemble these matrices, we obtain the required matrix.

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Chapter 70

Study on Innovative Teaching Mode of Mathematics

Youcai Xue

Abstract How to innovate the teaching of Mathematics Education is currently an important issue of mathematics teaching in the University. We conducted a serious explorations on the mode of mathematical thinking, problem solving, laboratory teaching, cultural environment teaching, and evaluation, which achieved good teaching results.

Keywords Mathematics · Creative teaching · Mode · Thinking methods · Problems

70.1 Introduction

Mathematics is junior foundation course at the University of engineering. How to implement innovation education, cultivating the creative ability of students is an important issue on which the university mathematics teachers have conducted an exploration and practice. For several years, we have made some successful experiences on the innovative teaching of mathematics in the University, which also has been recognized and appreciated by students. This mode included University mathematics teaching mode, the mode of teaching, experimental teaching mode, culture, environment, and evaluation mode.

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70.2 University Mathematics Teaching Mode of Thinking

Mathematical way of thinking is the soul of mathematics, thus the teaching of mathematics is the fundamental problem of mathematics education. Especially when the mathematics course is reduced in the university, we should highlight the teaching and thinking of university mathematics to enable students to grasp the most essential things in mathematics at the University, in the interest of students to continue learning and development in the future.

Mathematics teaching mode is the main method of thinking education in mathematics at the University, through well-designed series of teaching problem and associated mathematical research activities (process including exercises), mathematical thoughts could be really understood by students, and be able to adapt and, learn to think in mathematics way.

Case 1 Idea and method of elementary transformation.

Elementary transformation is one of the important ways of thinking in the Linear Algebra, and it is also one of the most widely used methods. Elementary transformation involving linear equations, the rank of a matrix, the vector group of great independent group, the base and dimension of the linear space, reduction of quadratic and many other important problems of linear algebra.

When we teach “Linear Algebra” in the class, we find that students are familiar with elimination method for three variable linear equation, so we abstract the way of thinking “elementary transformation of linear equations”, which means that with the elimination method to solve linear equations, the process is repeated in the following three basic equations transform to simplify the original equations [1].

1. Exchange equation in the position of the two equations;
2. With a nonzero number multiplied by a certain equation;
3. An equation multiplied by a number, and then adds the result to another equation.

Then we gradually put this extended approach to elementary transformation of matrix and elementary transformation of determinant.

After we establish the elementary transformation method of thinking, we constantly strengthen the thinking of the teaching and training through courses: Solutions of determinant, simplified and popularity rank of the matrix, matrix decomposition, and solving of equations, they are repeatedly emphasized and used which enable students to master the basic way of thinking.

Teaching of mathematical thinking is to break through the traditional teaching model, new models treat mathematics as an experimental inductive science, not merely as a “deductive logic system.” In the teaching process, new problems especially the well-known problems, we encourage students to use methods to analyze with the usage of analogy, induction, speculation, sensible way of thinking, abstract reasoning, etc. Make the process of learning mathematics as a process of mathematical invention of the “repetition.” Only in this way, students

will be able to understand the flexibility of mathematical ideas and methods, not just read a proof of the solution process. Mathematics Teaching “cannot be confined to the building from the ‘known’ to ‘verify’ the logic chain, but to face the original scene, think the original issue, to drive with reasonable mathematical thinking of learners [2].”

70.3 Problem-Driven Teaching Mode of College Mathematics

Mr. Zhang Dianzhou, presented “problem-driven” teaching philosophy in 2004. The process of questioning, doing research, solving problems, is the only way of all scientific researches. Therefore, innovation in mathematics education should be integrated in the “Mathematics” teaching, not just the inculcation of knowledge.

There are four types on problem-driven mode of teaching. First, is to lead the process of teaching. In the teaching process, we focus on this issue and in conjunction with mathematical way of thinking, so that students can learn more in-depth understanding of content and inspire students to explore mathematics. Second, is to lead the development. Some of the concepts, theorems, examples in our books could be reprocessed, expanded, or extended to guide students ask new questions, learn to grasp the method of asking questions. Through this type of problem-driven learning and training, and then gradually guide students to learn mathematics independently, can provide questions and solve problems, which can develop their creativity. Third, to lead critical thinking, which is to develop students’ critical spirit and open mind. Fourth, is to lead the application.

Case 2 Given A is matrix, make elementary transformation on A into standard

$$\text{form } A = \begin{pmatrix} 2 & -1 & -1 & 1 & 2 \\ 1 & 1 & -2 & 1 & 4 \\ 4 & -6 & 2 & -2 & 4 \\ 3 & 6 & -9 & 7 & 9 \end{pmatrix} \rightarrow \begin{pmatrix} 1 & 0 & -1 & 0 & 4 \\ 0 & 1 & -1 & 0 & 3 \\ 0 & 0 & 0 & 1 & -3 \\ 0 & 0 & 0 & 0 & 0 \end{pmatrix}$$

$$\text{We obtain } B = \begin{pmatrix} 2 & -1 & 1 \\ 1 & 1 & 1 \\ 4 & -6 & -2 \\ 3 & 6 & 7 \end{pmatrix}, C = \begin{pmatrix} 1 & 0 & -1 & 0 & 4 \\ 0 & 1 & -1 & 0 & 3 \\ 0 & 0 & 0 & 1 & -3 \end{pmatrix}$$

Making $A = BC$

We can get the Theorem: Set A be a $m \times n$ matrix of rank r , then there is a $m \times r$ matrix B of rank r , and a $r \times n$ matrix C of rank r , making: $A = BC$ [3].

Case 3 Let B be key matrix, let $C_1 = \begin{pmatrix} -1 & -1 & 0 \\ 4 & 3 & -3 \end{pmatrix}^T$

Using matrix multiplication, there is plaintext matrix, combined of 3rd, 5th columns of matrix $A D^T = BC = \begin{pmatrix} 1 & -2 & 2 & -9 \\ 2 & 4 & 4 & 9 \end{pmatrix}$

Let A is the ciphertext matrix, the key matrix is product matrix made on a series of elementary transformation, that is, there is a full rank matrix P , let $PA = C$. C is cleartext matrix.

Case 4 In the complex domain, is the problem-solving process in the next question correct? If there is an error, please point out the wrong reasons.

$8^{\frac{1}{6}} = (2^3)^{\frac{1}{6}} = 2^{\frac{1}{2}} = \pm\sqrt{2}$ this kind of problem is simple, but it is helpful for students to develop critical thinking. Students often due to the migration habits of thinking, tend to make real number operation puzzled with complex number computations. Through these problems, students can make analogy and induction between new knowledge and the old, do analysis of their nature or difference. It is a good teaching method. This will not only develop the habit of students to think hard, but also be helpful to collate the knowledge, discover the new conflicts, and learn critical inheritance.

Cultivating students' mathematical consciousness and the ability to ask questions are important parts of innovation education in mathematics. Problem-oriented teaching mode is designed to develop students to be good at finding problems, asking questions, thereby improving their ability to create and solve the problems. As noted by Einstein: "Asking a question, is often more important than solving a problem. On solving the problem is just a mathematical or experimental skill while providing new questions, new possibilities, seeing old problems with a new perspective, which needs a creative imagination."

70.4 Experiment-Teaching Mode in Mathematics

Mathematical experiment in mathematics education is actually a useful attempt in which science and technology practice are used.

In the teaching process, we put mathematics experiments generally into two types: first, those of machinery, computing skills required and calculation problems. We have them processed by the computer, to lighten the burden of students of mechanical calculation, mathematical thinking, and then can focus on learning; the second, those found by mathematical experiment problems, problem-solving experiments. Such experiments on which students apply mathematical thinking through the process of exploration program on computer.

Case 5 Using MATLAB to find the value of the residue [4].

Find the value of the function $\frac{\sin z - z}{z^6}$

This problem belongs to the first class of mathematical experiment, which is typical of computational problems [5].

Case 6 In the RLC circuit in series with DC e , Find the loop current $i(t)$ values (Fig. 70.1)

Fig. 70.1 The loop current $i(t)$ values

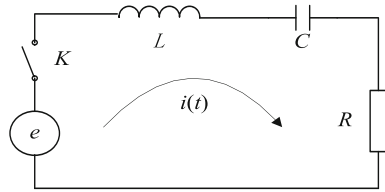
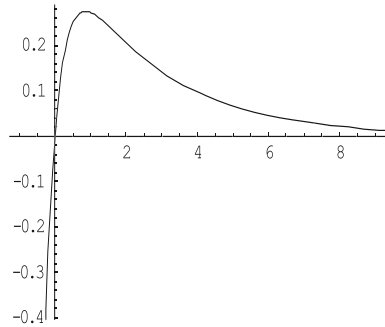


Fig. 70.2 $R > 2\sqrt{\frac{L}{C}}$



Solution: According to Kirchhoff's law, $u_C + u_R + u_L = A$, $u_R = Ri(t)$, $i(t) = C \frac{du_C}{dt}$, then, $u_C = \frac{1}{C} \int_0^t i(x) dx$, As $u_L = L \frac{di(t)}{dt}$, so after substitution, we obtain $\frac{1}{C} \int_0^t i(x) dx + Ri(t) + L \frac{di(t)}{dt} = A$, $i'(0) = i(0) = 0$ [6].

The following is the application of Mathematical in solving the above equation procedures:

```
In (1): = eq = 1/C ∫₀ᵗ i[x]dx + R * i[t] + L * i'[t] = A;
In (2): = e1 = Map [Laplace Transform [# ,t,s] &, eq];
In (3): = e2 = e1 /. {i'[0] -> 0, i[0] -> 0, Laplace Transform [i[t], t, s] -> II[s]};
In (4): = ans = Solve [e2, II[s]]
Out (4): = {{II[s] -> AC / (1 + CRs + CLs²)}}
In (5): = sol = Inverse Laplace Transform [ans [[1, 1, 2]], s, t]
```

$$\text{Out (5):} = \frac{A\sqrt{C}e^{-\left(\frac{R+\sqrt{-4L+CR^2}}{2L}\right)t} \left(-1+e^{\frac{\sqrt{-4L+CR^2}t}{\sqrt{CL}}}\right)}{\sqrt{-4L+CR^2}} \text{ (i.e. } i(t)\text{)}$$

If $R > 2\sqrt{\frac{L}{C}}$, for example, $C = 1, L = 1, R = 3, A = 1$

```
In (6): = soll = sol / {C -> 1, L -> 1, R -> 3, A -> 1}
Out (6): = e^{-1/2(3+√5)t} (-1+e^{√5t}) / √5 (i.e. i(t) = e^{-1/2(3+√5)t} (-1+e^{√5t}) / √5)
```

```
In (7): = Plot [sol1, {t, -1, 10}]
Out (7): = Graphics (Fig. 70.2)
```

If $R < 2\sqrt{\frac{L}{C}}$, for example, $C = 1, L = 1, R = 1, A = 1$

Fig. 70.3 $R < 2\sqrt{\frac{L}{C}}$

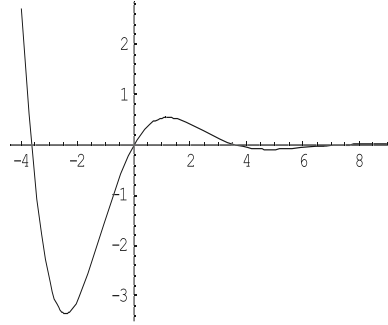
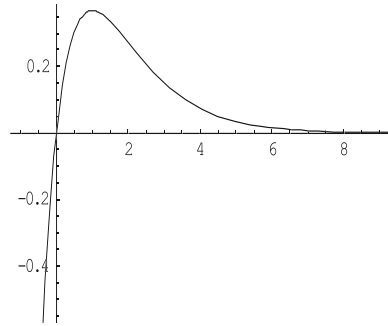


Fig. 70.4 $R = 2\sqrt{\frac{L}{C}}$



In (8): = sol2 = sol/{C → 1, L → 1, R → 1, A → 1}

Out (8): = $\frac{ie^{-\frac{1}{2}(1+i\sqrt{3})t}(-1+e^{i\sqrt{3}t})}{\sqrt{3}}$ (i.e. $i(t) = \frac{ie^{-\frac{1}{2}(1+i\sqrt{3})t}(-1+e^{i\sqrt{3}t})}{\sqrt{3}}$)

In (9): = Plot [sol2, {t, -4, 10}, Plot Range → All]

Out (9): = Graphics (Fig. 70.3)

If $R = 2\sqrt{\frac{L}{C}}$, for example, $C = 1, L = 1, R = 2, A = 1$

In (10): = sol3 = Inverse Laplace Transform [ans [[1, 1, 2]]/.{C → 1, L → 1, R → 2, A → 1}, s, t]

Out (10): = $e^{-t}t$ (i.e. $i(t) = e^{-t}t$)

In (11): = Plot [sol3, {t, -1, 10}]

Out (11): = Graphics (Fig. 70.4)

Below are the above equation solving in Mathematical, omitting the specific procedures and processes [7, 8].

Math experimental course aims to train students to apply mathematical knowledge to analyze and solve practical problems and the application of computer science and computing. For engineering students in terms of mathematical modeling and mathematical experiment opened the way for the application of mathematics, and raised students' awareness and interest in ability, and the ability to develop innovative spirit [9, 10].

70.5 Summary

Creative education in mathematics is a big problem. What we made in the teaching of linear algebra was only a preliminary exploration of the work. We hope to have more teachers in the University to enjoy themselves into the exploration and practice of innovation education in mathematics, and achieve better results [11].

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Part VIII
Information Management Systems
and Software Engineering

Chapter 71

Research on an Intelligent Distance Education System Based on Multi-agent

Wen Shu Duan, Yan Ma, Lun Peng Liu and Tian Ping Dong

Abstract This paper presents construction of an intelligent distance education platform under the network by the technology of agent. This platform can provide collaborate virtual teaching environment for teachers and students in different sites. The architectures and communicative mechanism of multi-agents in this platform are described in detail.

Keywords Agent · Intelligent · Distance education platform

71.1 Overview

Modern Distance Education is characterized with computer network, satellite communications, and broadcasting television as the main transmission way, using the digital and intelligent technology and multimedia technology, which is convenient with real-time, two-way communication to achieve education resources sharing better, and it takes the network school as the main education approach.

Intelligence of modern distance education system refers to an education system that has the human “thinking, judgment, reasoning” ability, according to the students’ feedback information, making some suitable decisions and actions for students in the teaching process.

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71.2 The Elements Based on Multi-agent in Distance Teaching System

Agent is a software entity of independent operation in a certain environment, it has learn ability, intellectual, initiative and collaborative, and other characteristics that can help in communication with each other, learning, and perception between agents. In the multiagent system, agent is equally collaborative. Using the collaborative operation to complete the given task is consistent with the CSCW system, which emphasis on collaborative work through the computer network [1]. Therefore, adopting the multiagent to realize the computer support intelligent distance education system is feasible.

Distance education system covers each teaching link in general, which is a multiagent structure and according to the user’s different identity, the system is divided into teachers Agent, students Agent, managers Agent. Every agent use the BDI beliefs desire intention model to design the behavior of the individual, which includes the faith ability intention and the behavior rule set, and to make the necessary communication to coordinate action with each other. And faith is an awareness among their own state and environment; Ability refers that it can perform action when the particular premise condition is contented; Commitment is a kind of agreement to carry out specific action for other agent in particular moment; Intention is a goal that the agent wants to achieve, that is to achieve a specific state; Behavior rules equivalent to control structure, deciding the action that agent can perform at each time point in the whole operation process. All those can be divided specifically, such as teachers’ faith: teachers registered teaching, learning material, problem sets, knowledge database, etc. Students’ faith: student registration, and course schedule, results, examination evaluation, etc. Managers’ faith: registration application for admission, professional course constitution, arrangement of graduate management, etc. As shown in Tables 71.1, 71.2 and 71.3.

Complete distance education system also need to include the several support subsystems as follows: teaching courseware release, generate, uploading and administration subsystem, online answer and assignment submission evaluation subsystem, distance online examination evaluation subsystem, video on demand and video conference learning subsystem, interactive discussion, and background

Table 71.1 The teachers agent

Teachers	Intention	Ability	Commitment
1	Give lessons	Courseware Making: A B C D E	Assessment of Learning: F G
2	Teaching quality evaluation	Guiding students to learn	Online interaction

A knowledge management, *B* organizing the learning material, *C* problem sets maintenance, *D* examination paper generated, *E* review the material of induction, *F* approval application for examination, *G* grade analysis and the instruction

Table 71.2 The students agent

Students	Intention	Ability	Commitment
1	Learning	Self management: A B C	Online interaction
2	Examination	Autonomous learning: D E F G	Accept the guidance of teachers
3	Graduation		

A Personal file management, *B* Personal goal maintenance, *C* Personal learning adjustment, *D* courseware learning and records, *E* self practice and progress adjustment, *F* personal review, *G* application for examination and evaluation

Table 71.3 The managers agent

Managers	Intention	Ability	Commitment
1	Educational administration management	Identity verification: A B C D	Course arrangement: E F
2	Recruitment of teachers and students	Teaching evaluation	Graduate management

A proselytize application, *B* admission, *C* teaching identity authentication, *D* learning identity authentication, *E* major setting and the course, *F* semester curriculum

management subsystem, etc. These subsystems accumulate the massive useful teaching resources and reference material information, such as access log book, the examination results, question–answering information, discussion, assignments, study progress, and the page visits, etc.

71.3 The System Architectures of Intelligent Distance Education Platform

This platform takes Internet/Intranet as network environment and uses three C/S structure, as shown in Fig. 71.1. On the client, teachers and students can go into synchronous or asynchronous teaching environment through teachers’ site and students’ site. The server is divided into two layers by the collaboration server and the database server respectively, the collaboration server is used to support the coordinating operation between agents, and the database server manage the user’ data, cooperation information, and teaching resources.

Distribution in students’ site, teachers’ site, and multiple agents in the collaboration server consists of a agent group, according to the different role and function that each of the agent play in the group, which can be divided into teachers Agent, students Agent as well as communication control Agent, cooperation management Agent, and collaborative application Agent located in collaboration server and be used to support cooperative teaching. In the specific network teaching environment, the main teaching activities take the teacher as control center, the teacher is responsible to arrange, implement and adjust teaching contents and methods, and the students’ learning revolve around the teacher.

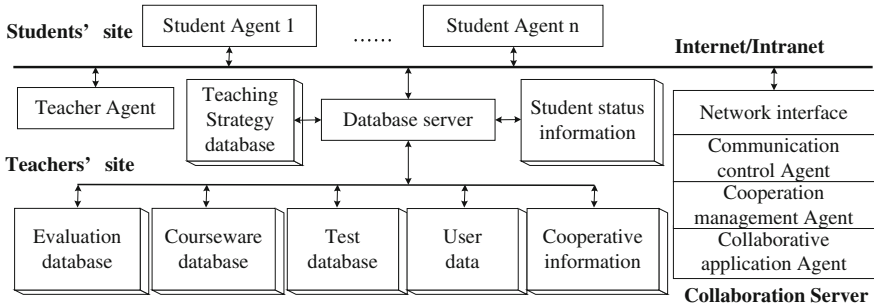


Fig. 71.1 The system structure of intelligent distance education platform

Therefore, this system mainly adopts the teacher master control, s and the centralized control method which applies to students [2]. When the students need to use the other multimedia interactive tools except for the text communication, classroom questioning, such as electronic white-board, they must apply to teachers through students Agent. The teachers render approval or disapprove through the cooperation management Agent. The teachers have to allow or prohibit the students from participating in the classroom learning, giving talks, white-board discussions and other rights, in order to embody the role of teacher to maintain the classroom discipline and manage the teaching in the classroom.

71.4 The Design of Intelligent Distance Education Platform

71.4.1 The Teachers Agent

Teachers Agent is used to assist teachers in teaching to manage and control, it consists of user interface module, monitoring module, assessment module, learning instruction module, control module, communication module, and knowledge base, as shown in Fig. 71.2. The user interface module is an interactive channel between Agent and teachers, the teacher’s intention and operation through the user interface module is transmitted to control module for further processing, and receives the other agent’s message feedback to teachers by the user interface module. Monitoring module is used to monitor student’s learning process, the current study condition, to determine whether to allow its operation, so as to determine what teaching strategy for the student. Evaluation module uses the information from monitoring module and evaluation database to measure students’ learning situation, in order to improve the teaching methods, adjust teaching strategy. Learning instruction module can provide guide, communicate, and discuss for the student’s study, and timely adjust their teaching strategies based on evaluation results and teaching strategies library. Control module is the nerve center of the agent, after it receives the messages from teachers or other agent, the

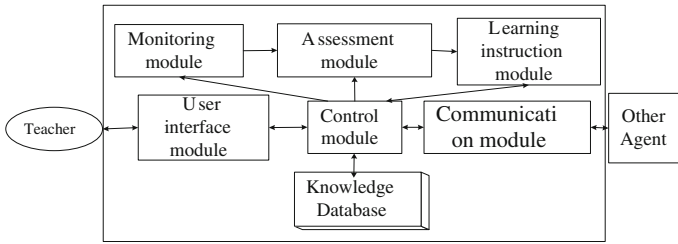


Fig. 71.2 Teachers agent

knowledge in knowledge base commands and coordinates the implementation of other modules. Communication module is a channel to deliver the message between agents, be responsible for negotiation and interaction with agents, embodying the cooperation in agents. The knowledge base stores control knowledge, monitoring rules and methods, and communication knowledge, etc.

71.4.2 The Students Agent

Students Agent is used to assist students in learning under the control of teachers Agent, consisting of the user interface module, learning module, self-test module, control module, communication module, and knowledge base, as shown in Fig. 71.3. The user interface module provides interactive interface for students, who can choose to enter asynchronous team teaching environment or synchronous teaching environment. In the asynchronous teaching environment, students can login system, browse courseware, participate in group discussions and give teachers or other members to send e-mail or get question answer; In synchronous teaching environment, students can join all activities in a real-time virtual classroom, including log on to the system, join a class meeting, browse courseware, follow the teacher learning, approved by the teacher to interact through chat rooms, video conference, and electronic white-board with teachers and members. Learning module is used to support student learning activities, and records students' learning state to information base. Self-test module is used for students self-evaluation in the current study condition, mainly to determine their level of knowledge and the error through interaction with the evaluation database, test database. Control module commands and coordinates the implementation of other modules according to the knowledge in knowledge base. Communication module is responsible for interaction with the outside world and teachers Agent, having the ability of perceive external events, that is activated when the trigger condition is contented and accept the instructions of teachers Agent [3]. The knowledge base stores control knowledge and communication knowledge, etc.

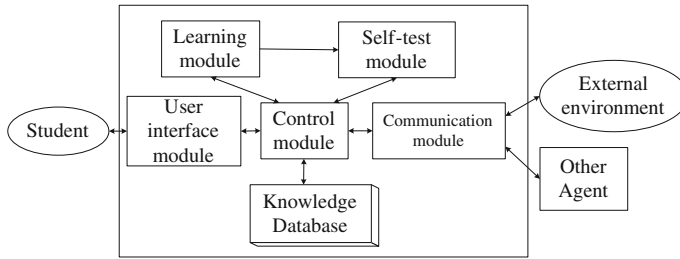


Fig. 71.3 Students agent

71.4.3 Collaboration Server

Collaboration server is used to support the Multi-agent collaborative operation, consisting of communication control Agent, cooperation management Agent, and collaborative application Agent.

Communication control Agent realizes the exchange between the Agents and between teachers and students Agent and the server. it supports HTTP, FTP, TCP/IP, and various UDP communication protocols, responsible for message routing, QOS management and bandwidth allocation, store-and-forward, etc.

When this Agent examines a certain or some participants put forward the application for the collaborative learning, first of all the identification to the applicant, and then according to the teachers Agent confers its permission of participation in the activities and add to the activities. Besides cooperation management Agent is also responsible for the coordination between agents, collaborative conflict detection and elimination, and the consistency of the collaborative information. This Agent is maintaining a global sharing information database of collaboration, through the ODBC interfaces to access the database, in order to guarantee the consistency of the data between the members of cooperation.

Collaborative application Agent realizes application sharing services, Chat services, electronic white-board, video conference and multimedia interactive services, and so on. In order to keep the basic features of traditional teaching such as interaction between teachers and students, students and students in the network teaching process, this Agent offers the following six kinds of collaborative tools: (1) Courseware browsing tools. (2) Applications to share tools. (3) Electronic white-board tools. (4) Synchronous text communication tools. (5) Classroom questioning and answering tools. (6) Synchronous voice/video transmission tools.

71.5 Communication Mechanism of Multiagent

The communication mechanism is the basic way of the agents mutual perception and information communication. It includes communication mode, communication primitive, and communication content, and can be expressed as:

Communication mechanism ::= <communication mode>/<communication primitive>/<communication content>

Communication mode ::= <point-to-point Communication>/<indirect communication>/<agreed communication >/< mixed communication>

Communication primitive ::= <announcement>/<appointment>/<request>/<promise>/<notification>/<rejection>/<response>

Communication content ::= <behavior>/<source Agent>/<target Agent>/<time>/<reason>/<information>

Communication mode is divided into point-to-point communication, indirect communication, agreed communication, and mixed communication, described as follows:

1. Point-to-point communication: It is a direct communication between Source Agent and Target Agent, has the advantages of good security because of only two sides know each other. This mode is adopted in teaching for individual coaching.
2. Indirect communication: Source Agent releases the announcement information to the electronic white-board, other agent may acquire the information released and this kind of means is suitable for the broadcast and multicast communication. And this mode is adopted in distance teaching or group guidance, free talk, etc.
3. Agreed communication: Source Agent will send the information to location which is appointed with target Agent, such as a public data area, to realize indirect communication.
4. Mixed communication: In the team, teaching process sometimes not only requires the point-to-point communication between team radio and the group members, but also requires different groups that have selective point-to-point communication. The above three modes do not meet the requirements of the multigroup cooperation communication, so, the way to realize the requirements is that the mixed communication mode. Its principle is that the electronic white-board is divided into a public data area and several logic areas corresponding to grouped tasks, called the group areas.

The above communication mechanism uses the KQML language to realize [4]. KQML is a language of communication based on message and information exchange protocol, it supports high-level communication of agent, can effectively share knowledge between agents. KQML information is described in three levels: content layer, message layer, and communication Layer. Content layer contains the actual contents with message, and KQML can carry any contents of language expression, including ASCII and binary code. Message layer increases the describing features about the content on the expression of the content layer to help correct information transfer and the receiver analysis data, so it is regarded as “talk and action layer”, one of the important characteristics is that it indicates an action during the agents dialogue, such as assertion, inquire, response, and error

messages. Communication layer adds to the describing features of the lower communication on the basis of the message layer, such as the sender, the receiver, and the unique identifier related with communication, etc.

71.6 Conclusion

Intelligent distance education platform based on Multi-agent provides a good collaborate teaching environment for teachers and students and supports two modes of synchronous collaborative and asynchronous cooperative, can greatly improve the mutual cooperation and the exchange of information quality between teachers and students in the process of complete the teaching task. Research on this platform is adapted to the information society on the education needs.

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Chapter 72

Research of Enterprise Knowledge Portal System for Product R&D

Ben-Gong Yu and Shu Ping Zhao

Abstract Knowledge Management has become one of the core competitions in the enterprise. In order to minimize product development cycle and promote market competitiveness, we need to optimize the level of knowledge management in complex product development processes based on the analysis of the characteristics of enterprise knowledge management for product R&D process, and make use of knowledge management theory and information technology. This paper put forward the knowledge management process of the product R&D enterprise and the architecture model of enterprise knowledge portal (EKP) system, which can provide the theoretical basis and the reference model for the implementation of Enterprise Knowledge Management for product R&D. Finally, the EKP system for product R&D based on the platform of sharepoint is constructed.

Keywords Product R&D · Knowledge management · Enterprise knowledge portal · Knowledge base · Sharepoint

72.1 Introduction

The twenty-first century is the year of knowledge economy. With the rapid development of information technology and nowadays increasingly fierce competition among enterprises, the level of independent research and development of

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enterprises has risen to a critical position, especially in business R&D activities, which are number of links related to complex process, requires the exchange and cooperation between the department and staffs, requires interdisciplinary skills and expertise. With product R&D technology constantly being updated, knowledge of these industries in development and innovation are contained in all aspects of product development.

As the modern product R&D processes become more complex, there is more emphasis on the collaboration design of knowledge resources during the product R&D process. Although a variety of knowledge produced during the product R&D process is scattered piecemeal, it is difficult for people to obtain the desired knowledge, which leads to being unable to reuse and share knowledge. Currently, how to find right information and knowledge has become the bottleneck of the product R&D process. To shorten the cycle of the product R&D, it is imperative to realize the rapid acquisition of knowledge and knowledge sharing and reuse. In this paper, using the knowledge management and technology enterprise information portal, in combination with the current situation and characteristics of knowledge management during the process of product R&D, it is discussed how to construct the platform of product R&D enterprise knowledge portal (EKP), which can also provide the latest technology support and effective management of related knowledge during the process of product R&D, which will get enterprises to work more efficiently, enhance new product R&D ability, and reduce promotion of new products, so that enterprises have the advantage in the fierce market competition.

72.2 EKPs of Product R&D

72.2.1 EKP

EKP is a new form of expression of combination of enterprise information portals and knowledge management. It is not only related to the integration of enterprise business process and inside and outside networks, which are concerned by enterprise information portals, but also has the function of information retrieval, integration, classification, personalized display, and systems resource management [1]. Its integrate platform contains knowledge process, knowledge publishing, knowledge acquisition, and decision-making, combining different kinds of knowledge of information resources. EKP allows users to get information about the common values, experience and insight of enterprise, realize the acquisition, usage, retrieval and sharing of information and knowledge, help staffs to learn and absorb new knowledge quickly, and make the best decisions for enterprise managers and staff.

72.2.2 Knowledge Management Process of Product R&D

Enterprise’s product R&D knowledge management is the management of explicit knowledge of enterprise and tacit knowledge in the distributed staff’s brain, to improve the ability of change and innovation through the capture, sharing and integration of the collective knowledge and the use of collective wisdom. In the process of product R&D every step, every stage carried out continuously the recycle of acquisition, sharing, usage and innovation of knowledge. The knowledge management of the product R&D includes the management of explicit knowledge and tacit knowledge. The explicit knowledge of product R&D process contains the project graphs, function plans, materials list, standards brochure, research and development programs and product catalogue of parts suppliers. Tacit knowledge is the knowledge in R&D staff’s brain and experience and methods of solve problem personally. Taking the characteristics of product R&D knowledge, this paper presents the schedule of product R&D knowledge management, shown in Fig. 72.1.

The database stored with the obtained explicit knowledge that was classified, coded, the formal represented at the platform of the EKP. The R&D staff and experts communicate in various ways such as discussion boards, and one piece of paper of experience, so that externalize the tacit knowledge, even the knowledge sharing and reuse. When carry out the knowledge management, every staff can provide knowledge to the knowledge portal platform, so that every staff’s

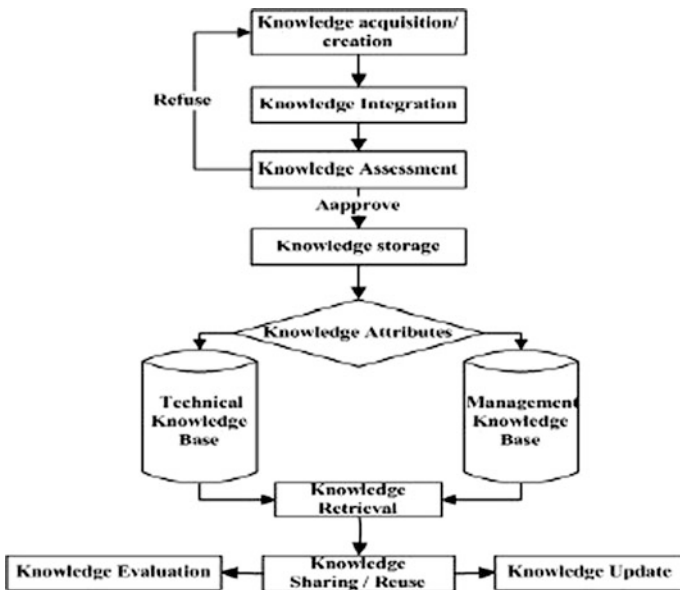


Fig. 72.1 Flowchart of product R&D knowledge management

knowledge becomes part of knowledge portal platform, the knowledge sharing freely realized by staff access to the network at any time.

72.2.3 The Architecture of Product R&D EKP

Referring to other enterprise’s successful experience of establishment of EKP, based on the need of product R&D enterprise to knowledge management, and combine with SOA concepts, and IT technology. This paper put forward architecture model of product R&D EKP system [2-4], and provides a unified management support platform for the enterprise, shown in Fig. 72.2.

The EKP of product R&D based on SOA concepts, using multi-layer B/S architecture model, consist of the data storage layer, function layer, application layer, display layers:

Data storage layer: the management for data storage, including distributed management and security management etc.

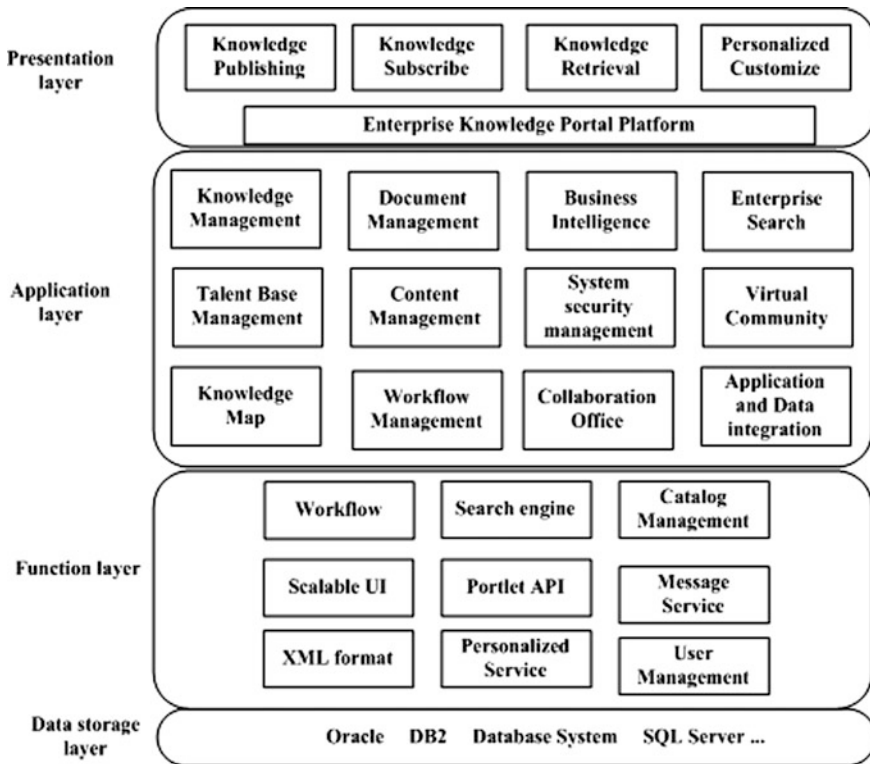


Fig. 72.2 The architecture of product R&D EKP

Functional layer: providing service to application layer and Presentation layer, connect the underlying service to the upper application, realize the storage and transmission of the database of date storage layer. The layer include knowledge discovery, collation, storage and dissemination; the same time the layer provide basis public service to the application layer, such as user management, workflow, search services, personalized service, etc.

Application layer: processing logic for a variety of business management and knowledge management, and also determines the function of the knowledge portal system, meet different business needs, such as the provision of knowledge management, construction of knowledge maps, content management and management of user's right, ensure the application of EKP in various ways.

Presentation layer: The layer provides personalized system, present the "people-oriented" personal information, flexible display information and knowledge concerned according to the demands of personal, department, enterprise and provide multiple access methods. Users can subscribe to frequently used files, press notice. The knowledge maps provide navigational charts for the knowledge sharing of enterprise. Finally, various ways of retrieval of knowledge provided by the efficient search engine and it also meet the user's needs of search for knowledge quickly.

72.3 Implementation of the Product R&D EKP

This paper builds the system of Product R&D EKP based on information sharing and collaboration platform of Microsoft's SharePoint [5]. This platform help enterprises to combine personnel, information, systems and business together, which can better share knowledge, strengthen communication with customer and improve work more efficient. According to the function of the system architecture model of product R&D EKP and knowledge process of R&D enterprise, main realize knowledge management modules of R&D EKP system.

72.3.1 Knowledge Acquisition

The product R&D process produce various unstructured knowledge and structural knowledge, such as electronic documents, news alerts, regular meeting of project, meeting produced tasks and the meeting minutes, etc. The R&D Staff release, view, modify and delete the above contents of classifying in the system platform according to him limits of authority; staff can set the browsing contents according to the need, can classify and search its contents. R&D staff submits experience knowledge can be stored in experience knowledge base, which needs to be approved by the experts.

72.3.2 Knowledge Assessment

The product R&D enterprise follows a uniform business processes by using the workflow technology, improve enterprise's efficiency and production efficiency by managing the related tasks and steps of business processes, such as electronic document approval, plan task approval, sending e-mail, etc. In order to prevent various unvalued of no value of no value knowledge stored in knowledge base by organizing experts to assess the knowledge, this paper realizes knowledge assessment making use of workflow technology. After submitting to the knowledge, the system will automatically generate the task of knowledge assessment through workflow technology, inform related experts through e-mail. If their knowledge was approved, it is stored in various Knowledge Bases for other R&D staff sharing and learning, or it is refused to store in the Knowledge Base, not being unavailable by other staff when needed.

72.3.3 Knowledge Storage

Product R&D knowledge have explicit knowledge and tacit knowledge, structural knowledge and unstructured knowledge in product R&D process. The platform can build various knowledge bases to store the generated knowledge in product R&D process, such as basal knowledge base, experience knowledge base and product database, etc. The basal knowledge base store various unstructured knowledge, such as working templates, parts library, technical documents, pictures library, etc. The experience knowledge base store mainly electronic document, which result from the summary of semi-structured knowledge of various technical issues and product R&D experience that have been approved by approval workflow, realize dominance and solidification of the personal tacit knowledge. The product knowledge base store various structured knowledge was formed in product R&D process, such as product structure and configuration, parts definition, design data, test data and CAD drawing files, etc. Figure 72.3 shows display interface of the experience knowledge.

72.3.4 Knowledge Retrieval

The EKP needs a fast knowledge retrieval tools, which make staff to find and search needed information, knowledge or the content of document quickly in a great deal of information or knowledge resources of product R&D database, so that realize information and knowledge sharing and reuse. The EKP provides a powerful indexing engine and retrieve engine in knowledge search. Users can set the portal retrieve engine criteria, such as Content sources, content types and crawl



Fig. 72.3 The treeview of product R&D experience knowledge base

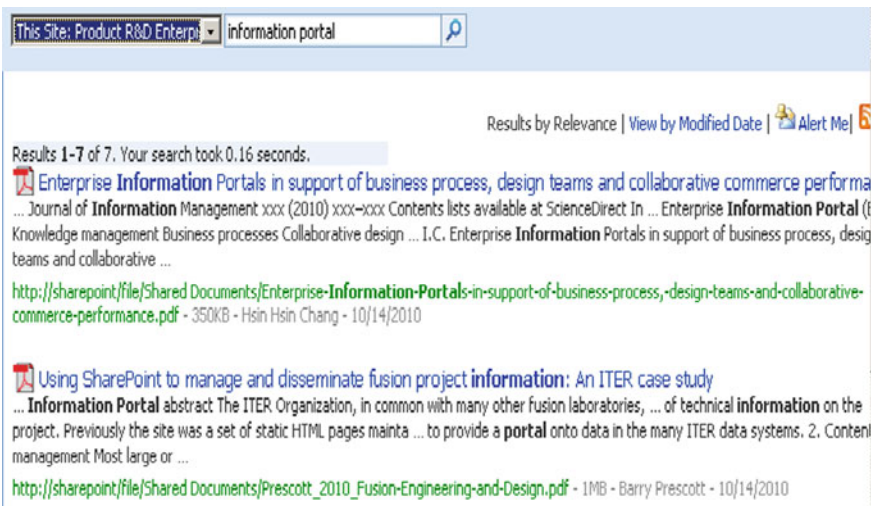


Fig. 72.4 The knowledge retrieval of PDF full-text

net rules, etc., user can design personalized search interface, integrates with other search engines, so that help users search and find the knowledge of the system, and improve work efficiency. Shown in Fig. 72.4, the system can realize the full-text search of the PDF files by integrating Adobe Ifilter search engine.

72.3.5 Knowledge Exchange and Sharing

Users can retrieve the knowledge documents and various data that they want in a variety of knowledge base of EKP; at the same time the it also offers all kinds of function about products R&D knowledge, such as technical topics forum, online Q&A, information publishing etc. The staff can gather kinds of question online by using the “investigation” list in system, can construct various special forums of techniques knowledge for the knowledge exchange and discussion online among engineers by using the “discussion board”, issue a variety of solution of the technique question, the EKP system can realize the dominance of implicit knowledge, the personal tacit knowledge sharing.

72.4 Summary

This paper analyzes the situation, characteristics, and knowledge management processes in the product R&D enterprise, builds the EKP System of product R&D, and discusses the architecture and specific technology Implementation of system profoundly. All staff of company can obtain, excavate, use the knowledge of company-owned by EKP system, improve themselves skills level and thus enhance the ability of new product R&D, improve the quality of product R&D, reduce the costs of product R&D, improve the competitiveness of business, has reference significance for the implementation of knowledge management of other R&D enterprises.

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Chapter 73

GPS-Based On-Board Road Test System for Automotive ABS Evaluation and Calibration

Wenlin Wang and Weidong Chen

Abstract To obtain an objective and accurate system for automotive anti-lock braking system (ABS) evaluation and calibration by overcoming the bottleneck of vehicle speed measurement, a novel global positioning system (GPS) based on-board road test system is developed in this study. The vehicle speed acquisition module with a GPS antenna is capable of sensing vehicle speeds on-board between 0.8 and 185 km/h with a high resolution of 0.01 km/h, which is satisfactory for ordinary ABS road test; four specially designed photoelectric sensors are fixed to pertinent wheel hub for reliable wheel speed acquisition. Thus, the road test system uses all credible “outside” information for ABS evaluation and calibration, this would also make no disturbance to ABS signals. A case road test study confirms that the developed system performs well in ABS testing and analyzing. So far, the road test system has been applied successfully in several ABS products development and is being commercially available on the market.

Keywords Anti-lock braking system (ABS) · On-board road test system · Vehicle speed · Global positioning system (GPS) · Evaluation and calibration

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73.1 Introduction

Anti-lock braking system (ABS) is widely used in automobiles to provide active [1] safety during braking, by regulation of the wheel slip at its optimum value in real time. Although many advanced methods [2, 3] are still being studied theoretically or experimentally to ever improve control quality of ABS, road test is crucial and essential for evaluation and calibration in any ABS development. Therefore, obtaining an objective and accurate on-board road test system is of great significance.

However, measurement of vehicle speed is the development bottleneck of any on-board road test system or ABS itself. So far, there are two, indirect or direct, approaches to obtain vehicle speed. The indirect approach is to secure vehicle speed by referring to sensed wheel speeds [4, 5], or by parameter estimation [6, 7] through vehicle dynamics modeling or complex algorithms, so the obtained value is usually named as the reference vehicle speed; the direct approach, as it indicates, uses sensors such as the speed-over-ground [8, 9] or the global positioning system (GPS) [10, 11] to measure vehicle speed directly. The former approach is the cheapest solution, yet suffers from estimation errors; the latter one is accurate but technical challenging and expensive in price and to maintain [12].

This study introduces the design and implementation of a GPS-based on-board road test system for automotive ABS evaluation and calibration. The system design configuration, hardware and software development, and a case road test study are presented in the next sections; the on-board road test system is now being applied to industrial use for vehicle ABS development and matching, it is also commercially available on the market.

73.2 Hardware Configuration

Figure 73.1 demonstrates the hardware configuration of GPS-based on-board road test system for automotive ABS. Figure 73.1 shows that the system consists of four main parts: the sensors, the data acquisition unit (DAU), the upper computer and the ABS online monitor, and adjuster. GPS antenna receives vehicle positioning signals in real time from the satellites and sends them to a decoder in the DAU, the decoder calculates the transient vehicle speed and transfers it to the main micro-processor of the DAU by RS-232 communication protocol; Wheel speeds are collected by four photoelectric sensors fitted on each wheel hub; Pressure signals, including two signals from each chamber of the master cylinder and four signals from each wheel cylinder, are collected by pressure sensors; Vehicle body yaw rate and steering wheel angle are sensed by a gyroscope and a turn angle meter, respectively.

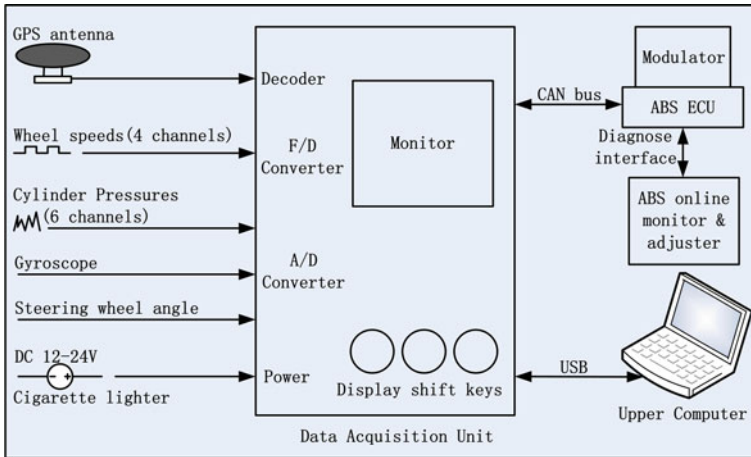


Fig. 73.1 Hardware configuration of GPS-based on-board road test system for automotive ABS

The DAU, with a DC 12–24 V power supply from the cigarette lighter, receives all the above signals, converts them into computer-compatible digital signals and stores them in its memories. Additionally, the DAU reads a series of digital ON/OFF signals directly from the ABS ECU via a controller area network (CAN) bus; the read ON/OFF signals include one brake pedal position signal, one servomotor signal, and eight solenoid valve signals from the hydraulic modulator. Finally, the DAU is connected to a powerful laptop upper computer by universal serial bus (USB) communication.

The upper computer receives all the data acquired by the DAU and analyzes them to secure ABS performance indices and curves, the obtained indices and curves give detailed information for engineers to evaluate the ABS on test; finally, all the data and information could be stored in a database for retrieve. ABS parameter calibration can also be finished conveniently on the upper computer, by giving orders to the DAU, the DAU then rectifies the ABS parameters via the CAN bus.

73.3 Software Development

The upper computer software is developed in Visual Basic 6.0 environment, according to the Economic Commission for Europe (ECE) Regulation No.13 [13] and Chinese Standard GB/T 13594-2003 [14]. Road test items for vehicle with ABS include emergency brake on straight road, emergency brake during cornering, and brake reliability test under severe conditions; the main performance indices for ABS braking quality evaluation are stopping distance, deceleration, adhesion coefficient utilization rate, and body yaw rate; the calculation methods of vehicle deceleration and adhesion coefficient utilization rate are introduced as the following.

The mean fully development deceleration is used in software programming, it is given by

$$a = \frac{v_b^2 - v_e^2}{25.92 (S_e^2 - S_b^2)} \quad (73.1)$$

where v_b is the vehicle speed at $0.8v_0$ and v_e is the vehicle speed at $0.1v_0$, v_0 is the initial vehicle speed; S_b is the distance traveled between v_0 and v_b , S_e is the distance traveled between v_0 and v_e .

The adhesion coefficient utilization rate is given by

$$\varepsilon = Z_{\max}/K_m \quad (73.2)$$

where Z_{\max} is the maximum value of deceleration as a proportion of the gravity acceleration g , it can be calculated by $0.849/t_m$, where t_m is the mean value of three tests of deceleration time, when the vehicle with an initial speed of 55 km/h decelerates from 45 to 15 km/h; K_m is the mean adhesion coefficient, it is formulated by

$$K_m = \frac{K_f F_{fdyn} + K_r F_{rdyn}}{Pg} \quad (73.3)$$

where K_f and K_r are adhesion coefficients of the front and rear wheels, respectively; F_{fdyn} and F_{rdyn} are dynamic loads of the front and rear axles, respectively; P is the vehicle laden mass.

In Eq. 73.3, K_f and K_r can be formulated by the following equations, respectively

$$K_f = \frac{Z_m Pg - 0.015F_r}{F_f + \frac{h}{E} Z_m Pg}, K_r = \frac{Z_m Pg - 0.01F_r}{F_r - \frac{h}{E} Z_m Pg} \quad (73.4)$$

where Z_m is the mean value of deceleration as a proportion of the gravity acceleration g , it can be calculated by $0.566/t_m$, where t_m here is the mean value of three tests of deceleration time, when the vehicle with an initial speed of 50 km/h decelerates from 40 to 20 km/h; F_f and F_r are static loads of the front and rear axles, respectively; h is the height of vehicle center of gravity and E is the wheel base of the vehicle.

Finally, In Eq. 73.3, K_{fdyn} and K_{rdyn} can be given by the following equations, respectively

$$F_{fdyn} = F_f + \frac{h}{E} Z_{\max} Pg, F_{rdyn} = F_r - \frac{h}{E} Z_{\max} Pg \quad (73.5)$$

The developed computer package consists of six modules: test condition, communication, algorithm, post processor, parameter calibration, and database. The test condition module sets all the test conditions including vehicle parameters and reference road adhesion coefficients; the communication module transfers data between the upper computer and the DAU; the algorithm and the post processor

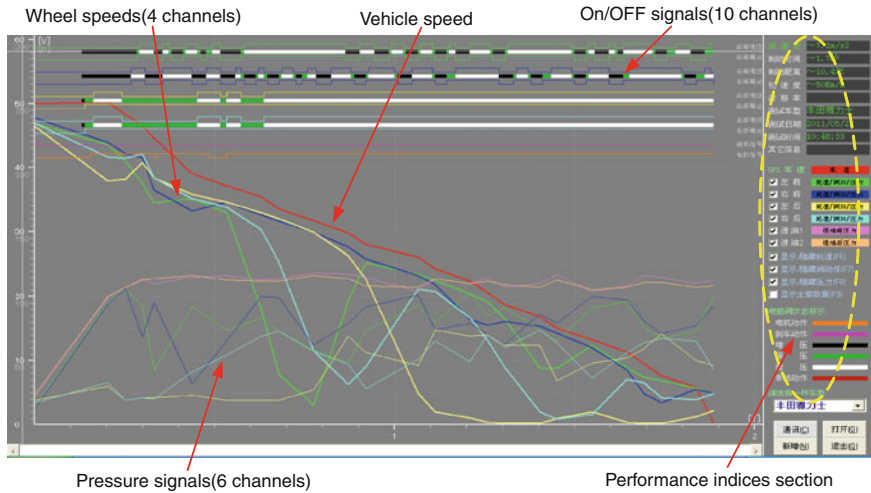


Fig. 73.2 Principal page of the upper computer software GUI

modules output ABS performance indices and curves; the parameter calibration module calibrates all the sensor signals and ABS ECU parameters; the database module stores data and information optionally. Finally, all the above modules are integrated and organized by a graphical user interface (GUI); Fig. 73.2 demonstrates the principal page of the software GUI.

73.4 A Case Road Test Study

A case road test study was conducted on a Chinese SUV HaFo-H3, using the developed on-board road test system. The purpose is to demonstrate functions of the developed ABS test system and to preliminarily evaluate ABS braking performance of the vehicle on test. For illustration, Fig. 73.3 shows one of the test results of emergency straight braking performance of the SUV.

Figure 73.3 illustrates that all the wheels performed well when tracking vehicle speed under ABS control, except that the rear-left wheel was locked approximately at vehicle speed of 12 km/h, which is allowable by road test standards [13, 14] (below 15 km/h). Figure 73.3 also shows that during the emergency braking, there is a large load transferred from the rear axle to the front axle; thus, the front wheel cylinder pressures are apparently higher than that of the rear wheel cylinders. Finally, the SUV stopped in 2.17 s, with a stopping distance of 9.2 m and a body yaw rate of 0.29 deg/s, which are both acceptable.

Table 73.1 lists a fraction of the road test results about emergency straight braking performance indices of HaFo-H3 ABS. The decelerations, the stopping times, and the stopping distances are all acceptable; thus, the braking ability of the tested vehicle on ordinary road conditions is satisfactory, in a macro sense.



Fig. 73.3 Emergency straight braking performance of HaFo-H3 ABS (on dry concrete road, initial speed = 50 km/h)

Table 73.1 Emergency straight braking performance of HaFo-H3 ABS

Road surface	Adhesion coefficient	Initial speed (km/h)	Deceleration (m ² /s)	Stopping time (s)	Stopping distance (m)	Body yaw rate (deg/s)
Dry concrete	0.70	33.80	2.30	1.70	3.12	0.15
		51.10	6.90	2.17	9.20	0.29
		81.50	8.11	3.38	23.20	0.31
Rainy concrete	0.55	31.50	2.23	1.97	3.54	0.20
		50.73	6.06	2.51	11.35	0.35
		81.55	7.24	3.89	25.79	0.47
Dry asphalt	0.65	32.10	2.20	1.89	3.49	0.12
		52.70	6.60	2.40	10.46	0.19
		81.90	7.98	3.45	24.56	0.23
Rainy asphalt	0.50	31.00	2.07	2.22	4.03	0.15
		50.70	5.50	3.00	12.79	0.22
		80.89	7.20	4.10	26.97	0.28

Therefore, the above case road test study confirms that the developed on-board road test system performed well in automotive ABS performance testing and analyzing, the ABS performance of the test vehicle is satisfactory on ordinary road conditions. Extensive road tests, however, such as braking on icy road and on split road [13, 14] should be conducted to further confirm the ability of the developed system and evaluate the ABS performance on test comprehensively.

73.5 Concluding Remarks

Measurement of vehicle speed in real time is the development bottleneck of any ABS on-board road test system or ABS itself. This study introduces the novel design and implementation of a GPS-based on-board road test system for automotive ABS evaluation and calibration.

The developed vehicle speed acquisition module is capable of sensing vehicle speeds at 0.8–185 km/h with a high resolution of 0.01 km/h, which is sufficient for ordinary ABS road test; four photoelectric wheel speed sensors are specially developed and fixed on pertinent wheel hub for reliable wheel speed acquisition. Thus, the road test system uses all directly obtained accurate “outside” information for ABS evaluation, this approach makes the evaluation more credible and has no disturbance to ABS ECU and signals.

A case road test study concludes that the developed on-board road test system performs well in automotive ABS performance testing and analyzing, test results also show that the ABS performance of the HaFo-H3 is satisfactory on ordinary road conditions. So far, the developed road test system has been applied very successfully in several ABS products development and is being available on the market.

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Chapter 74

Network Automatic Test System Based on Database Middleware

Jia Zhiyan and Xie Han

Abstract According to the feature of data format in network automatic test system, a database model integrated DBMS and file system is advanced in this paper. Based on the model and java technology, combined with general and common features of business operation, a database middleware of network automatic test system is designed and implemented. The middleware provides users with a single, powerful application interface. And it is able to provide client a common CRUD and data access service, which enhances the scalability and reusability of system, and reduces the burden of system maintenance and upgrade. Experiments show that the network automatic test system based on database middleware is stable and scalable.

Keywords NATS · Network automatic test system · Database middleware · Data access object · Business operation

74.1 Introduction

Network automation test system (NATS) [1] is a comprehensive subject which integrates modern microelectronic technology, computer network technology, virtual instrument technology, information technology, and artificial intelligence

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and database technology. NATS is the development direction of automatic test technology. In this paper, we apply database middleware technology to NATS in order to solve the problem of device interoperability, improve system performance, enhance system capability and reusability, and reduce the burden of maintenance and upgrade.

74.2 Architecture of NATS

With the rapid development of test technology, the goal of test is not limited to acquire test data and control test task, but also focused on exchange and integration of test data, interoperability of test data and test equipment, display and analysis of test data, and simulation of test process, and so on. Therefore, a four-tier NATS is outlined in this paper, and is shown as Fig. 74.1.

Data acquisition layer collects data through a variety of measuring and control equipment. Data management layer is responsible for data storage and querying of network test database. Data access layer is a middleware of NATS, which defines the interface of transmission and processing in network test system, and ensures compatibility between the various devices. NATS provides data services for the external by the middleware, and the useful return information, which is processed in the external, will be stored in the database. Test application layer is an outer application of entire NAST. According to the information provided by

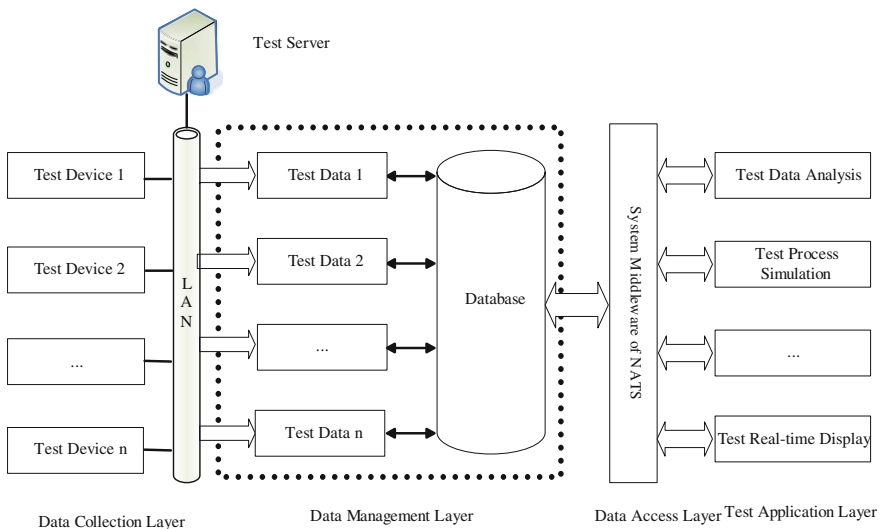


Fig. 74.1 Four tier of NATS

middleware, test application layer can process deeply information, provide those functions such as data analysis, test process simulation, and test real-time display.

It is very complicated for the data information in NATS, which can be divided into resource data such as person information, geographic information, weather information, device information, etc., dynamic test data which are from radar, high-speed camera, GPS, etc., and field control data. Moreover, the difference of data format is tremendous, in which there are structured data, and unstructured multimedia data such as sound, graph, video, and so on. Based on objective factors as above, data organization based on data format is used in this paper. According to the difference of data type, different storage mode is used as follows:

- Storing data in DBMS. Structured data such as human resource, device information are stored directly in database, using relational database model.
- Storing data in DBMS and file system. Unstructured data such as radar information, high-speed video tape are stored in file system, and an index table, whose primary key is task ID, is created in DBMS. In the index table, association rules between DBMS and file system is stored. System database model is shown as Fig. 74.2.

According to analyze the database model, it is known for us that the core of NATS is how to process various data stored in DBMS, and how to interact between DBMS and file system. Therefore, middleware technology based on

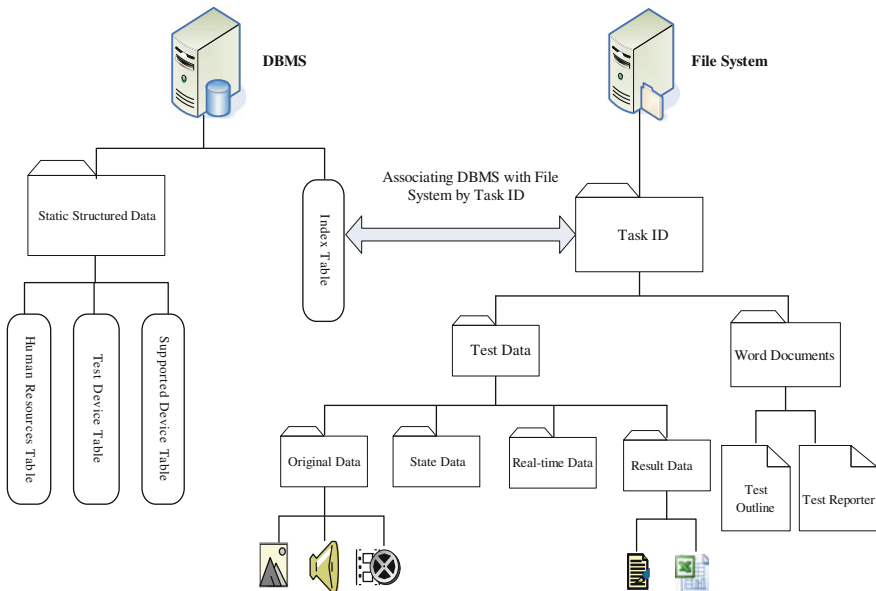


Fig. 74.2 System database model

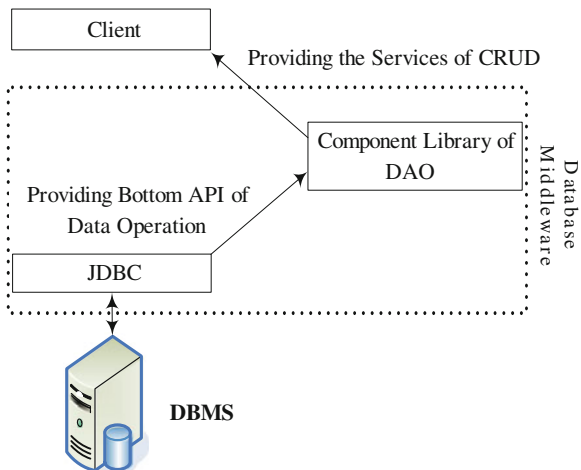
database middleware is applied to design middleware of NATS in order to data communication and data exchange between various heterogeneous data.

74.3 Design and Implementation of NATS Middleware

Database middleware [2] is a middle layer between client and database, and its function is to ensure the communication between application and local or nonlocal database. Database middleware provides a series of application programming interface to access database regardless of the operating system and network [3, 4]. Traditional database middleware uses the design idea of separating the data access object component from business logic component, which makes middleware more highly cohesive, low coupling, and extensible. But, at the same time, this design idea also increases complexity of design because it is necessary to make a business logic component by abstracting each business operation and maintenance each business logic component during the later maintenance. Therefore, business logic data access object, which is combined with data access object component and business logic component, provides general services of CRUD and data access for client, and lows complexity of design. The middleware is shown as Fig. 74.3. The reason that database middleware uses this design idea is shown as follows:

- Although there is large amount of data in NATS and data format is complicated, business operation is simple and similar. Hence, it is able to make a general business logic component by abstract to avoid a business operations corresponding to a business logic component.
- GUI supporting user’s CRUD operation is universal. According to analyzing the GUI, it is known that data are put into text box, combo box, and table. In Java

Fig. 74.3 Architecture of database middleware



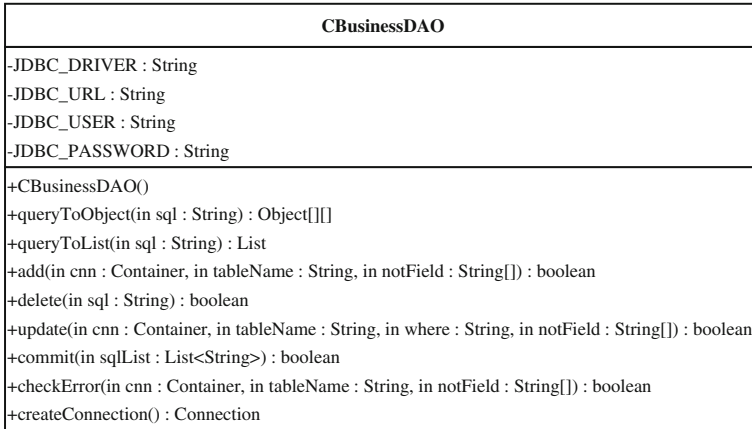


Fig. 74.4 Class graph of database middleware

class library, the component corresponding to text box is JTextField, and the component corresponding to combo box is JComboBox, and the component corresponding to table is JTable. Based on these characteristics, a universal business logic component can be made out by abstract.

Figure 74.4 is the UML class graph of database middleware. The class of CBusinessDAO provides general function of CRUD and error handling, in which the core is method such as add, update, and check Error. The class shields the system operational differences and can process data input and edit, error handling.

Making sure that the method of adds and update is general, it is necessary to restrict all components in GUI, so that each component is corresponding to a field in a table and the name of corresponded field can be got. The role is shown as follows.

- Supposing that a JTextField component corresponding to a field in a table, it is necessary to set the component's name as "txt" with this field name. If a JTextField is not corresponding to any field in a table, it is necessary to set the component's property of name as null.
- Supposing that a JComboBox component corresponding to a field in a table, it is necessary to set the component's name as "cmb" with this field name. If a JComboBox is not corresponding to any field in a table, it is necessary to set the component's property of name as null.

The method of add is described as algorithm 1. The method of update is approximately similar to the method of add, so it is not described.

Algorithm 1: Method of add

```

boolean add(Container cntn, String tableName, String[] notField)
{
    Calling the method of createConnection and getting the connection of database into cn;
    Calling the method of getStatement by cn and getting an object of Statement class into st;
    Setting sql the value as "select * from " + tableName + " where 0 = 1";
    Calling the method of executeQuery(sql) by st and getting the an object of ResultSet class
    into rs;
    Calling the method of getMetaData by rs and get an object of ResultSetMetaData class to
    rsmd by which metadata of table structure such as field name and field type, etc. can be
    got;
    for each component in cntn
    {
        if (class name of the component is "JTextField", and the component's property value of
        name is not null and the front three letters are equal to "txt")
        {
            Getting the component's property value of name and removing the front string of "txt"
            into cmpName;
            for each field in rsmd
            {
                if (the field value is equal to cmpName, and cmpName is not in notField)
                {
                    Adding the cmpName into listField and adding the component's property value to
                    listValue;
                    break;
                }
            }
        }
        else if(class name of the component is "JComboBox", and the component's property
        value of name is not null and the front three letters are equal to "cmb")
        {
            Getting the component's property value of name and removing the front string of "cmb"
            into cmpName;
            for each field in rsmd
            {
                if (the field value is equal to cmpName, and cmpName is not in notField)
                {
                    Adding the cmpName into listField and adding the component's property
                    value to listValue;
                    break;
                }
            }
        }
        Creating and executing "insert" sentence according to listValue, listField and tableName
        return true;
    }
}

```

At the same time, to make sure the universal of the method of check Error, it is necessary to restrict database as follows.

- Each field in a table must give its description which must be consistent with a label component, corresponding to a text box or combo box component in GUI. The goal is able to give error hint according to the filed description.
- A view named `all_fields_description` must be created. The view contains the following details: database name, table name, field name, is null, is key, data type of field, length of field, description of field, which is the criterion of judging validity of data.

74.4 Conclusion

With the rapid development of test technology and test objective, test object is extending and deepening. In this paper, a database middleware is designed and implemented based on Java technology in order to solve exchange, transmission, and storage of heterogeneous test data in NATS. By this middleware, the system's scalability and reusability is enhanced, and burden of system's maintenance and upgrade is reduced. The future work is to analyze test data query and display in NATS and design and implement business logic of query and display, and perfect deeply the database middleware.

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Chapter 75

Underground Pipelines Information System Based on Vector Metagraph

Fengguang Xiong and Xie Han

Abstract Accessing and updating of digital topographic map is an extreme bottleneck in underground pipelines information system (UPIS). According to vast analysis and research, the method of vector metagraph development and embedding is put forward to solve above problem in this paper. The development of vector metagraph is implemented by Visual Basic and MapInfo, and embedding of vector metagraph is implemented by Delphi and MapX. The method is proved accurate and reliable by vast experimental results, and can meet the requirements of UPIS. Experiments show that the UPIS based on vector metagraph is stable and scalable.

Keywords Digital topographic map · Vector metagraph · Embedding · OLE

75.1 Introduction

Underground pipeline information system (UPIS) [1, 2] is based on application platform of geographic information system (GIS), which not only has the basic functions of GIS [3], but also has the function of managing interactively underground pipeline and analysis of decision making. The core of UPIS is spatial information and attributes information of underground pipeline, using computer

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technology, computer graphics, database management systems and information visualization techniques to provide accurate direction and depth of underground pipeline, and relevant information for the construction sector and management. Through various statistical analysis and spatial analysis can provide decision support for the leadership department, and realize the scientific and automatic management of underground pipelines.

However, in the practice of city planning, municipal utilities, land, property management, promotion of UPIS is not smooth, in which acquisition, supply and update of digital topographic map and underground pipes map are tremendous bottleneck in a large-scale application of UPIS. In particular, the digital topographic map, which involves a large number of buildings in construction, trees, roads, and so on metadata vector, are a very tedious time-consuming things, if each vector metagraph need to be draw and update. Therefore, the acquisition and update of digital topographic maps is a major obstacle to the promotion of UPIS.

Graphical elements in vector metagraph are called objects. Each object is a self-contained entity, which has the color, shape, contour, size and screen position, and other attributes. Since every object in vector metagraph is a self-contained entity, so it can maintain its original clarity and curvature, while its properties are changed and moved without affecting the property of the other objects. These features make the vector-based program suitable for the legend and three-dimensional modeling, because they are usually required to create and manipulate a single object. Vector metagraph [4] has nothing to do with the resolution. This means that it can be scaled to any size and can be shown to the output device at any resolution without affecting the clarity. Therefore, the vector metagraph can be applied to the digital topographic maps of UPIS.

75.2 Analysis of Vector Metagraph

Through in-depth research, it can be found that the vector metagraph of digital topographic map in the UPIS has the following characteristics:

A large number of vector metagraph have the same or similar style. For example, a large number of blocks of buildings, trees, and roads have similar style, or are the same style, and all those metagraphs are the vector metagraph of point, line, and surface.

Regardless of vector metagraph can be decomposed into the basic vector of line, circle, rectangle, line, and so on. Hence, the complex vector metagraph can be composed with the primitive shapes. In the Fig. 75.1a, b and c all are vector metagraphs, and a can be decomposed into b and c, that is to say, one b and four c can generate one a.

By analyzing the two characteristics of vector metagraph, it proposes to use vector metagraph to solve the existing problems in digital topographic map of UPIS. The so-called development of vector metagraph is based on a large number of similar vector metagraph to build an abstract vector metagraph model, and using

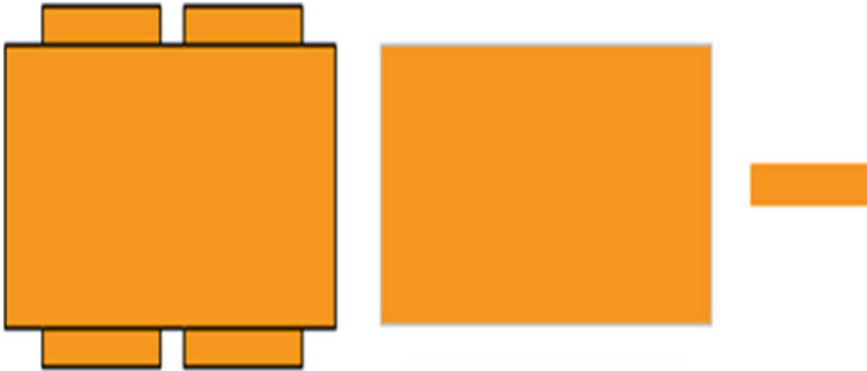


Fig. 75.1 Decomposition of the vector metagraph

the most basic line, circle, rectangle to compose the abstract vector metagraph model, and then using this abstract vector metagraph to generate the specific vector graph and embedded into the special application.

75.3 Implementation of Development and Embedding of Vector Metagraph

The development and embedding of vector metagraph are two separate processes, in which involves development and embedding. But the two are interrelated, in which the developed vector metagraph must be identified and embedded into the underground pipeline management system. Hence, it must be considered to coordinate and arrange the relationship between other during the process of design and development.

The implementation of development of vector metagraph is used with Visual Basic 6 and MapInfo 7. The implementation of embedding of vector metagraph is used with Delphi 7 and MapX 5.

75.3.1 Development of Vector Metagraph

Developing a vector element is based on MapInfo's OLE automation development, the principle is Visual Basic, Delphi, Visual C++ and other applications written by COM send MapInfo comes with the secondary development of language, is similar to the Basic explanatory language (MapBasic) or MapInfo MapInfo-process command to the server, MapInfo OLE automation server objects in the background, the supply of output with the program calls its properties and methods. Specific development of the following steps:

Step 1: Importing type library of “MapInfo 7.0 OLE Automation Type Library”.

Step 2: Creating a global instance DMapInfo, which is equivalent to a MapInfo-process server. The application can send MapInfo command or Mapbasic statement to MapInfo-process via COM. Specific code is shown as follows.

```
Public DMapInfo as Object
Set DMapInfo = CreateObject (“MapInfo. Application”)
If (DMapinfo = “”) Then
    Set DMapInfo = CreateObject (“MapInfo. runtime”)
    If (DMapInfo = “”) Then
        MsgBox “No MapInfo Release Edition or MapInfo Professional can’t
        running!”
    End if
End If
```

In Visual Basic, creating a MapInfo-process server has CreateObject (“MapInfo, Application”) or CreateObject (“MapInfo, runtime”). Of course, the prerequisite is that MapInfo has already installed on your computer, otherwise it cannot create MapInfo-process server.

Step 3: Sending MapInfo commands of drawing line, round, rectangle, and other vectors to DMapInfo instance object, and then super positioning and combining these vectors, at last developing appropriate vector metagraph.

The command of Drawing line, arc, polygon, oval, and rectangular is shown as follows:

The command of drawing line is: DMapInfo.RunMenuCommand M_TOOLS_LINE.

The command of drawing arc is: DMapInfo.RunMenuCommand M_TOOLS_ARC.

The command of drawing polygon is: DMapInfo.RunMenuCommand M_TOOLS_POLYGON.

The command of drawing ellipse is: DMapInfo.RunMenuCommand M_TOOLS_ELLIPSE.

The command of drawing rectangle is: DMapInfo.RunMenuCommand M_TOOLS_RECTANGLE.

The command of drawing polygon is: DMapInfo.RunMenuCommand M_TOOLS_POLYLINE.

The other operation command related with line, arc, polygon, oval, and rectangular is shown as follows.

The command of selecting metagraph is: DMapInfo.RunMenuCommand M_TOOLS_SELECTOR.

The command of zooming out metagraph is: DMapInfo.RunMenuCommand M_TOOLS_SHRINK.

The command of zooming in metagraph is: DMapInfo.RunMenuCommand M_TOOLS_EXPAND.

Fig. 75.2 The interface of development of vector metagraph



Vector metagraph is stored in the local disk in order to be accessed when the embedding program uses it. The interface is shown as Fig. 75.2.

75.3.2 *Embedding of Vector Metagraph*

The embedding of vector metagraph is based on MapX control. The principle is that Visual Basic, Delphi, Visual C++ and other applications read vector metagraph file, which has been developed and saved as file, and get vector metagraph using MapX control's property and method, and embedded it into the application. Specific development steps are shown as follows.

Step 1: Installing the MapX control into Delphi 7.

Step 2: Creating MapX instance object, and invoking its property and method to identify vector metagraph file, and then embedding the vector metagraph in the file to the digital topographic maps of UPIS.

Special code is shown as follows:

```
//FileSpec is the path of vector metagraph
FileSpec :=ExtractFilePath(ParamStr(0)) + 'TYKV' + TblName + '.tab';
//Designating the type of LayerInfo
LayerInfo.Type :=miLayerInfoTypeTab;
//Designating the file name to LayerInfo
LayerInfo.AddParameter ('filespec', filespec);
//Designating the metagraph's name to LayerInfo
LayerInfo.AddParameter ('Name', TblName);
Try
//Opening metagraph file
Map1.Layers.Add (LayerInfo, 0);
```

```

//Identifying all basic vector objects from metagraph file
Ftrs :=Map1.Layers [TblName].AllFeatures;
//Embedding all basic vector objects
For I :=1 to Ftrs.Count do
Lyr.AddFeature (ftrs.Item[I], Empty);
Except
Show Message ('Embedding metagraph wrong!');
End;

```

In which Map1 is an instant object of MapX control. Map1 invokes the method of layers.add, and makes all the specified vector metagraph by Layinfo object into the temporary layer of Map1, and then invokes the method of layers. All features to make all the basic vector objects stored into the object Ftrs, at last reads all the basic vector objects in Ftrs and embeds into the digital topographic maps (lyr) in turn.

75.4 Conclusion

Development and embedding of vector metagraph provide an effective method and direction for solving access and update of topographic maps in UPIS, which cannot only improve efficiency, but also reduce system development costs and development cycle, and drive the development of the integrated pipeline information technology.

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Chapter 76

Logistics Management System Based on Workflow

Xiao-Hui Yan and Lei-Jun LI

Abstract Twenty-first century is the century of the logistics industry, for a company to grow and develop a good logistics management system is very necessary, it is directly related to the competitiveness of enterprises. There are many logistics management systems now which is designed in this paper is a computing model based on workflow, and it is using the J2EE software architecture. This paper not only demonstrates in detail the implementation of the workflow process, it also gives the specific design of the logistics management system, the overall system architecture, software design, and database design.

Keywords Logistics · Management system · Workflow · J2EE · Database

76.1 Introduction

With the development of economic globalization, the logistics industry becomes an important role more and more. But in today's society, there are a lot of logistics enterprises which are not very mature in the information construction convenient, they does not have their own logistics management system. Even some small businesses have not implemented computer management; most enterprises still

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remain in the stage of manual registration. These phenomena are incompatible with the busy traffic of logistics enterprises, the backwardness of the logistics management system of a serious impact on the competitiveness of enterprises, reducing the efficiency of enterprises [1]. Now many companies have an urgent need to build their own personalized logistics management system, improving the business environment, management, rational use of the allocation of resources, and work efficiency.

76.2 Introduction of Workflow

Public stream (Work Flow) is calculation of the workflow model, logic and rules of the upcoming in the workflow and how organizations work with an appropriate model in the computer side, and its implementation to calculate work. Workflow is to solve the main problem: to achieve a business goal between multiple participants, using the computer automatically passes documents, information or tasks according to some predetermined rules. Simply put, the workflow is a series of interrelated business activities or tasks automatically. Modern office systems, workflow products are not only to achieve a leap from the traditional manual way but to send and receive files to the way of workflow automation, at the same time by means of the visual process definition and process monitoring, process optimization, and restructuring [2]. With the gradual deepening of office automation systems, office automation business will become more complicated and comprehensive and in many matters people need to work together. Workflow technology in the collaborative field is a hot research topic.

76.3 The Design of the Workflow Model

76.3.1 The Design of the Workflow Engine

Design and implementation of the workflow engine is based on this reference model. It is shown in Fig. 76.1:

76.3.2 Design and Implementation of a Message Send Interface

Supporting data transmission, messaging middleware, to send and receive through the preparation of the corresponding module to achieve the information. There is no standard method to follow the exchange of information. Therefore, in order to achieve a variety of communication between the operating platform, heterogeneous

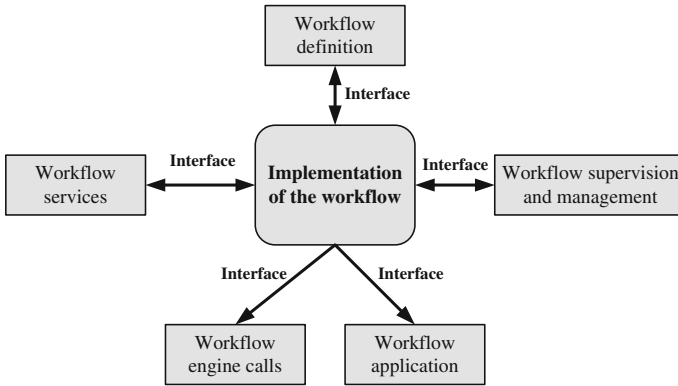


Fig. 76.1 Workflow engine model

environment, a number of applications, we take all the application specific programming information exchange. Messaging middleware can be used as a separate module, which independently takes the underlying communication of the whole system [3]. Its advantage is the flexibility and reusability of the system to greatly enhance, system developers only need to deal with workflow-related issues. This way is a Java Message Service (JMS) messaging middleware capabilities to carry, JMS is a set of Java application programming interface, and its function is to provide users with the message handling services, such as message creation, message sending, and receive messages and read messages. The JMS API is the Sun's lead with other companies to design a set of common application programming interface and the appropriate syntax for the communication port, and other message components. The specific method is: First, design a generic message listener interface to the Generic the Message Listener function is a JMS Message the Listener interface. At this point, a design feature is the Generic JMS Message the Listener interface, abstract class Abstract Jams the Listener, but also realized the registered message listener method on the message. The service runs a specific listener method run; subsequently, the JMS Queue Listener inherits the abstract class Abstract JMS the Listener and the JMS the Topic the Listener for the design of specific point-to-point messages and broadcast the message listener. This step is based on JMS session Connection to connect to a specific function. The system is running, first to use the message engine JMS Service Engine, this engine is registered to the service center of the Web service [4]. Class of message service JMS Message of a call to activate the listener listening followed by the JMS the Listener Factory. Thus, as long as there is news, the listener will be able to read and send real time. Send process is through the workflow Entry workflow instance Simple Workflow the Entry class and nonworkflow entity the Model Entity base class package into message implemented by JMS Message Function the Provider interface.

76.4 Design of the Logistics System of Relations

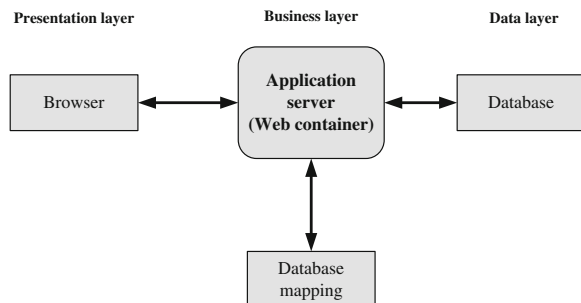
76.4.1 The Overall System Architecture Principles

The workflow to run the execution engine scheduler to perform workflow running process: The user issued the command from the local client; the workflow engine receives the command to start running the command required to complete the task but also to get. Task Manager Workflow engine calls and run a particular task and activate the tasks handled by the Task Manager in accordance with certain business rules select the corresponding application object [5]. Application object processing workflow application data, relevant data will be sent to the Task Manager, When the Task Manager to get these data, and then run the final processing results sent to the workflow engine, workflow engine management control to achieve the task and the user is passed to deal with the results. It is shown in Fig. 76.2:

76.4.2 Software Design Goal

Logistics management system helps logistics companies to complete the purchase, sales, storage integrated information management, and with distribution, transportation, customs, and decision making. Through that the system can achieve the following objectives: System is running stable, safe and reliable, and the corresponding designated applications; Information query is convenient, accurate, flexible, fast, and safe and reliable data storage; Information security; User input data, the system of strict inspection of the data, rule out human error as far as possible; Interface design beautiful, friendly man-machine interface; Meet the dual keyboard and mouse operation, and fully supports the Enter key; Data confidentiality, and set the appropriate permissions for each user level.

Fig. 76.2 The basic system structure



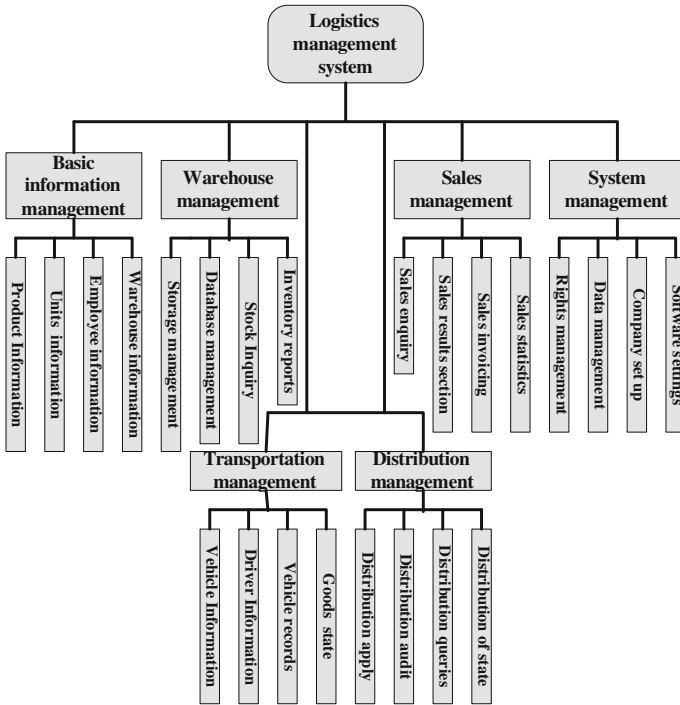


Fig. 76.3 System function structure chart

76.4.3 System Function Block Diagram

System function by function, as the basis of information management, sales management, warehouse management, systems management, staff training, distribution management, transportation management, customs management, and decision management module, the system structure is shown in Fig. 76.3.

76.4.4 The Main Module Design

The system consists of the module a lot; it is a flow chart of a commodity information query module as shown in Fig. 76.4.

76.5 Database Designs

The system’s database design is more complex, the following will give a small part in the design of the main data table (Tables 76.1, 76.2).

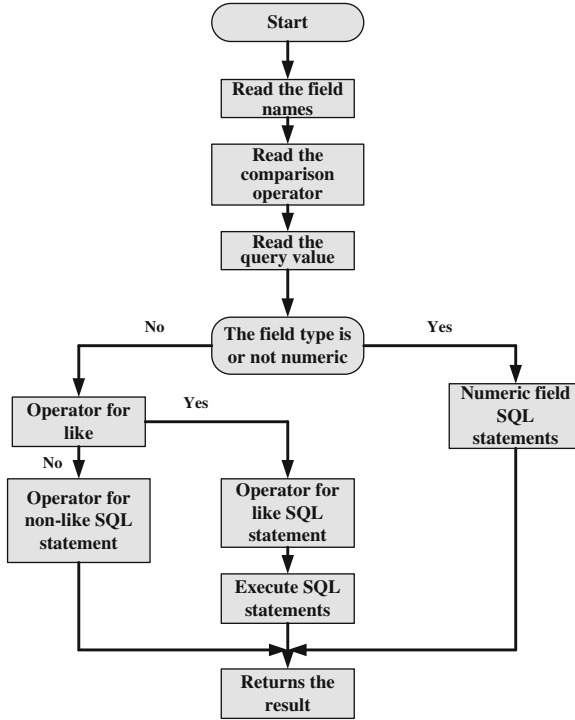


Fig. 76.4 Product information query flow chart

Table 76.1 Product information sheets

Field name	Field type	Length	Primary key to whether	Allowed to be null
Number	Int	4	T	F
Name	Varchar	50	F	F
Place of origin	Varchar	100	F	T
Barcode	Varchar	30	F	F
Units of measurement	Varchar	20	F	T
Selling price	Varchar	20	F	T

Table 76.2 Table of inventory information

Field name	Field type	Length	Primary key to whether	Allowed to be null
Product bar codes	Varchar	30	T	F
Inventory number	Int	50	F	F
Specific location	Varchar	100	F	F
Warehouse labels	Varchar	50	F	F

76.6 Summary

Logistics industry is developing fast, large scale, automated, rapid oriented, and so on. In order to meet the development of the logistics industry, the design of the system needs to continuously improve on the original function. It can effectively reduce the cost of system uses to simplify procedures, improve system security, and maintainability. Hence, I hope that the logistics management system designed in this paper would certainly help the development of modern logistics industry.

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Chapter 77

Developmental Model of Industrial Cluster in Chongqing Liangjiang New District

Anyun Li

Abstract Chongqing Liangjiang New District is a newly established state level developmental zone which is supposed to cultivate various industrial clusters. In consideration of the status quo of enterprises development in Liangjiang New District, the empirical analysis has been adopted. The author presents a developmental model which covers the electronic information and biopharmaceutical industrial clusters under the multi-core developmental mode, and automobile rail transport, power equipment industrial clusters under the arbor wheel developmental mode, and so on. The author also proposes solutions for the development of industrial clusters such as cultivating domestic listed companies, driving the development of industrial clusters with high technologies, enhancing ecological construction in Liangjiang New District, building regional brands of industrial clusters, and so on. These solutions are helpful in enhancing the competitiveness of the industrial clusters of Liangjiang New District in the global market and for boosting the sustainable development of those clusters and the overall regional economy.

Keywords Liangjiang new district · Industrial cluster · Developmental mode · Solution

77.1 Foreword

Established in 18 June 2010, Chongqing Liangjiang New District is a state-level new zone of development and is opening up. In the past decade and more, the focus of China's economic development was on coastal areas like Guangdong,

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Fujian, Zhejiang, and Shanghai. The economic developmental mode is characterized with external needs driving internal needs, focusing on international market, and promoting domestic production through large amount of export. However, since the financial crisis originated in the US in 2008, global market demand shrank and exports to foreign countries encountered barriers. As a result, enterprises in coastal areas suffered a lot. The birth of Liangjiang New District is a major strategic decision of the government to catch up with the general economic trends of globalization and integration of regional economies, development of growth polar in western China, and waking up the domestic demand market. It is a major measure in China's economic development strategy layout.

The development of Liangjiang New District inevitably involves the development of industrial clusters inside the area. Professor Michael E. Porter, an expert in strategic management from Harvard Business School defines industrial cluster as “interrelated enterprises, professional suppliers, service providers, manufactures of relevant industries, and related institutions (such as universities, standardization agencies, trade associations, etc.) which both compete and cooperate with each other in specific fields and concentrate in certain geography.” [1]. According to his definition, industrial clusters are a group of geographically close and interrelated enterprises and institutions which reside in a certain industrial area and are bonded together by common and supplementary features.

Industrial clusters could be classified into different models and systems by different standards. In terms of internal market structure, they could be divided into five major modes, namely, the arbor wheel mode, the multi-core mode, the Web mode, the mixture mode, and the intangible big factory [2]. Industries nurtured inside Liangjiang New District include electronic information, automobile manufacturing, rail transport, power equipment, biopharmaceutical, logistics and processing, financial services, and so on. Liangjiang New District is supposed to select the developmental modes of industrial clusters according to the status quo and characteristics of different industries.

According to the developmental plan of Liangjiang New District, the general layout of Liangjiang New District will follow the model of “one core and four belts”—on core refers to the financial and commercial center; four belts refer to the urban function industrial belt, the high-tech industrial belt, the logistics processing industrial belt, and the advanced manufacturing industrial belt. It is an important topic in the development of Liangjiang New District aiming to build a scientific and reasonable developmental model of industrial clusters in Liangjiang New District and using proactive solutions to nurture industrial clusters in Liangjiang New District.

77.2 Selection of Developmental Modes of Industrial Clusters in Chongqing Liangjiang New District

77.2.1 The Developmental Mode of the Electronic Information Industrial Clusters

The electronic information industrial cluster can be built under the multi-core mode. This will be an industrial cluster consisting of numerous small-sized enterprises (SMEs) centered on three to five large-scale finished products manufacturers. The mode is characterized with the situation of multiple core enterprises forming multiple principal parts. By far, the world's top 500 enterprises like HP and Foxconn have set up branches in Chongqing. During the 12th Year Plan period, Chongqing will, inside Liangjiang New District and Xiyong Microelectronics Park, “focus on the construction and cultivation of 8 industrial chains, such as computer and peripheral devices, integrated circuits, telecommunications and Internet of things, and try to reap sales revenues of 100 million RMB.” [3]. As a high-tech industry, the electronic information industry is one of the key developments in Liangjiang New District. Compared to that in Beijing, Shanghai and Jiangsu, its development in Chongqing started late but is a step that Chongqing must walk out. The electronic information market has huge potential in the future and is a sustainable industry in nature. It is an important way to develop this industry by nurturing numerous small businesses centered on three to five giant electronic information corporations such as HP and Foxconn.

77.2.2 The Developmental Mode of the Automobile, Rail Transport, and Power Equipment Industrial Clusters

The manufacturing industry in Liangjiang New District is comprised by sectors like automobile, rail transport, power equipments, and so on. These industrial clusters could be developed respectively under the arbor wheel industrial cluster developmental mode which refers to the structure of numerous relevant SMEs centered on one super large finished product manufacturer. Liangjiang New District shall set the core brand enterprises of the automobile, rail transport, and power equipments industries as locomotives to vigorously develop their suppliers of spare parts, so as to build the automobile industrial cluster, the rail transport vehicle industrial cluster, the power equipment industrial cluster, for instance, Chang'an Automobile could develop SMEs to process and manufacture spare parts and accessories for its particular products, or provides services for it, so as to nurture an automobile manufacturing industrial cluster centered on Chang'an Automobile. Take the rail transport and power equipments sectors as another example, the dominating corporations in these two sectors respectively are

companies such as Chongqing Changke City Track Transport Vehicles Limited Company, and Chongqing Suntop Iron-Tower Manufacturing Co., Ltd. It is recommended to develop industrial clusters under the arbor wheel mode first, and then switch to the multi-core mode as leading companies in these two sectors grow and increase in number.

77.2.3 The Developmental Mode of the Biopharmaceutical Industrial Cluster

The biopharmaceutical industrial cluster shall be developed under the multi-core mode. The biopharmaceutical industry has two components: the biological technologies industry and the pharmaceutical industry. The former involves multiple sectors such as medicine, agriculture, maritime science, environment, energy, and chemical engineering. The biology industry is one of the seven strategic emerging industries designated by the state; in particular, innovative medicines such as biological medicines, new vaccines and diagnosis reagents, chemical medicines, and modern traditional Chinese medicines for the purpose of preventing and curing major diseases shall be developed vigorously. Liangjiang New District has a couple of famous leading corporations such as PKU International Healthcare Group, Swiss Novartis AG, and Chongqing Porton Fine Chemicals. If the multi-core biopharmaceutical industrial cluster around these famous brands is enthusiastically nurtured, it will be very helpful for the development and innovation of the biopharmaceutical industry.

77.2.4 The Developmental Mode of the Logistics and Processing Industrial Clusters

The logistics and processing industrial clusters are recommended to be built in Liangjiang New District under the Web mode, which refers to the industrial cluster formed by the concentration of the cross-connected and relatively independent SMEs. The logistics industry is a composite and polymerized industry formed by the industrialization of logistics and distribution resources which consist of transportation, storage, loading and unloading, packaging, distribution, processing, circulation, and so on. For Liangjiang New District, automobiles, machines, meters and devices, electronic information, biological medicines, new materials, and food are all processing and distribution objects of which process and logistics of products involve numerous SMEs in Liangjiang New District. So far, the district already has famous logistics enterprises such as Chongqing Chang'an Minsheng Logistics, Taiwan Evergreen Group, and so on.

77.2.5 The Developmental Mode of the Financial Services Industrial Clusters

The financial services industrial cluster is recommended to be built under the mixture mode which refers to a structure of mixture of the multi-core mode and the Web mode. There are several core enterprises and related small businesses and a great amount of SMEs which do not have cooperation with each other inside the clusters. Financial services refer to the activities of financial institutions negotiating goods of value in currency transactions, and providing benefits to clients and participants in financial activities hence being satisfied. With the development of Liangjiang New District, a large number of state-owned commercial banks and other commercial banks, nonbank financial institutions, foreign financial organizations will move in, forming a couple of large-size institutions and some small and medium-sized ones. By that time, we will witness a modern financial services industrial cluster with a basic rational structure and relatively complete functionalities.

77.3 Solutions to Development of Industrial Clusters in Chongqing Liangjiang New District

77.3.1 Cultivation of Domestic Listed Companies

It is proposed to cultivate about 10 listed companies in Liangjiang New District, preferably from emerging strategic industries such as energy saving, environment protection, emerging information industry, biological industry, new energy, new energy vehicles, advanced equipments manufacturing, and new materials, so as to drive the development of industrial clusters in Liangjiang New District with leading and core enterprises taking the lead. In the past, Chongqing gave favorable treatment to enterprises in traditional industries for developing listed companies, and did not treat high-tech enterprises with great support, and thus lost some opportunities of developing high-tech industries in Chongqing. Liangjiang New District thus should focus on high-tech industries and give support to listed high-tech companies in terms of financing and favorable policies. It is hopeful to build about 10 listed companies with annual output value of tens or even hundreds of billion RMB in Liangjiang New District.

77.3.2 Emphasis on Development of SMEs in Liangjiang New District

Geographically, Liangjiang New District is located in hills and mountains which have rich land and water resources, convenient transportation. This area is very

large and is thus beneficial for the development of SMEs. It is recommended to focus on the development of SMEs, and accelerate the development of SMEs by enhancing several large-scale core enterprises, and nurture SME processing groups, and consequently build high-tech industrial clusters. SMEs should develop science and technologies and cultivate talents and increase the quality and technological content of their products and enhance their own capacities of R&D and marketing, and the government is supposed to give preferential policies to SMEs in terms of financing and taxation.

77.3.3 Boosting Industrial Clusters with New and High Technologies

Hence, the development of Liangjiang New District shall be new and high-tech oriented; we should have our new and high-tech industrial clusters, and constantly make innovations in the research, development, promotion and application of new and high technologies, and actively participate in international competition to realize sustainable development of industrial clusters. New and high technologies are knowledge intensive and have such characteristics as significant intelligence resources, huge capital requirement, high investment risks, and handsome profitability. In Liangjiang New District, the ways to drive the development of industrial clusters through new and high technology are: first, to develop the local new and high-tech enterprises in Chongqing; second, to introduce domestically renowned new and high-tech enterprises; third, to introduce internationally influential new and high-tech transnational enterprises by the form of joint venture, cooperation, and sole proprietorship.

77.3.4 Enhancing Ecological Environment Construction in Liangjiang New District

Currently, the construction of natural environment and industrial ecological environment is a very important state developmental strategy. For a long period of time in the past, China overly developed natural resources and polluted and ruined the ecological environment. Now, many resources are in the state of insufficiency or exhaustion, hindering economic development. The initiator of industrial ecological system is Kalundborg in Denmark, where oil refineries, sulfuric acid factories, building board factories, bio-reagent plants, green house farms, and power plants utilize each other's sulfur, waste gas, and afterheat and waste water in a cyclical way. The byproducts of one company are important raw materials for other corporations. This recycling forms an industrial ecological system and well protects the ecological environment. It is a significant task of us to enhance the

construction of the natural environment and the industrial ecological environment in Liangjiang New District. Relevant measures include: first, high technology projects which play an important role in saving resources and protecting the environment; second, emphasis on the development and utilization of the industrial ecological environment, recycling along the industrial ecological chain and construction of ecological industrial parks; third, enhancement of financial input in environment-protecting equipments and environmental protection. The sustainable development of industrial clusters is only possible when we enhance environmental protection and promote long-lasting coexistence of the industrial ecological system and the biological circle.

77.3.5 Building Regional Brand of Industrial Clusters in Liangjiang New District

I propose to boost the development of industrial clusters in Liangjiang New District under the regional brand effect. Regional brand, also referred to as corporate public brand, means a public brand jointly shared by qualified enterprise groups which hold a comparative advantage of the area as core value with a certain geographical location [4]. We should, in the way of marketing and promotion of the regional brand, display enterprises, products, services and natural resources in the area to the public to generate the regional brand effect and consequently upgrade the area's overall image and improve the general competence of industrial clusters. We have a couple of methods to build a regional brand: first, building regional brand through the legal channel, such as applying for collective registered trademarks or geographical labels; second, building regional brands via existing famous corporations, for instance, we could build the "automobile made in Chongqing" regional brand of the automobile industrial cluster centered around Chang'an; third, building an abstract regional brand which is a regional brand unregistered in the commercial and industrial administration and is not tangible in any core enterprise. The difference is that an abstract regional brand has no specific trademark, but its market function and value are equal to those of registered trademarks, for example, Chongqing Liangjiang New District and Xiyong Micro Electronics Park have already become well-known at both home and abroad.

77.4 Conclusion

Liangjiang New District is one of the key industrial parks in Chongqing. There are multiple modes of industrial clusters development. The rational selection of the mode will propel the development of industrial clusters in Liangjiang New District. The industrial cluster mode is a dynamic mode which changes as the incoming enterprises vary. If we find positive solutions to build industrial clusters in

Liangjiang and carry out cooperation between these clusters and realize scale economy, it will greatly reduce costs of production, sales, and labor and render help to enterprises to participate in competition in domestic and foreign markets. Liangjiang New District has rich water and land and human resources plus favorable business and taxation policies which are greatly helpful for the development of industrial clusters. With such development, we will build a famous Liangjiang New District which is vigorous and dynamic, innovative and sustainable, and will ultimately contribute to the sustainable development of Chongqing's economy.

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Chapter 78

A Taxonomy System for Information System Requirements

Bin Chen and Qiang Dong

Abstract Well-formed requirement description is necessary to overcome complexity of requirements development, which depends on appropriate requirements taxonomy. Research of representative requirements taxonomy systems existing and with experience of requirement engineering practice, a complete and new system for requirements taxonomy was proposed to unify and include these representative requirements taxonomies. In this system, requirements were classified into goal domain, operation domain, and technology domain according to requirements development domain. In every domain, requirements were further classified as operational or nonoperational. On this basis, a detailed list of requirements taxonomy was offered. Moreover, there are compact correlations among requirements in different domain with different properties. Goal of requirements development is to construct a complete, consistent, or eclectic requirements set. With the requirements taxonomy system, analyst can construct requirements set more efficiently and reduce possible requirements change in other phases of requirements development life cycle.

Keywords Information system · Requirements development · Taxonomy system

78.1 Introduction

Process of requirements development is systematical, coordinated, and iterative, which consists of activities participated by various stakeholders such as clients, users, analyzers, system designers, programmers, and test personals. Many problems are

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involved in this process about domains such as social domain, cognitive domain, and cultural domain [1]. So well-formed requirement description which depends on appropriate requirements taxonomy [2] is necessary to overcome complexities of requirements development. With an appropriate requirements taxonomy system, analysts can construct requirements set more completely and efficiently, and reduce possible requirements change in other phases of requirements development life cycle as well.

Essential of research on requirements taxonomy is research on requirements intension, which is in persistently developing [3]. So far, a unified and complete requirements taxonomy system is still not shaped. To solve this problem, some representative requirements taxonomy systems existing had been discussed in this paper. Correlation and difference of requirement sorts involved in these systems had been compared. Relationships of different systems had been clarified. Based on this research and with the experience of requirement engineering practice, a complete and new system for requirements taxonomy was proposed to unify and include these representative requirements taxonomy systems.

78.2 Related Work

There are two viewpoints for requirements taxonomy. First is about requirements development, which thinks requirements can be classified according to factors such as requirement level and content. Second is about requirements change management, which thinks requirements can be classified into stable and variable requirements. Discussion in this paper is based on the first viewpoint. Some, respectively, researches are listed as follows:

- (1) Object management group (OMG) presents three core concepts about software system which must be involved when presentation of unified modeling language (UML): structure, behavior, and property. Herein, structures describe composing or deployment of system as well as interconnection or distribution of system components. Behaviors define interactions between system and environment or between system components. Properties define measurable features of structures or behaviors. Requirements describe expected structures, behaviors, and properties of system-to-be.
- (2) Requirement is defined in IEEE Software engineering standard vocabulary as : (1) Requirement is condition or capability necessary for users to solve problems or to achieve goals; (2) Requirement is condition or capability necessary for system or system components to satisfy contract, standard, criterion, or other official documents; and (3) Requirement is documentation for condition or capability described in (1) or (2).
- (3) Requirement workgroup of international conference of system engineering (INCOSE REWG) classifies requirements as follows: (1) Business requirements describe high-level goals of system-to-be required by organization or

- clients; (2) Features define exterior features of system-to-be expected by system operators from viewpoint of users; (3) Functional or nonfunctional requirements define capabilities or constraints requirements of system-to-be from viewpoint of system. Herein, functional requirements include behaviors or data requirements. Nonfunctional requirements include performance and other restrictions such as usability, extension, interface, maintainability, and safety; (4) Business rules describe high-level constraints; and (5) Constraints describe other restrictions in business or technology.
- (4) Software Requirement [4] classified requirements into three levels: (1) Business requirements reflect the goals of organization or clients who want to achieve in high level, which are described in documents about project view and scope; (2) Users requirements describe tasks of users must perform with system-to-be, which are described in used cases documents or scenarios scripts; (3) Standing on system level, system requirements describe functional requirements, qualities properties, constraints, or other nonfunctional requirements of system-to-be, which make users to perform their tasks and to satisfy business requirements finally.

From these classic perspectives for requirements taxonomy discussed above, we can obtain some results. OMG defines requirements mainly according to contents from viewpoint of system itself, which classifies requirements as concrete description of expected structures, behaviors, and properties of system-to-be. IEEE also classifies requirements as situations and capabilities requirements according to contents. But IEEE defines requirements not only from viewpoint of system itself, but also from viewpoint of users who will operate system-to-be. Basically coincident with perspective of «Software Requirement», INCOSE defines requirements from different levels which are more detailed than IEEE: High-level requirements describe initial and abstract business goals or business needs of system-to-be required by organization or clients; Middle level requirements describe operational needs for users to perform their tasks. Low- level requirements describe exterior features of system-to-be such as functional, performance, or other nonfunctional needs. On the other hand, requirements are classified according to contents in more detail.

The results showed that requirements can be classified according to stakeholders, different levels of contents. In fact, classification by stakeholders is interrelated with classification by requirement levels. According to this discovery, a new and comprehensive requirements taxonomy system is offered in this paper with a compositive classification by requirements, contents, and domains involved in requirements development.

78.3 Requirements Development Domains with Stakeholders

Many kinds of stakeholders are involved in requirements development of information system such as clients, managers, users, architecture designers, programmers, and maintainers, which come from different domains [5]. There are

differences among stakeholders in their background knowledge or interests. Consequently, “communication gaps” are there in requirements development shape. To overcome the “communication gaps”, stakeholders in different domains need to come to a common view for system-to-be through communication continuously. Concretely, there are three kinds of domains involved in requirements development.

- (1) Goal domain: stakeholders in goal domain include clients and managers in enterprises or organizations. Correspondingly, goal domain consists of clients and managers as well as goals and interests they want to achieve. Goal domain constraints why clients will pay for system-to-be. Commonly, they hope system-to-be bring them new chances in new technology change, to make their business automation, improve run efficiency of their business, solve problems or lower prices, and so on .
- (2) Operation domain: stakeholders in operation domain include users who will operate system-to-be as well as some system existing in operational environment which will interact with system-to-be. Correspondingly, operation domain consists of users, maintainers, system existing as well as activities, managements, rules, and constraints in operational environment system-to-be will run. Operation domain constrains tasks users perform or problems they want to solve with system-to-be.
- (3) Technology domain: stakeholders in technology domain include system architecture designers, programmers, and maintainers who will develop or maintain system-to-be. Correspondingly, technology domain consists of architectures, programmers, and maintainers as well as information system development technology, language, environment, pattern, and process management. Technology domain constraints which things technology can or cannot bring for human being about project of system-to-be now or in future.

Requirements intersection of three domains discussed above shapes requirements set about system-to-be (Fig. 78.1).

78.4 A Taxonomy System for Information System Requirements

According to domains involved in the development of system-to-be, requirements can be classified into goal domain, operation domain, and technology domain. Furthermore, according to content requirements can be classified as functional and nonfunctional requirements [6], which have different exhibitions in different domains. A taxonomy system for information system is showed as Fig. 78.2.

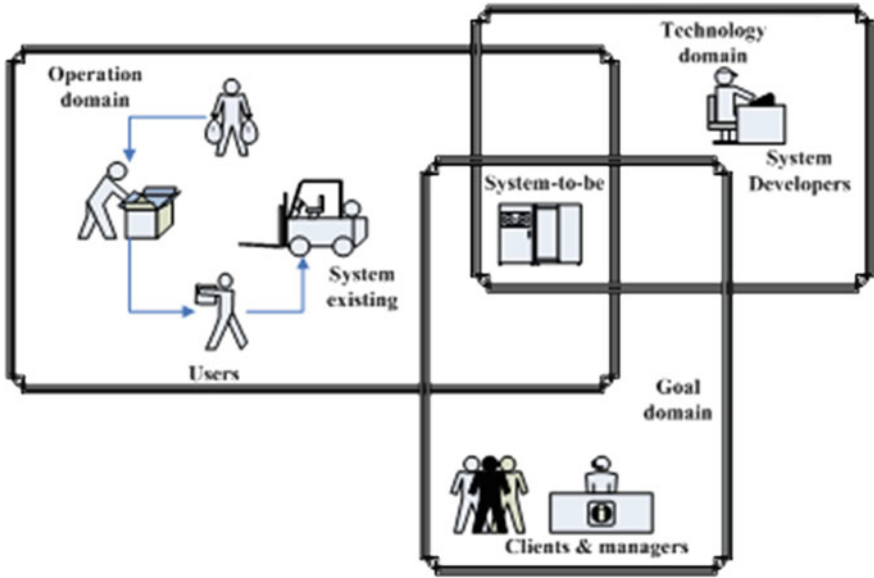
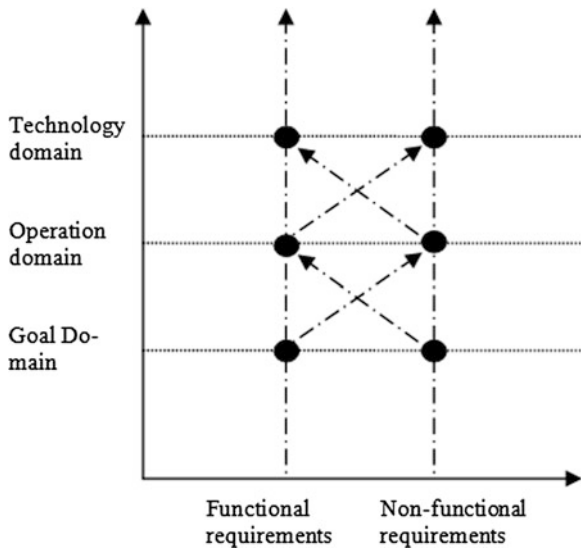


Fig. 78.1 Requirements development domains with stakeholders

Fig. 78.2 A taxonomy system for information system requirements



A complete taxonomy system of information system requirements should include these six kinds of requirements. For requirements analysts, granularity of the taxonomy system is very coarse-grained. So the taxonomy system needs to be refined further. More detailed requirement sorts must be reduced. A detailed taxonomy system helps requirements analysts to acquire requirements systematically and to organize requirements explicitly.

78.4.1 Requirements in Goal Domain

Requirements in goal domain describe why clients want to develop a new system, which often mean interests they hope system-to-be bring them or goals they want to achieve with the help of system-to-be such as financial income and market share. For example, “improve market share 10 %” and “lower complaint of clients” are typical requirements in goal domain. The reason we call them as “requirements in goal domain” is because requirements in this domain are often business goals which can be verified. Requirements in goal domain can be acquired from investors or clients who purchase the system, managers of business, marketing departments, or planning departments.

78.4.1.1 Functional Requirements

In goal domain, functional requirements are exhibited as vision or goals organization or clients who want to achieve. Relating to whole system, vision of product describes final appearance and the future purpose of system-to-be, which unifies efforts of all stakeholders to one direction. When strategic positioning or business goal changes, vision of product must change too. Business goal describes why clients invest for system-to-be, which is criterion for judging whether or not new system is success. For example, “this system should guarantee error between budget and actual cost not higher than normal difference 5 %” is a business goal.

78.4.1.2 Non-functional Requirements

Non-functional requirements in goal domain describe project scope or restrictions. Project scope defines concepts and scope of project solution, and make certain which part of the current project will be implemented in long-term planning of system-to-be. Project restrictions list some functions which cannot be accomplished and make certain cost and schedule of current project. Project scope and restrictions distinguish requirements belonging to current project. Details of project scope and restrictions provide requirements baseline for development team of current project, which help analysts determine which requirements are realistic. In practice, clients often expect some features out of cost or not in scope preconcerted.

78.4.2 Requirements in Operation Domain

Requirements in operation domain are users' requirements, which describe tasks users will perform or problems they want to solve with system-to-be.

78.4.2.1 Functional Requirements

In operation domain, functional requirements are exhibited as capabilities requirements, which describe tasks users perform or problems they want to solve. "This system should support task of charge registration, which includes recording experience data and quoting price according to experience data" is a typical functional requirement in operation domain, because it describes a task system-to-be will support user to participate in.

78.4.2.2 Non-functional Requirements

Nonfunctional requirements in operation domain commonly include business rules and reversal requirements. Business rules constraints business from some aspects, including specifying business structure or control behaviors in business. An enterprise always runs according to a whole set of enterprise policy, accounting standards, and calculation method. In addition, it must obey large numbers of government rules of law, industry regulations, and standards. All of those are called business rules. When users say only special users can do an action, he or she may talk about a business rule. People have proposed many kinds of taxonomies to organize business rules. Typical classification includes five basic sorts, that is fact, business constraint, action enabler, inference, and computation [4]. Reversal requirements define what users expect system-to-be not to do. For some safety critical system, users always offer safety or privacy demand such as "don't send message through system which is not encrypted according to regulation" and "don't visit resource unauthorized".

78.4.3 Requirements in Technology Domain

Requirements in technology domain are system requirements from viewpoint of system itself, such as functions, exterior features, and quality properties of system-to-be, which are expected by users to satisfy their operation requirements.

Functional Requirements In technology domain, functional requirements describe what system-to-be should do, which specify functions system developers must implement in system-to-be. For example, "system should send an email to notify users that their reservations have been accepted" is a typical functional

requirement. Functional requirements are observable behaviors of system-to-be in special situations, so they are called as behavior requirements too.

Typical functional requirements include data requirements, function requirements, and exterior interface requirements. Herein, data requirements specify storage data of system-to-be. Function requirements define data utility of system-to-be as well as how to record, compute, transform, and modify data. Interface requirements describe how system communicates with circumstance, although specifying exterior observable behaviors expected by users or system existing such as user interface, hardware interface, software interface, and communication interface. Interface requirements specify which interfaces system-to-be must provide, but not specify how to implement them.

Non-functional Requirements Nonfunctional requirements in technology domain specify properties features of system-to-be which must be provided with to satisfy functional requirements. Nonfunctional requirements describe running qualities of system-to-be rather than concrete behaviors of system-to-be. They are important criterions to judge whether system-to-be accords with qualities demand. For example, a functional requirement may declare system-to-be must provide function for verify user identification, a nonfunctional requirement may declare that the verification should be accomplished in 5 s.

Non-functional requirements commonly include performance requirements, qualities properties, and requirements constraints. Performance requirements define how rapidly and effectively for system-to-be to accomplish special function. Typical classification of performance requirements includes speed, such as response time for query, throughput such as quantity of transaction per second, handling ability such as concurrently loading and timing such as strictly time demand [4]. Qualities properties complementally describe qualities of some functional requirement. So they always relate to functional requirements. Otherwise, qualities properties may reflect qualities of whole system. There are two kinds of qualities properties from different viewpoints of different stakeholders. From viewpoint of users, qualities properties state how system-to-be behave when users perform some operation such as usability, validity, flexibility, integrality, interoperability, reliability, and robustness. From viewpoint of developers and maintainers, qualities properties state how system-to-be behave when developers and maintainers perform some operation such as maintainability, portability, reusability, scalability, and testability. Requirements constraints regulate situations which must be obeyed when system-to-be is designed or implemented. They describe situations imposed by users or environment to project. Aim for requirements constraints proposed at the stage of requirements analysis is to constrain selected scope of design or implementation for developing system-to-be instead of substituting procedure of design or implementation for developing system-to-be. Design constraints restrict design decision making for problem solutions such as architecture system-to-be adopted, software and hardware

platform selected. Implementation constraints limit technology and resource for constructing system-to-be. For example, developers may in advance specify programming language and tool adopted as well as operating system or database utilized, and decide whether interoperate with system existing.

78.4.4 Relationships Among Requirements in Three Domains

Various kinds of requirements stated above may be included when a complicated information system is developed. Table 78.1 lists the requirements taxonomy in detail.

There is a hierarchy relation among requirements in different domains. Requirements in higher level are always source or base of requirements in lower level. Requirements in lower level are often acquired by decomposition or refinement of requirements in higher level.

Concretely, requirements in goal domain locate at top level in the requirement hierarchy. Requirements in operation domain and technology domain must accord with vision or goals described in goal domain. Requirements in operation domain locate at middle level in the requirement hierarchy. They are the most important basis for extracting requirements of system-to-be in technology domain. Requirements in technology domain locate at lowest level in the requirement hierarchy. Requirements in goal domain or operation domain are finally reduced as requirements in technology domain.

Except explicit hierarchy relation, other affinities exist between requirements with different quality, just as shown in Fig. 78.2. Non-functional requirements in higher level not only may be source or base of nonfunctional requirements in lower level but also may be source or base of functional requirements in lower level. The same things happen in functional requirements. Furthermore, qualities properties and functional requirements may be derived from requirements constraints. And qualities properties such as robustness and usability may finally be realized by functional requirements. Otherwise, there may be consequential or inconsistent relations between requirements in same domain and same type. At last, it is actually not easy to partition functional requirements from nonfunctional requirements in every domain. For example, a requirement defines a signature verification system should fulfill user verification in 4 s. According to taxonomy proposed above, it can be classified into either functional requirement or non-functional requirement [7].

78.5 Conclusions

In this chapter, some representative requirements taxonomy systems existing had been discussed. Correlation and difference of requirement sorts involved in these systems had been compared. Relationships of different systems had been clarified.

Table 78.1 List of requirements taxonomy

Requirements in goal domain	Functional requirements	Product visions			
		Business goals			
	Nonfunctional requirements	Project scope			
Requirements in operation domain	Functional requirements	Capabilities requirements			
	Nonfunctional requirements	Business rules	Fact		
			Business constraint		
			Action enabler		
			Computation		
			Inference		
		Reversal requirements	Safety		
			Privacy		
	Requirements in technology domain	Functional requirements	Data requirements		
			Function requirements		
Exterior interface requirements			User interface		
		Hardware interface			
			Software interface		
			Communication interface		
Nonfunctional requirements		Qualities properties	Properties important for users	Usability	
				Validity	
				Flexibility	
				Integrity	
			Interoperability		
			Reliability		
			Robustness		
		Properties important for developers and maintainers	Maintainability		
			Portability		
			Reusability		
			Scalability		
			Testability		
	Performance requirements	Speed			
		Throughput			
		Handling ability			
		Timing			
	Requirement constraints	Design constraints			
		Implementation constraints			

Based on this research and with experience of requirement engineering practice, a complete and new system for requirements taxonomy was proposed from domains of requirements development and contents of requirements.

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Chapter 79

Design of Natural Gas Pipeline Inspection System Based on Smart Phone

Ling Luo

Abstract The natural gas pipelines daily inspection is an important work to protect pipelines security. The paper designs and develops the pipeline inspection system based on smart phone integrated with GPS, GPRS technology. First, this paper introduces GPS, GPRS and smart phone technology, and then designs the system architecture and function modules of the system, finally develops the system. The system can effectively complete the patrollers monitoring, pipeline and devices data collection, real-time exception handling, inspection data statistics and analysis. Practice proves the system accelerates the information process of pipeline inspection and makes the pipeline inspection management more standard and effective.

Keywords Pipeline inspection · GPS · GPRS · Smart phone

79.1 Introduction

The pipelines daily inspection is a very important work to protect pipelines security, because the pipelines have the characteristics of large span, long length, and easy to be damaged by the nature and human beings. The traditional inspection work is mainly manual inspection and the pipeline patrollers write the inspection information on papers and report the inspection information by telephone. This way has several problems such as nobody knows if patrollers accomplish their

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pipeline inspection according to their assigned inspection lines, they did not report in time, they did not write down the inspection information correctly and the reported information did not be inputted into computer correctly, and so on. The second inspection system using some advanced automatic identification tools such as information button and bar code to do computer management has been applied generally and played a significant role in the management of production safety. However, due to the complex product installation, and long-term exposure in the wild, vulnerable to be damaged, not to effective management; furthermore, inspection information is still manual recording which does not reduce substantial work of inspection information analysis and statistics [1–3].

Therefore, using 3G technology, this paper designs and develops a pipeline inspection system based on intelligent terminal which can do real-time inspection of patrollers' patrol line and working status, real-time alarm, and shows the fault point by locating graph. The system that is not only get rid of the management and preservation problems of the first generation system but also make up for the lag and without visualization of the second generation system realizes the inspection of electronic, informational and intelligent, enhances working efficient in great degree and guarantee pipelines' safe operation with high efficiency and lower failures.

79.2 Key Technologies

79.2.1 GPS Technology

The Global Positioning System (GPS) is a space-based satellite navigation system that provides location and time information in all weather, anywhere on or near the Earth, where there is an unobstructed line of sight to four or more GPS satellites. It is maintained by the United States Government and is freely accessible to anyone with a GPS receiver [4].

So the inspection system combined with satellite position technology, GPRS communication business and computer network technology can dynamically trace and monitor inspection status, display inspection spot in electronic map and show the planned inspection route to facilitate the operation of patrollers.

79.2.2 GRRS Technology

General Packet Radio Services (GPRS) is a packet-based wireless communication service that promises continuous connection to the Internet for mobile phone and computer users. The higher data rates allow users to take part in video conferences and interact with multimedia websites and similar applications using mobile hand-held devices as well as notebook computers. GPRS is based on Global System for

Mobile (GSM) communication and complements the existing services such as circuit-switched cellular phone connections and the Short Message Service (SMS) [5]. Furthermore, the more attractive thing is that your payment is just according to your data consumption and the cost is low, which are beneficial to enterprises to reduce their operation costs.

79.2.3 Smart Phone

A smart phone is a mobile phone built on a mobile computing platform with more advanced computing ability and connectivity than a feature phone. Today's smart phone also serves to combine the functions of portable media players, low-end compact digital cameras, pocket video cameras, and GPS navigation units. Modern smart phones also typically include high-resolution touchscreens, Web browsers that can access and properly display standard webpages rather than just mobile-optimized sites, and high-speed data access via Wi-Fi and mobile broadband. The most common mobile operating systems (OS) used by modern smart phones include Apple's iOS, Google's Android, Microsoft's Windows Phone, Nokia's Symbian, RIM's BlackBerry OS, and embedded Linux distributions such as Maemo and MeeGo [6]. Such operating systems can be installed on many different phone models, and typically each device can receive multiple OS software updates over its lifetime.

79.3 System Design

79.3.1 System Architecture

This intelligent inspection system is such a patrol system that integrates GPS technology, GPRS mobile communications, smart phones, and so on. The system architecture is composed of three parts, which is shown in Fig. 79.1.

Smart phone is the intelligent terminal that has GPS module, GPRS communication, and so on. After login successfully, patroller can do his inspection according to assigned inspection task, input inspection information, and take photos, furthermore choice how to submit his GIP information by himself or by the smart phone automatically.

Center Web Server, the tasks of the server are receive inspection data uploaded by each smart phone terminal, and then automatically generating each one's inspection circuit on GIS map that is convenient for managers tracing and querying one's inspection situation, statistics and analyze abnormal information come from inspection data and alarm when necessary and create all kinds of report forms according to these inspection information [7].

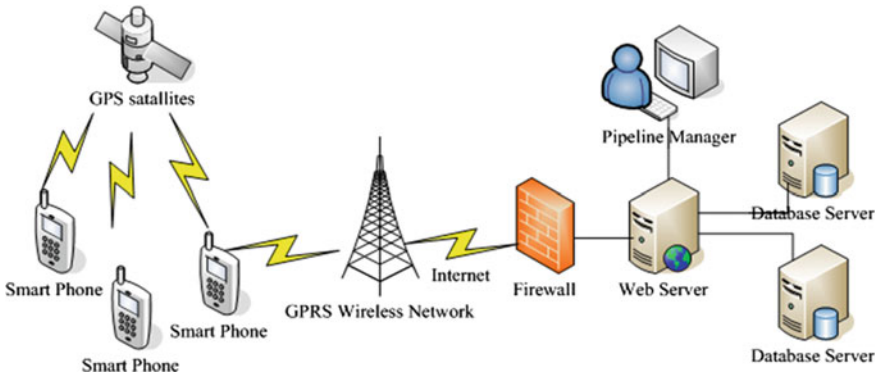


Fig. 79.1 System architecture

Management PC terminal, the managers use PC terminal to receive real-time data, monitor pipeline operation, give records, and supervise patrols.

79.3.2 System Function Modules Design

The overall system function modules are mainly divided into two parts: the intelligent terminal module and central server-side module. The intelligent terminal that is connected to server by TCP/IP protocol through GRPS network can upload and download data. The Web service center is in charge of data processing.

79.3.2.1 Intelligent Terminal Function Modules Design

System login: pipeline patroller can accomplish his own relevant inspection work after login the system successfully. The first time he must input correct username and password to login the system and the login information will be saved for a long time, and then he can login the system by default username.

GPS navigation: the main function is to get the GPS navigation information, such as latitude, longitude and altitude, time, and so on.

Inspection task query: after login successfully, patroller can view his own inspection task of today or any day of the week on-online or download the task into his smart phone, which is convenient to him to know his inspection task freely.

Temporary task receiving: receive temporary work arrangement sent from server and prompt patroller in time.

Daily inspection: the module mainly includes the following functions.

Routine inspection information upload: patroller may input then name of the inspection object, the specific information of the inspection object (mainly including the pipeline test potential, the status of three pickets and insulating anticorrosive coating, the operation circumstance of cathodic protection facilities equipment, and so on), choose photos patroller took on the spot through the data input interface, and then upload these information to the server as well as the inspection spot position coordinates gained automatically by the terminal system.

Natural gas well station operation status upload: mainly upload the gas pressure of every gas well, H2S content of Natural gas with desulfurized, and so on.

Inspection track browsing: Inspection patroller can real-time inquire his own inspection track that is pointed out on the electronic map. By this way, patroller can know what inspection work he already accomplished [8].

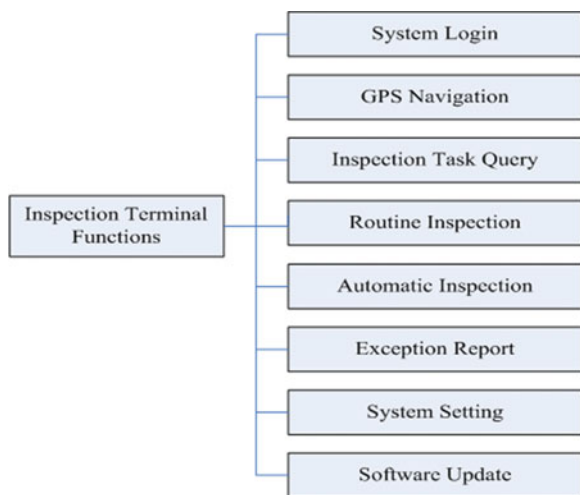
Automatic inspection: Automatic inspection is that the intelligent terminal can automatically collect and upload the GPS position information of the inspection spot after the distance and time have been set by patroller. This way can extremely reduce the patroller’s work in the case that pipelines are in less damaged and most of the pipelines are normal.

Exceptions: patrollers upload the exceptions into server that mainly are the device malfunction, security malfunction, illegal situation and so on, at the same time, the exception photos also must be upload. At the other hand, patrollers can inquire the solution suggestions and execute relevant work according to the suggestions.

Software updating: the module can remotely login the server to update software when there is new version which eliminates the trouble of re-installing the software.

The inspection terminal function module is shown in Fig. 79.2.

Fig. 79.2 Inspection terminal system function



79.3.2.2 Centre Server Function Module Design

Inspection plan management: Pipeline manager makes out weekly pipeline inspection plan, which includes the inspection area, lines, starting date, ending date of everyone patroller responsible for and so on, furthermore has the right to inquiry, add, delete, and modify these inspection plans.

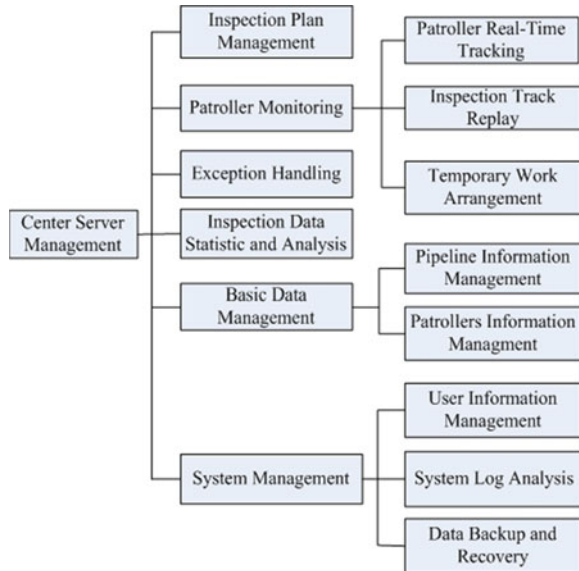
Inspection personnel monitor: the center server real-time receives the information uploaded from everyone smartphones. By this way, manager can trace any patroller’s position at any time and check if they are executing their inspection task, and also send temporary work schedule information to their terminal smartphones.

History inspection track replay: the system can playback personnel inspection track in any period or playback the history inspection track according to the pipeline name or the region.

Inspection data statistic and analysis: First, this module can automatically generate the inspection work logs according to the inspection tracks, the situation of exceptions reported and handled accomplishment circumstances of temporary work, and then can easily complete anyone’s work statistics at any time that ensure the authenticity and accuracy of anyone’s assessment. Second, the module can dynamically generates inspection circuit statistics, equipment faults statistics, security hidden trouble statistics, violation situation statistics, and all of these provide more accurate data for manager to analyze [9].

Exception handling module: the manager can gives specific handling advices according to these information of device faults, security hidden troubles and violation situation uploaded by patroller, and then send these advices to client terminal, meanwhile the module will alarm in the first time when pipeline exception occurs.

Fig. 79.3 Center server system function



Basic information management: the manager can query and maintain the basic information of patrollers and pipelines through the module.

System management: the module mainly includes user rights management, user login information management; ensure the security of the system through the log analysis, system data backup and recovery at regular time.

The inspection terminal function module is shown in Fig. 79.3.

79.4 The Ending

The structure of the inspection system is B/S, the development technology of center server is ASP.NET, the development environment is Visual Studio 2005, the database of back-end database server is SQL Server 2005, the operation system of smart phone terminal is Windows Mobile 6.0 and develop language is C#. Finally, we develop the pipeline inspection system integrated with GPS, GPRS, and Smart phone which can solve these problems how to supervise patrollers, collect pipeline and devices data, real-time handle exception, and data statistics and analysis. Practice proves the system accelerates the information process of pipeline inspection and makes the pipeline inspection management more standard and effective.

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Part IX
Multimedia Aechnology and Applications

Chapter 80

The Affective Adjustment Material Selection Model Used in E-Learning Environment

Xiang Wei Lai, Chen Lu, Guang Yuan Lui and Feng Ru Lui

Abstract The E-learning environment has broken the students and teacher interaction and classroom interaction model in traditional education process. In this paper, we suggested a student affective PAD value evaluated method by the user's GSR physiology signal. We also give an affective adjustment material ability evaluate and selected algorithm. And a test system is developed to evaluate the usability of the algorithm. Some music was used to adjust the user's E-learning process.

Keywords PAD · GSR · E-Learning · Affective adjustment

80.1 Introduction

In traditional education process, students can accumulate many kinds of affective experience with the teaching process. The research shows that the experience can direct the teacher and students interaction, intervene the students' study process and achievements, and it also can affect the student and teacher's personal development [1]. Many researchers had already discussed the importance of education affective in their research area. Zeidner's [2] research in the students' examination in quietude and Heckhausen's [3] achievement motivation theory all can give us some successful experience in modern education affective research.

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The E-learning environment has broken the students and teacher interaction and classroom interaction model in traditional education process. The new education model put the students into an isolate space. The electronic information transaction pattern always makes the students easy to fall into the negative affectives such as puzzled, bored, anxiety, loneliness, and so on.

Affection regulation is the combination of internal and external processes of the emotional response. In these processes, the unit monitoring, assess, and amend one's effective in order to achieve his goals [4]. It shows that affection regulation has a relation with social communication, social competence, and social adaptation mental health. Affection regulation makes the unit has adaptative existence and active crossing the emotional arousal retraining, controlled, adjusted, and modified [5].

Affection regulation includes both internal and external processes. Internal adjustment comes from the unit which adjusts by its inner world, such as self-consciousness of the individual heart. External adjustment mainly comes from the influence and the process which is related with the outside world [6]. So affection regulation is a process of cognition and behavior.

Picard [7, 8] of The MIT lab proved the effectiveness of the method using physical characteristics of the signal for effective identification in 1998 for the first professor lab report on evidence of technology, and recognized eight effective of actor using GSR, RSP, EMG and BVP signal with 40 features. It was discovered that in the state of the bigger effective change of subject, the range about changes of the GSR became big very much, and confirmed the feasibility using GSR to reflect the subject's anxiety. So it's proved that the GSR has an important value of effective recognize in Scherer's [9] research.

80.2 Pad Parameter Evaluate In E-Learning Environment

80.2.1 The PAD Emotional Model

To specify the user's emotional states, we use Mehrabian's PAD emotion space model [10, 11]. The PAD Emotional State Model consists of three nearly independent dimensions that are used to describe and measure emotional states (or feeling, affective conditions): pleasure and displeasure, arousal and no arousal, and dominance and submissiveness. Pleasure–displeasure distinguishes the positive–negative affective quality of emotional states, arousal-no arousal refers to a combination of physical activity and mental alertness, and dominance submissiveness is defined in terms of control versus lack of control.

The following sample ratings illustrate definitions of various emotion terms when the scores on each PAD scale range from -1 to $+1$: angry (-0.51 , 0.59 , 0.25), sleepy (0.20 , -0.70 , -0.44), and bored (-0.65 , -0.62 , -0.33). Thus, according to the ratings given for “angry”, it is a highly unpleasant, highly aroused, and moderately dominant emotional state.

80.2.2 PAD Parameter Attenuation and Composition

The same affective state has similar PAD value, but we can distinguish them by the different arousal. We can describe the affective change process with the time delay. By the research of psychology, we can use an exponential function to approach the emotional attenuation process. Just like the function 80.1:

$$e_t = e_{t-1} \times e^{-\beta \Delta t} \quad (80.1)$$

And the e_{t-1} means the original emotional state, β means the attenuation ratio, Δt means the attenuation time, e_t means the emotional state now.

The function means the emotional will attenuation with the time delay. In fact, people's emotional attenuation always shows by the attenuation of arousal and dominance value. The pleasure values will not attenuation by the time. We can change the attenuation function 80.2 as:

$$e_t(P_t, A_t, D_t) = e_{t-1}(P_t, A_t \times e^{-\beta \Delta t}, D_t \times e^{-\beta \Delta t}) \quad (80.2)$$

In E-learning environment, students will be affected by many kinds of emotional states such as hungry, sleepy, bored and so on. The emotional superposition can be described by the function 80.3.

$$m_t = \begin{cases} 0 & t = 0 \\ f(\alpha m_{t-1} + \beta e_t) & t > 0, \alpha + \beta = 1, \alpha, \beta > 0 \end{cases} \quad (80.3)$$

The m_{t-1} means the emotion states at the time t-1, e_t means then emotion state now, α, β is the weight, $f(x)$ is an S-style function which is used to Normalization the value of x .

80.2.3 Signals Collection

MP150 device is selected to collect the skin electrophysiology signals. Produced by Biopic Company, U.S., MP150 device is a kind of multi-channel physiological signals acquiring device with which the GSR signals collection channel is equipped [12]. A computer is used to play emotional materials and when the subject's emotion is stimulated, the GSR response signals are transferred to the acquisition software Superlab that installed in computer 2 through the sensors. In addition, computer 1 is equipped with a hidden HD camera for real-time observes the subject's emotion changes, so the examiner can give the corresponding notes in Superlab in real time if the subject's feeling fluctuating.

80.2.4 Original Skin Response Signals Collection

Experiment selected the GSR signals collection position between forefinger and middle finger. Because the influence of the temperature on GSR was relatively large, so the subject was suggested to rest for a couple of minutes, and then cleaned his/her forefinger and middle finger of the right hand with medical alcohol and kept them dry before posted GSR sensor electrodes.

80.2.5 Feature Extraction

The effectiveness of feature extraction is especially important for the follow-up recognition processes in the pattern recognition problems. Two aspects, which are time domain and frequency domain, can be extracted features after the noise reduction and normalization of the GSR signals. Observed the GSR response signals of the same subject under different emotional states we found that there was a large difference of the signal waveforms that evoked by different feelings; hence, only the statistical features that could most represent the changing of the GSR signals were extracted. According to the feature extraction methods of Jonghwa, the maximum value, the minimum value, value range (the maximum value minus the minimum value), mid-value, standard deviation, mean value, the ratio of the maximum value and the ratio of the minimum value, were the statistical features of the time domain that needed to extract, then calculated the one-order difference and the second-order difference for each statistical features, respectively. The GSR signals should be required to Discrete Fourier Transform (DFT) at first in the process of the frequency domain features extraction, and then extracted the related statistical features of the transformed data. Finally, 30 primitive statistical features are formed, which include mean value, mid-value, standard deviation, the maximum value, the minimum value, amplitude range, the ratio of the maximum value and the ratio of the minimum value of the original data, the data after one-order difference and the data after second-order difference, respectively, 24 statistical features of the time domain are obtained. Again, six frequency domain features are got after the DFT of the original data, which include mean value, mid-value, standard deviation, the maximum value, the minimum value, and amplitude range of the frequency domain signals. Because the 30 extracted features are different and the value interval of the feature values distribute in different ranges, consequently, it is necessary to normalize each feature of the whole data so as to unify the meaning of each feature represents. The normalization formula is shown as follows.

$$\tilde{X}_i = \frac{X_{i0} - X_{i\min}}{X_{i\max} - X_{i\min}} \quad (80.4)$$

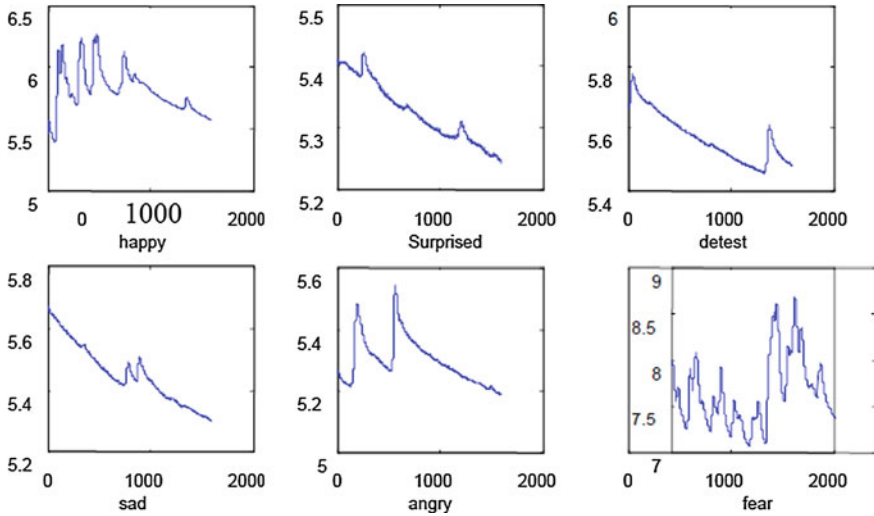


Fig. 80.1 6 typical emotional states' GSR signal

where X_{i0} is the i th ($i \in (0, 30)$) feature value of GSR that after feature extraction, and X_{imax}, X_{imin} represents the maximum value and the minimum value of the feature values on this dimension. \tilde{X}_i Is the i th feature value of GSR after normalized, and therefore get 30-dimension feature data whose values are all in between 0 and 1? (Fig. 80.1).

80.2.6 Feature Selection Algorithm

In view of the specific problem of feature selection, basic ideas such as SBS, PSO, and HPSO, were mainly used, respectively; considering the parameters mechanism of HPSO was not perfect, which led to difficult to find the optimal position, we applied the self-adjusting principal of biologic immune system into the parameters selection of HPSO and finally achieved the goal of the parameters automatic adjusted.

Some of the feature values of skin conductance are relatively obvious when there is one certain emotion. It shows that the subject is in the emotional state of fear if three feature values: sc-maxRation, sc1Dif-mean, sc2Diff-std, e.g., are obviously in skin conductance.

80.3 Affective Adjustment Material Ability Evaluate

The research uses namely reappraisal and suppression to adjust the emotion. Above the chart 1, the adjustment machining before emotional arousal includes situation selection, situation modification, antinational deployment, cognitive change, and it assigned to namely reappraisal. The adjustment machining after emotional arousal includes response modulation assigned to suppression [13, 14].

E-learning is the typical human–computer interaction process. We have not any more affective adjustment method can use. The adjustment materials we used are some video, music, and interaction games which can present by the computer. The adjustment materials must have some basic requirements:

- Positive adjustment directive
- Positive or negative arousal effects directive
- Positive dominance directive

We use some of human voice music as our adjustment materials in the research. It can avoid the human voice affect the user’s distribution of attention. And some other adjustment materials will be used in the next researches. Among eight, typical music was chose in the test. We must appraise the adjustment ability of the music first.

The material’s adjustment ability can be define as $\langle P_i, A_i, D_i, S, F \rangle$, and $P_i, A_i, D_i \in [-1, 1]$ P_i is the material’s pleasure adjustment ability, A_i is the arousal adjustment ability, D_i is the dominance adjustment ability, the positive value means positive adjustment directive, S is the material’s appear method, $F \in \{\text{true}, \text{false}\}$ means it is the user preference. We can get material’s adjustment ability by the affective test (Table 80.1).

80.4 The Material Selection Algorithm

In Gross’s opinion [15], affection regulation is a progress what the unit has, when it happens and how to feel and express the emotion. i.e., affection regulation is a

Table 80.1 The material evaluate adjustment ability value

No.	P_i	A_i	D_i
1	0.23	0.21	0.12
2	0.15	0.11	0.13
3	0.21	0.32	0.23
4	0.14	0.17	-0.21
5	0.07	0.34	0.32
6	0.24	-0.18	-0.17
7	0.09	-0.34	-0.23
8	0.25	0.18	0.22

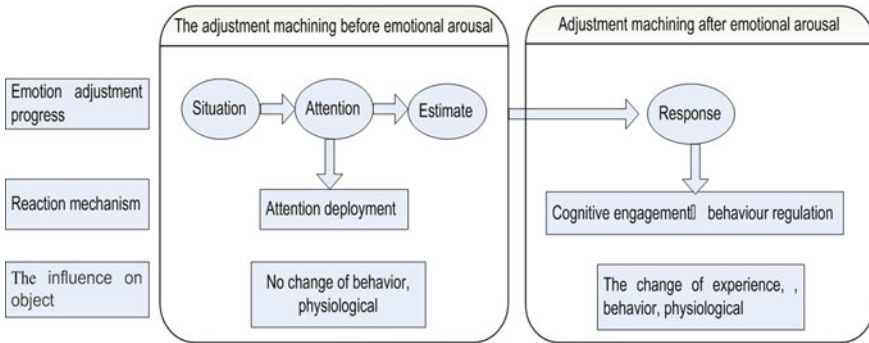


Fig. 80.2 Gross’s affection regulation progress

progress that unit makes effect on some object, the object includes the happen, experience, and express of the emotion. Affection regulation is a dynamic progress [16].

Gross put forwarded five strategies for affection regulation: situation selection, situation modification, antinational deployment, cognitive change, and response modulation (Fig. 80.2).

The arm of Affective Regulate is to make the student’s emotion to some positive states which can improve the learning efficiency and effect. But the excessive pleasure and arousal always make students easy to be tired. So we set the arm emotional states of affective regulate to a tranquillity state with a little positive pleasure. The state can make the students study efficacious. The state’s PAD value is $AE = \{0.1, 0.2, \text{ and } 0.1\}$.

The Material Selection algorithm is:

- Collect the student’s Original skin response signals
- Feature extraction and Feature selection algorithm
- Calculate the student’s PAD value
- Calculate the space distance between the current affective state and the regulate

arm states by the function
$$D(X_1 - X_2) = \frac{|x_1^2 + y_1^2|}{\sqrt{\sigma_1^2 + \sigma_2^2}}$$

- Choose the Material which has minimum variance

80.5 Conclusions and Discussion

In the paper, we suggest an affective material selection algorithm used in E-learning environment. But there are also some works should do later. Such as: Development of a real-time HCI affective adjustment system.

More type of material should be include in the system and more detail material evaluate method.

The mapping method from GSR and other physiology signal to the user's affective states.

We will try to expand this search to the normal human-computer interaction process. And it will help us to develop a more harmonious interaction environment.

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Chapter 81

Face Detection-based Video Key Frame Extraction

Jian Yin and Su Huan Wang

Abstract Nowadays, online video viewing is one of major applications of the Internet. And what we studied is how to use a few key frames to express a video. In addition to using single threshold of frame difference, we use the sequence of faces number we detected in every frame of the video to get a summary of semantic meaning of the video. But the classifier we used in face detecting is not good enough. And because of its false detection and miss detection, we got too many false key frames. So with the continuity of videos, we introduce a method to solve this problem, which at last reduces the number of key frames.

Keywords Content-based video retrieval · Key frame · Face detect

81.1 Introduction

With the rapid development of Internet and multimedia technologies and the continuous improvement of transmission speed of network, a large number of videos appear on the Internet. Some are films and TV series, produced by film and TV companies and some are short films produced by individual. These are a wide range of good and bad content.

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At present, the main ways people used to search for video they are interested in are searching and categories recommending, then reading title, content introduction and user comments, and so on. However, some low-quality videos always use sensationalistic title to attract viewers. Extracting the key frames of video for quick view can solve this problem to some extent.

81.2 A Simple Method of Key Frame Extraction

At first, we adopt a simple key frame extraction method [1, 2] which is based on color histogram. Total 52 % are selected to represent frame difference proportion, which means as long as the ratio of difference of color histogram to total pixels of image is greater than 52 %; we consider a transition occurs at this point of the video. Two frames before and after the point are stored as key frames. In this paper, threshold and frame difference proportion have the same meaning. In addition, we also set up another lower threshold that is 5.2 % t for further comparison.

This method has the advantage of high speed and easy to understand, at the same time, the disadvantage of the method is simple and crude, and the video data mining is not deep enough. It is difficult to set frame difference proportion. If frame difference proportion is set too high, many key frames will be lost, on the other hand, if the proportion is set too low, many key frames we do not need will be detected. Another problem is that Video is not well understood by adopting the above method. To solve the problem, we introduce face detection. It will improve semantic understanding of video.

81.3 Introduction of Face Detection

Now videos on the Internet mainly are films and TV series and so on. People focus on the plot of the movie. Changes in the number of people means plot changes in most cases. Therefore, we introduce face detection technology.

This paper we adopt a classifier included in OpenCV [3, 4]. The classifier combines haar feature and AdaBoost [5] algorithm. The classifier detects the number of face of adjacent frames in frame sequence. If the number of face changes, we save the next frame as key frame.

The result is inferior to my original idea for that the result of face detection is not good. Results prove that the mistake rate and miss rate of face detection are high. You can see examples as shown below:

As you can see from the above two figures, this method of face detection has its limitations. Now there is no perfect solution to solve the problems.

But we are not helpless. Considering characteristics of video and face detection, we put forward a new way to solve the problem to some extent.

81.4 Algorithm Improvement Combined with Video Characteristics

This paper proposes an improved algorithm; based on the fact that the video has characteristics of continuity [6, 7]. The improved algorithm is designed to solve the problem that face detection is not accurate.

At the very beginning of the video stream, we continue to use the simple method of faces' number comparing mentioned before. When the faces' number of two frames adjacent to each other are different, we take the latter frame as key frame. And then, for the faces' number difference happened again we use the new faces' number set method to accommodate the instability of the face detection.

We will describe faces' number set method below: we put the first two different faces numbers into the set. For all of the face number of next continuous frames, if the number is in the set, we consider the plot is stable. Otherwise, if we get a faces number which was not in the set, we add it into the set and delete an older one from the set. In this way, we can always keep a set with two unstable faces number.

On the other hand, we use diff-like method to set up double insurances. In our program, variable like is a threshold for the frame difference, which is settled as 5.2 %. If the frame difference of two frames adjacent to each other is less than the variable like, we consider the two frames are continuous. So the difference of their faces number is useless, and we do not need to check it anymore.

81.5 Experimental Results and Discussions

We use different method in our experiment to do comparative analysis. The methods are listed as below:

The set of faces number algorithm (without diff-like)

Simple faces number algorithm (without diff-like)

The set of faces number algorithm (with diff-like)

Simple faces number algorithm (with diff-like)

Single threshold of frame difference algorithm

The system keeps all experiment data correctly recorded analysis. The data are stored in the folder named imgStore.

The record contains data as follows:

Cache all of the key frames.

The information of video and the total frame count cached is recorded in file named info.txt

The information of key frames cached is recorded in log.txt

The information of each frame including frame number, face number, and frame difference with the former frame is recorded in records.txt.

Table 81.1 Data compare of different method

	Simple faces number algorithm	Simple faces number algorithm (with diff-like)	The set of faces number algorithm	The set of faces number algorithm (with diff-like)	Single threshold of frame difference algorithm
Cost time	176	173	179	179	8
Key frames number	411	401	366	361	310

```

31 intersection length: 302
32 the diffence num:
33 imgStore-just Simple faces number algorithm(without diff-like) num: 60
34 imgStore-just The set of faces number algorithm(with diff-like) num: 104
35 imgStore-just The set of faces number algorithm(without diff-like) num: 56
36 imgStore-just Simple faces number algorithm (with diff-like) num: 95
37 imgStore-just Single threshold of frame difference algorithm num: 8

```

Fig. 81.1 Analyzing log files created by python

Finally, we use python and awk to tabulate data recorded in info.txt. Python is mainly used in two respects. First, gather data. Second, analyzes the difference of key frames then do operations including intersection, difference. Awk is used to extract data from info.txt then tabulate data. Data format shown in Table (81.1).

There are another analyzing log files created by python. Shown in Fig. (81.1):

The figure shows using python to do comparative analysis of data generated in the system.

Intersection length is standard for intersection of key frames of all the methods. As shown in the figure, the difference number of different method stands for difference set of key frames. That means the number of key frames only generated by the single method. All of the key frames are cached for further study.

The central focus of our study is listed below:

1. First is intersection length, which is the same part of all methods. Second is different number of different method which stands for the single part of single method.
2. We can see form the above figure, the number of key frames generated by using frame difference method is least; in addition, these key frames generated by using frame difference method is limited in showing video content. However, it is obvious that the method has the advantage of time saving. Several other methods have the same level of time complexity.

81.6 Conclusion

The system using Color histogram as feature of video frames to do shot segmentation of video under the situation of Image compressed. We also used face detection to extract key frames of each shot. The face detection we used combine

haar feature and AdaBoost algorithm. And above all, single threshold algorithm and the set of faces number algorithm are adoptive to improve the performance of the simple face detection algorithm. At last, all of the key frames are stored for user browsing.

Of course, we still have more things to deal with:

1. This paper uses face detection as semantic elements in key frames extraction. So the system is not suitable for videos that do not have persons. Scenery video is an example.
2. This paper focuses on MV video format, further study and experiment need to be done on other popular video format.
3. We can try a new approach to combine other information of video to do content-based video retrieval, such as audio, subtitles, and so on. Dig deeper for video plot to enhance the emotional and semantic experience of user.

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Chapter 82

Research on the Image Sensor Imaging System

Yao Cheng and Xiang Hui Yuan

Abstract In order to research the imaging effect of the image sensor, the image sensor's imaging system is developed based on virtual instrument technology. The system was constructed with NI's data acquisition card, PC computer and imaging software system. The image sensor's signals were acquired into computer using control signals to control the image acquisition sequence. The acquired serial voltage signals were changed to the two-dimensional special image signals by the imaging software system. The changed image was displayed on software screen by gray mapping and pseudo color enhancement. The feasible of system was validated with the imaging experiment. This system is flexible and its function can be extended. People can watch the imaging effect directly. It plays an important role in device's modification and design.

Keywords Image sensor · Imaging system · Virtual instrument

82.1 Introduction

The imaging technology has developed rapidly as the progress of scientific technology [1]. The imaging systems use the image sensors to receive image signals of the measured objects, which are amplified and processed to display

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and form two-dimensional images. Acquiring the image data, a series of processing and finally displaying the visual images are important contents of the research of the imaging. The states of the various types of equipments can be measured by using the images. And there are wide uses of applications, such as the automated diagnosis of electrical troubles, noncontact online temperature measure and monitoring, and so on. In the mean time, it is widely used in military affairs, such as night vision, infrared detection, infrared guided, military communications, radar, and so on.

The traditional research of the imaging system is designing multiple versions of hardware circuitry of the entire system, through the repeated revision and validation. This method needs long time, expensive cost and the researcher often do not know which part is the problem [2]. The design of the system involves the design of the detector [3], but the imaging effect wont be known until designing the hardware circuit. By using the virtual instrument technology and building virtual instrument systems, the image acquisition and display can be achieved at the same time. The image data are acquired by the DAQ card based on computer bus and the image is processed and displayed by the software platform of computer. This research of the system based on the virtual instrument can save development time and can be designed easily. The operation of the system is simple and the function can be defined and modified conveniently by the user. The true image quality of the designing imaging devices can be observed directly, and the user can modify and validate the image sensors and devices.

82.2 Imaging System

After the optical signal is converted into electrical signal by the image sensors, the results must be injected into the read out circuit to output [4]. ROIC is a special digital and analog mixed signals processing integrate circuits [5]. The output of the image sensors is read in turn by read-out circuit, and then the video signals are gained by a series of signal processing [6].

In this paper, the imaging system is designed by using NI's PCI-6115 DAQ card and the PC computer to form the PC-DAQ virtual instrument system. The system is to build a PC-DAQ system using virtual instrument technology. Virtual instrument is the result of combining computer technology and modern equipment technology [2]. By the principles of the imaging, the system uses the external signals to control the output data collection of the read-out circuit. Through the acquisition card, the video output signal is accurately sampled, processed, and displayed using the image software system.

The acquisition and display of image can be achieved at the same time by building virtual instrumentation system. To construct the imaging system based on virtual instrument, it is simple and convenient to design, debug, modify and

operate, which can save development time, and is one of the new options of infrared imaging system.

82.3 Imaging Hardware System

The compositions of the system include the hardware and software. The hardware involves image sensors, drive circuits, junction box BNC-2110, data acquisition card PCI-6115, and PC. The structure diagram of the system is shown in Fig. 82.1.

BNC-2110 box is a connecting bridge between external signals and acquisition card. The image signals and control signals are connected to the 6115 acquisition card by the box.

The image acquisition of the system is achieved by the 6115 data acquisition card of National Instruments Company. The acquisition is controlled by external clock signals which are generated by drive circuit. Drive circuit is to provide the driving signals in time sequence for the image sensor device. The image signal is output by image sensor which is droved by drive circuit. Meanwhile the time sequence is controlled by acquisition software based on LABVIEW platform.

To acquire the accurate signal of every pixel output, external clock signals must be satisfy the time sequence of sensor. According to the drive circuit, the line scanning start signal S_y is used as the trigger signal of signal acquisition to control the start of one acquisition. And the number of pixels is used as the number of sampling points to control the end of one acquisition [7]. The column scanning clock signal CP_x is used to generate the sampling clock ADST to control the acquisition card to acquire when every pixel output is smooth. So S_y and ADST output by drive circuit must be connected to PFI interface in box. Video signal is connected to the analog input channels.

The timing sequence of acquisition is as shown in Fig. 82.2 [8]. Channel 1 shows the output of the read-out circuit of infrared image sensor. D0 represents S_y , and D1 represents ADST. What can be seen from the figure is that S_y do acquire data when triggering falling edge. And the result is that using ADST can get stable pixel output. The acquired data then can be changed into the images and displayed after a series of processing.

Fig. 82.1 Virtual instrument system for image acquisition of the image sensor output

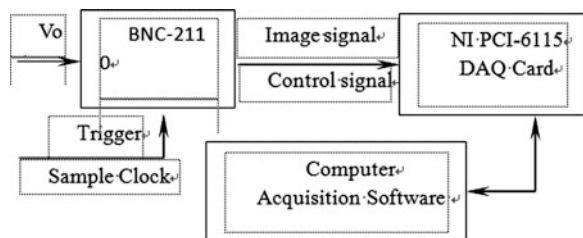
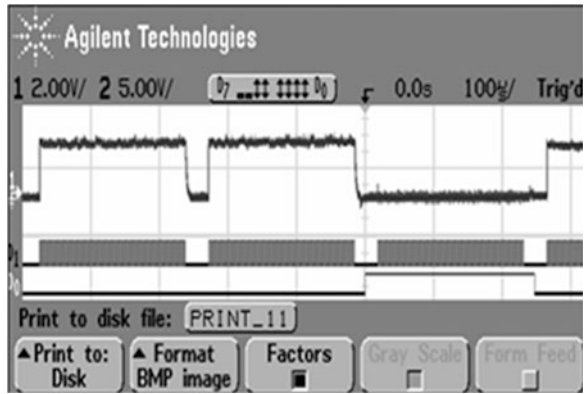


Fig. 82.2 The sequence of image acquisition



82.4 Imaging Software System

The imaging system is constructed by the hardware platform and the program based on the virtual instrument. The front panel of the system is shown in Fig. 82.3. After completing the hardware connection, and setting the parameters of the front panel in accordance with the connection, as well as the detector parameters, run the program can start the system. When the users want to end the system, the back button can be pressed.

The software of the imaging system is the core, since running the software can operate the system. The software of system is programmed based on LABVIEW software platform. LABVIEW is the compiler-based graphical programming environment based on the data flow. This style of graphic development provides the code modules for each VI which allows users to call other code modules [9].

Fig. 82.3 Front panel of the infrared imaging simulation system

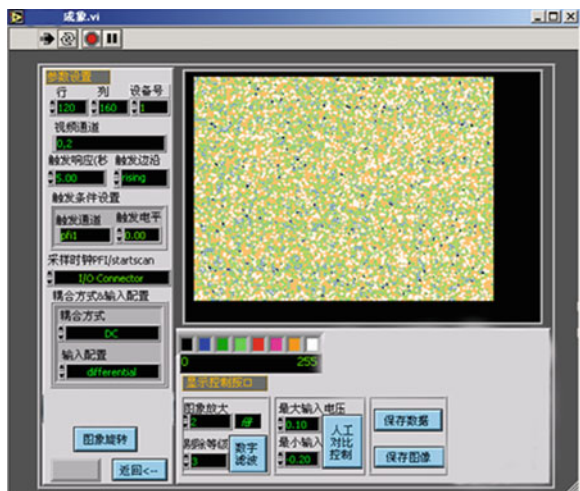
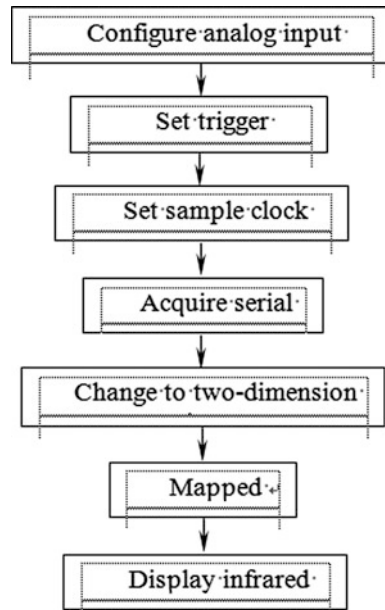


Fig. 82.4 The structure diagram of imaging software



The block diagram of imaging software is as shown in Fig. 82.4. The design of the program consists mainly of two parts. One is to control the timing sequence of the PCI-6115 acquisition card. Another part is to convert the video signal and display the image.

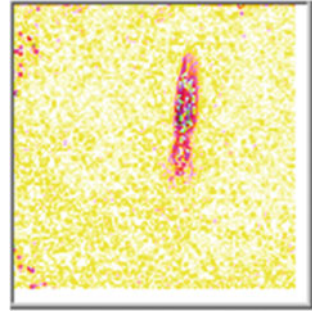
The control to PCI-6115 acquisition card includes the configurations of the input channels, the acquisition trigger, and the sampling clock. The configurations of the input channels need to configure the buffer size of them, the sequence number of the acquisition channel, the coupling and input configure of the acquisition signals, as well as the choice of acquisition card. Acquisition trigger configurations include: the manner, the channel, the level, the edge, as well as the time limit of the trigger. The configuration of the sampling clock is the choice of the sample clock source.

The image data acquired in the computer are the voltage value. In order to be displayed as images, the serial output data must be transformed into the two-dimensional video data firstly. And then the voltage data should be mapped to gray value. Based on gray grade, different voltage data are linearly mapped into different gray values. Then the infrared image is displayed on the virtual instrument software platform using display program.

82.5 Experimental Results

The pyroelectric ROIC developed in integrate circuit laboratory of Chongqing University, and the detector developed in Kunming Physics Institute have been connected, and then the imaging system can be applied to the imaging experiment

Fig. 82.5 The image in interlink experiment



of them. Then the system can display the image. The imaging experiments had been finished for the iron by using the pyroelectric image sensor and imaging system, finally the thermal image was displayed as shown in Fig. 82.5.

From the thermal image, user can see intuitively the effect of imaging. So using the system, the users can find some quality problems of sensors. The imaging system can provide some timely references for the design and modification of devices. It can also save time and money for debugging and design of the thermal imaging systems.

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Chapter 83

Research on Video Abstraction

Linglin Wu, Xiaoyu Wu, Lei Yang and Linwan Liu

Abstract This paper focuses on designing a system that is capable of abstracting useful video frames for archiving, cataloging, indexing, and editing purpose. Among the different features of video frames, statistics histogram is adopted to detect key frames because of its low sensitivity toward motion, low complexity of calculation, and robustness to noise. In addition, cumulative histogram is adopted to detect the edges of video frames due to its lower sensitivity to the motion of objects/camera and illumination variations than statistics histogram. Dynamic threshold-based sliding window is used to detect the shot boundaries and efficiently get the key frames in favor of its representativeness.

Keywords Video abstraction · Histogram · Shot boundary detection · Key frame

83.1 Introduction

Along with the rapid development of multimedia and IT technology, multimedia has brought needs for tools that aim at improving contents browsing, searching, and interacting. As the richest style of media, videos are getting more popular than

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ever; however, how to enable a quick browsing of a large video database has posed challenge to us. In this context, we investigate the abstraction approach, which presents a set of key frames, constituting a salient collection of frames extracted from the video. This set of key frames is remarkably shorter than the original video stream but preserve the representative contents, thus brings efficient content access.

Application of video abstraction techniques is wide ranged, such as in data archiving and indexing, film industry, family entertainment, military and public security, medical imaging, image analysis in Aeronautics and Astronautics, and so on. [1]. Storage media such as tape, P2 card store video frames in form of streams, which poses great difficulties to data management and editing. Our goal is to design a system that can efficiently detect the shot boundaries in a certain stream then generates a key frame set for users to locate the video segments they need conveniently.

83.2 Shot Boundary Detection

83.2.1 Shot Boundary

In order to generate the key frames set, a segmentation of video content is required before descriptive frames are selected. Thus, shot boundary detection is a crucial technique in video abstraction. Considering massive video, in this paper we present a simple and fast segmentation method based on shot boundary methods. Hence, the change of shot can be determined by detecting shot boundary.

Video shot boundaries present in two different appearances: abrupt temporal changes and gradual temporal transitions [2]. Since this system is designed for unedited video streams, gradual temporal transitions will not be discussed in this paper. Abrupt video shot boundaries are featured with significant discontinuity between two frames, such transition has no editing effects or time duration, the former frame represents a certain scene, and the next represents another.

83.2.2 Image Features

As the basic unit of a video sequence, a given shot is featured with similarity between scenes and contents. Correspondently, the video frames in the same shot will present certain continuity. Changes of shots will cause discontinuity along the time domain. There are several features of image that can measure the degree of similarity among frames: gray feature, edge features, motion feature, and histogram.

Table 83.1 Image features compared

Feature	Sensitivity to motion	Computational complexity	Sensitivity to noise
Gray	High	High	High
Histogram	Relatively low	Relatively low	Relatively low
Edge	Relatively low	High	High
Motion	Relatively low	High	Relatively low

Among all these features of image, the key point is to select the most suitable one. Multiple factors shown in Table 83.1 are taken into consideration. Histogram feature can be evaluated as suitable due to its low sensitivity to motions, low computational complexity, and robustness to noise. Therefore, we can detect shot boundaries through evaluating of difference between the histograms.

83.2.3 Shot Boundary Detection Based on Histogram

Image histogram is a 1D discrete function, defined as:

$$H(k) = \frac{n_k}{N}, \quad k = 0, 1, \dots, L - 1 \quad (83.1)$$

where k is the value of the selected feature, L is the number of possible values, n_k is the number of pixels with value of k , N is the total number of pixels in the image.

Histogram approach will be ineffective while the illumination variation of multiple frames within one shot is remarkable different; in addition, histogram remains sensitive to camera motion. To overcome this limitation, we use cumulative histogram as an alternative.

A cumulative histogram is also a 1D discrete function, defined as:

$$H(k) = \sum_{i=0}^k \frac{n_i}{N}, \quad k = 0, 1, \dots, L - 1 \quad (83.2)$$

where the denotation of each parameter is same to ones in Eq. 83.1 [3].

To evaluate the dissimilarity between frames, we can calculate the distance of cumulative histogram after the histogram of frame is acquired.

There are four kinds of distance of cumulative histograms: correlation, Chi square, histogram intersection, and Bhattacharyya distances [4]. Empirically, histogram intersection is fast but less precise, Chi square and Bhattacharyya are less efficient but accurate.

In this paper, Chi square distance is employed:

$$d_{\text{chi-square}}(H_1, H_2) = \sum_i \frac{(H_1(i) - H_2(i))^2}{H_1(i) + H_2(i)} \quad (83.3)$$

For Chi square distance, shorter distance reflects better matching. Chi square distance will be zero with matching. As the disparity become larger, Chi square distance will be arbitrarily large. Thus, we normalize the Chi square distance to make the value equal to 1 with complete dissimilarity.

83.2.4 Selection of Threshold

Shot boundaries can be detected when a large discontinuity occurs between histograms. To recognize a cut, we have to select a threshold value for cumulative histogram difference while single peak appears.

Two different methods for choosing a threshold exist: global thresholding and adaptive thresholding.

Global thresholding is the simplest method of thresholding by choosing a single pre-defined value. A shot boundary is determined when histogram difference exceeds the threshold. A problem with global thresholding is that camera motions across the scene may cause histogram difference to vary differently, which leads to inaccurate detection.

In this paper, we deal with the problem by employing adaptive thresholding. In adaptive thresholding, we determine the threshold value according to the histogram difference automatically instead of having a single global threshold [5]. We therefore adopt sliding window technique, using a sliding window of a predetermined size where only the sample within this window is considered for estimating the shot boundary threshold. We define the window size *win*, the maximum in the window *max*, the minimum in the window *min*, the means *avg*. We compute the median between *max* and *min*, define it *median*. Then we divide these values into two groups based on median: a group with larger value and a group with smaller value, and compute the means *max_avg* and *min_avg* respectively. While proposition $|max_avg - min_avg| > Factor \times avg$ is true. Empirically, we multiply the *Factor* by a factor (varied from 3 to 5) to get an ideal threshold. We set $T = \frac{max_avg \times 2 + min_avg}{3}$ as the shot boundary threshold, difference between neighboring histogram H_1 and H_2 that is larger than T can locate a shot boundary; otherwise there is no scene cut within the window. The experimental results of segmenting the shot are described in Sect. 83.4.

83.3 Extracting the Key Frames

83.3.1 The Key Frames

Video abstraction is a collection of the most representative frames. Therefore, selection of key frames is the crucial point. Key frame(s) should be as few as

possible and reflect the main content of each shot, similar to key words in text search.

Currently, the popular approaches to key frame extraction include shot based and scenario based, the result of which can be frame, shot, and scene [6]. A shot is defined as a sequence of frames that runs for an uninterrupted period of time without abrupt changes in scene or objects. According to this, we can simply select the first frame of one shot as its key frame. Therefore, in this paper, we will focus on shot-based approach. When there is no significant change within one shot, one frame will be adequate; otherwise we should select more than one frame.

83.3.2 The Algorithm of Extracting the Key Frames

In shot-based approach, frame equalization and histogram equalization are classic alternatives. Frame equalization is to compute the arithmetic mean of all frames in one shot at a particular pixel, then select the frame of which the corresponding pixel has the closest value to the mean as the key frame. Histogram equalization is to compute an average histogram of all cumulative histograms and select the frame of which histogram is the closest to the average histogram [7].

Other efficient approach is to compute the distance of feature space. In this paper we compute the distance of feature space based on histogram.

Threshold algorithm is similar to threshold selection of sliding window algorithm, but key frame(s) should reflect object/camera motions and illumination variations, thus, we choose statistical histogram instead of cumulative histogram as the image feature. While local threshold T is acquired, H_2 can be determined as the key frame if the difference between H_1 and H_2 is larger than T ; otherwise, there is no significant change within the shot that requires extra key frame descriptor.

Consequently, we select the key frame base on histogram difference and choose the first frame of each shot as the key frame.

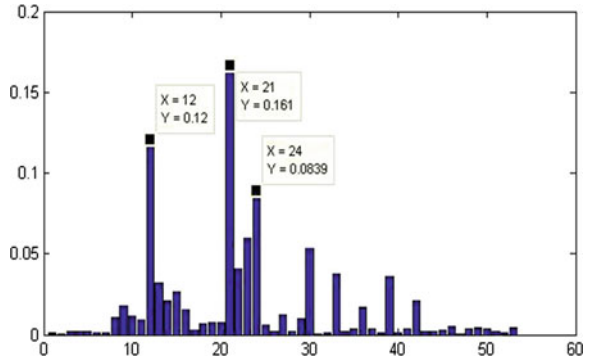
83.4 Experimental Results

The system discussed in this paper is designed for unedited video sequences which are featured with abrupt changes between shots. We tested the system on a part of movie <Hugo> with a total frame of 146 (no gradual transitions included).

83.4.1 Detecting the Shot Boundary

In Fig. 83.1, it is shown that the result of computing the histogram difference based on Chi square distance. We can see abrupt changes after frame 54 and 116.

Fig. 83.1 The neighbor frame difference of cumulative histogram among the all frames



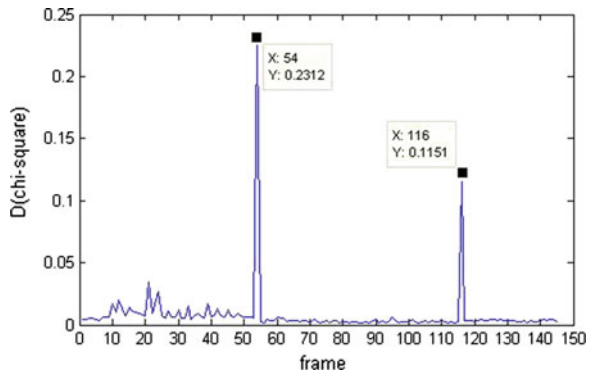
When $win = 15$, $Factor = 4$ is used on sliding window to compute the threshold by comparing the neighbor frame difference of cumulative histogram among the all frames.

83.4.2 Key Frame Extraction

We still computed the differences of neighboring histograms within three shots respectively, using Chi square distance. The result is shown in Figs. 83.2, 83.3, and 83.4.

We still used $win = 15$, $Factor = 4$ sliding window to get the threshold within the window. While a value is obtained, any frame where difference exceeds the threshold should be a noticeable change, thus we extract a key frame; otherwise no frame is extracted.

Fig. 83.2 Differences of neighboring histograms in shot 0 (frame 1 to 54)



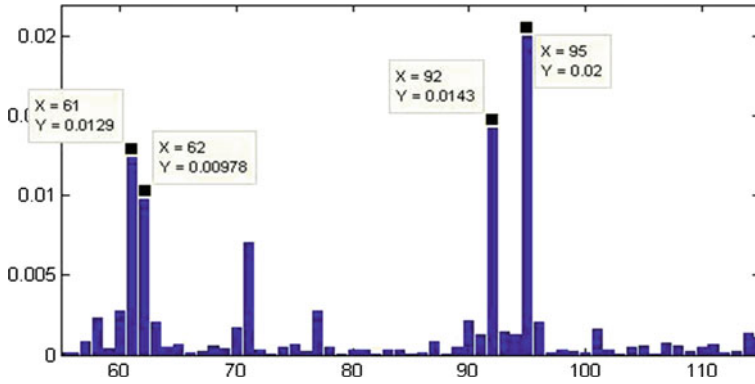


Fig. 83.3 Differences of neighboring histograms in shot 1 (frame 55 to 116)

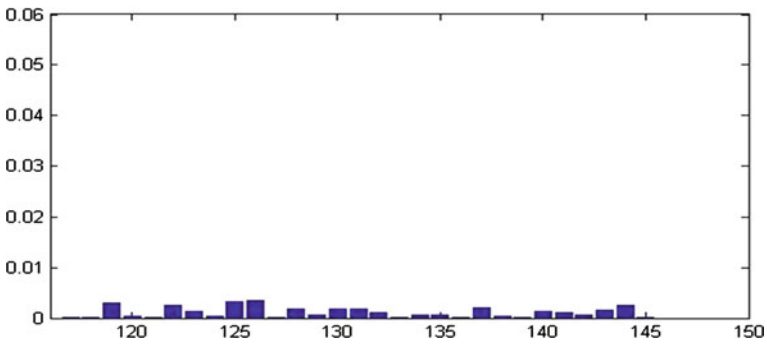


Fig. 83.4 Differences of neighboring histograms in shot 2 (frame 117 to 146)

83.5 Framework and Implementation of the System

The video abstraction system is implemented on VC6.0 platform. Using the algorithms above, we can get the results of the shot detection and corresponding key extraction.

83.6 Conclusion

The video abstraction system is designed for unedited video sequence that only have abrupt scene changes. Chi square distance of cumulative histogram and sliding window thresholding is employed to detect shot boundaries; Chi square distance of statistical histogram and sliding-window thresholding is used to extract key frames. The system works well on shot boundary detection and key frame

extraction. In this paper, the difficulty of detecting smooth boundaries is not considered. However, gradual transitions, fades, and dissolves are common in edited video sequences and it requires further investigation.

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Chapter 84

Studies of Quadratic Watermark Based on MD5

Shibo Qiu, Taolin Ma and Lei Liu

Abstract In the area of digital watermark's copyright protection, it is difficult to identify the rightful ownership in multiple marks, namely the interpretation attack. In this paper, we propound the quadratic watermark based on the message-digest algorithm 5 (MD5). By embedding a watermark and the MD5 into the products in proper order, the products can resist to the physical attack and the interpretation attack effectively.

Keywords Digital watermark · Interpretation attack · MD5 · Quadratic watermark

84.1 Introduction

Currently, most digital watermark technologies are based on the physical attacks, in addition to these robustness attacks, there is also the interpretation attack. The implementation of the interpretation attack is very simple, but how to prevent it or to self verify when it has implemented is quite complex [1].

In this paper, we propound the quadratic watermark based on the message-digest algorithm 5 (MD5). This model has two layers of watermarks, one is related to the carrier image and the other is not. The watermark which is not related to the carrier image is used to resist physical attacks. As the MD5 have one-way relationship to the carrier image, we can use it against the interpretation attack effectively.

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84.2 Theories Analysis

In this section, we introduce how to calculate the MD5, to preprocess the watermark and to embed the watermark and the MD5.

84.2.1 Calculating the MD5

How to calculate the MD5 is given as follows [2]:

Complement bits.
 Add the length of the input data.
 Initialize the MD5 parameter.
 Define four basic MD5 bit operating functions.
 Transform input data.
 Output.

84.2.2 Watermark Preprocessing

By image scrambling technology, we can make the carrier image chaotic. Hence, the copyright offenders only get garbled information even if the image information is illegally robbed.

In this paper, the watermark image scrambling algorithm is based on the Arnold transform [3]. Arnold transformation is proposed by the Russian mathematician Vladimir Arnold. For an $N \times N$ digital image, its two-dimensional Arnold transformation is defined as follows:

$$\begin{pmatrix} x' \\ y' \end{pmatrix} = \begin{pmatrix} 1 & 1 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} \pmod{N} \quad (84.1)$$

Here $x, y \in \{0, 1, 2, N - 1\}$ state the pixel position before transforming. x', y' stands for the pixel location transformed, mod means the modular arithmetic.

84.2.3 The Embedding Process

The embedding process of the quadratic watermark based on the MD5 is shown in Fig. 84.1 [4].

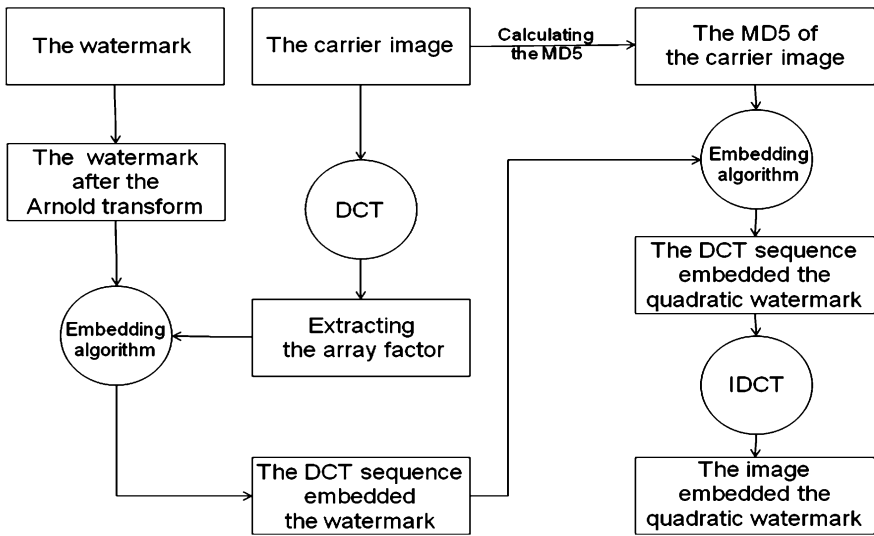


Fig. 84.1 The embedding process

84.3 Experiments and Discussions

The watermark is an 8 bits image of which the content is CS and the area is 128×128 [5]. The carrier image is the 24 bits Lena image of which the area is 512×512 .

84.3.1 The Optimal Embedding Number of the MD5

We divide the carrier image, and then embed MD5, respectively. In order to divide image evenly, the number of the MD5 is n^2 , where n is a natural number [6]. To ultimately determine the optimal number, we do the following two experiments.

84.3.1.1 The Number of MD5 Completely Extracted from the Carrier Image Embedded MD5 and Suffered Physical Attacks

In this experiment, we do attack tests for the carrier image embedded the MD5. Then extract and detect the MD5.

From the Table 84.1, when the number is 49, we can extract nearly 50 % of the MD5 even if image suffered some destructive physical attacks. In the final MD5 detection process, as long as more than half of the MD5 extracted consistent with the embedded, the final extraction results must be the same as the original after

Table 84.1 The number of MD5 extracted

Attack	Extracted/ embedded	Extracted/ embedded	Extracted/ embedded	Extracted/ embedded	Extracted/ embedded	Extracted/ embedded
Compressed 20 %	13/16	23/25	33/36	47/49	62/64	76/81
Compressed 40 %	8/16	13/25	20/36	28/49	40/64	53/81
Compressed 60 %	4/16	7/25	15/36	23/49	31/64	41/81
Rotated 15 %	10/16	16/25	21/36	32/49	43/64	61/81
Rotated 30 %	7/16	11/25	15/36	27/49	36/64	48/81
Rotated 45 %	4/16	7/25	12/36	22/49	30/64	41/81
Cut the four corners 25 %	7/16	14/25	16/36	25/49	34/64	45/81
Cut the center 25 %	9/16	12/25	14/36	24/49	33/64	46/81
Gaussian blur (radius is 3)	12/16	19/25	30/36	29/49	41/64	53/81
Gaussian blur (radius is 6)	10/16	13/25	15/36	25/49	32/64	45/81

mean computing. Therefore, the number we selected in this experiment should be greater than or equal to 49.

84.3.1.2 The Similarity Between the Image Embedded MD5 and the Carrier Image

When embedding the MD5, we meet the following three requirements [7]:

1. PSNR close to 31.9 db is the best.
2. The NC value close to 1 is the best.
3. The ratio of the total data of MD5 and the watermark data amount is not greater than the watermark data amount and carrier image data amount (Table 84.2).

As shown in Table 1.2, with the number of MD5 embedded growing, the PSNR gradually reduced, but still far away from 31.9. Because PSNR close to 31.9 db as the best is under the premise that the embedded data and the original data are in the

Table 84.2 The PSNR and NC values of the carrier image embedded MD5

Embedded number	PSNR	NC	Embedded number	PSNR	NC	Embedded number	PSNR	NC
1	/	1.000	81	66.804	0.999	256	61.735	0.999
4	81.096	1.000	100	65.862	0.999	289	61.244	0.999
9	76.893	0.999	121	65.012	0.999	324	60.748	0.999
25	72.066	0.999	144	64.316	0.999	361	60.276	0.999
36	70.380	0.999	169	63.624	0.999	400	59.831	0.999
49	69.014	0.999	196	62.923	0.999	441	59.404	0.999
64	67.849	0.999	225	62.298	0.999	484	59.000	0.999

same order of magnitude, but in this experiment, there are obviously not. As the MD5 embedded changes the carrier image very small, the NC values are very close to 1. Therefore, requirements (1) and (2) cannot represent restrictions well.

Now, we qualify the number of the MD5 in accordance with the requirement (3).

$$\begin{aligned} \frac{\text{A single MD5 data}}{\text{watermark data}} &\leq \frac{\text{watermark data}}{\text{carrier image data}} \\ \text{The number of MD5} &\leq \frac{(\text{watermark data})^2}{(\text{carrier image data}) \times (\text{a single MD5 data})} \\ &= \frac{1284}{(521 \times 512) \times (3 \times 5)} \approx 68 \end{aligned}$$

Depending on the experiment 1.3.1.1 and the experiment 1.3.1.2, the optimal number of the MD5 embedded in this experiment should be 64.

84.3.2 The Robustness Experiment of the Quadratic Watermark Based on the MD5

This experiment is aimed at detecting the robustness of the watermark system [8]. We use a variety of means to process the generated image embedded watermark and the MD5. Then, extract the watermark and the MD5. Finally, we detect the robustness of the system by comparing and computing some correlation values.

As shown in Table 84.3, from the data above, we know that the robustness for image compression and rotation is strong, while the robustness for the cut and the Gaussian noise is poor. When the number of MD5 embedded is 64, we can guarantee MD5 detected close to half of the number embedded after a variety of attacks. As the MD5 detected results can be consistent with the MD5 embedded, this system can resist the interpretation attack well.

Table 84.3 The experiment of the watermark’s robustness

Attack	PSNR	Watermark detecting result	Extracted/embedded	MD5 detecting result
Compressed 20 %	47.232	Yes	62/64	Consistent
Compressed 40 %	51.121	Yes	40/64	Consistent
Compressed 60 %	56.874	Yes	31/64	Consistent
Rotated 15 %	31.476	Yes	43/64	Consistent
Rotated 30 %	29.865	Yes	36/64	Consistent
Rotated 45 %	26.333	Yes	30/64	Consistent
Cut the four corners 25 %	49.232	Yes	34/64	Consistent
Cut the center 25 %	56.211	Yes	33/64	Consistent
Gaussian blur (radius is 3)	25.667	Yes	41/64	Consistent
Gaussian blur (radius is 6)	21.153	Yes	32/64	Consistent

84.4 Conclusions and Discussions

With the quadratic watermark based on the MD5, we can effectively resist the interpretation attack.

In practical application, in order to make this system more accurate and easier, we can publish the MD5 and the image embedded watermark on a security website. In this way, we can mark the registering time or the releasing time and the carrier image through the MD5. Without introducing a third impartial party and doing complex signatures for the time stamp, at the same time the embedding data are much smaller, so it is more suitable for practical applications.

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Chapter 85

Research on Machine Vision-Based Alignment System in PCB Inkjet Printer

Zhuang Chen, Hui Jiang, Yin Qian Wang and Yu Qiag Jing

Abstract The paper introduced the research and design of the machine vision-based alignment system of an emerging PCB inkjet printer. It proposed to use template matching algorithm in the alignment system. It gave detailed design method of the alignment system; includes the architecture and operational process. Then it proved the feasibility by a series experiments, including time cost, threshold setting, and precision.

Keywords PCB inkjet printer · Machine vision · Alignment system · Template matching

85.1 Introduction

At present, “energy saving and emission reduction” regarding the PCB industry will be a long-term and arduous challenge for us. The traditional manufacturing process originated in the 1950s is no longer adapts to the development of modern society’s urgently demand, the whole industry call for a thorough technology innovation [1]. With the rapid development of computer technology and printing technology, PCB character printer came into being. With a lot of new advanced machine vision and mechatronics technologies adopted, the new PCB character printer can print characters and graphs automatically. In traditional PCB manufacturing process, the Gerber file format based on RS274 protocol suite is the most extensive in PCB design. To smooth transit from traditional approach, it is

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imperative to parse the RS274 protocol in the PCB character printer system, also, to graphically display of the Gerber documents, to cure and print the characters and graphs in one step from the Gerber design documents. In the whole PCB character printer, the machine vision-based alignment system acts as “eye” in it.

85.2 Related Works

85.2.1 *Related Research on Machine Vision-Based Alignment System*

For now, there are many researches about machine vision-based alignment system, also, a lot of application have being used in some industry environment. Generally speaking, there are two feasible approaches which can be employed in machine vision-based alignment system—Hough transform and Template matching. For example, paper 1 [2] gives an approach extracting edge images and using least square method to calculate the center of the circle, and develop an automatic positioning and drill device, but in most cases, the edge images contain a lot of noise which is hard to distinguish from the wanted circle edge; paper 2 [3] proposes a method using Hough transform combine with least squares circle to detect circle, but it is not precise when the edge of the circle’s binary image has a breadth; paper 3 [4] presents a method dividing the whole process into two steps; first the fuzzy alignment and then accurate alignment; the fuzzy alignment uses the chord’s properties to reduce the detecting range, the accurate alignment uses the result of the first step, adopt Hough transform to detect the circle, the disadvantage of this method is obvious, it is not suitable when there is more than one circle in the image.

Generally speaking, all the methods above have a common disadvantage, the priori knowledge of the detecting context is neglected. Hence, we propose a method based on the priori knowledge of the detecting registration hole, such as radius and center of the registration hole. The method is based on normalized correlation coefficient (NCC), which can return a outcome matrix contains the best matching candidate after calculating the correlation between the template image and detecting image. It is a half-supervised machine learning method while the template image needs to be selected by hand, this method proved useful when the matching threshold being set reasonably.

85.2.2 *Template Matching Algorithm*

Template matching is a basic method of image processing, pattern recognition, and computer vision. The template is a small given image, template matching is to find

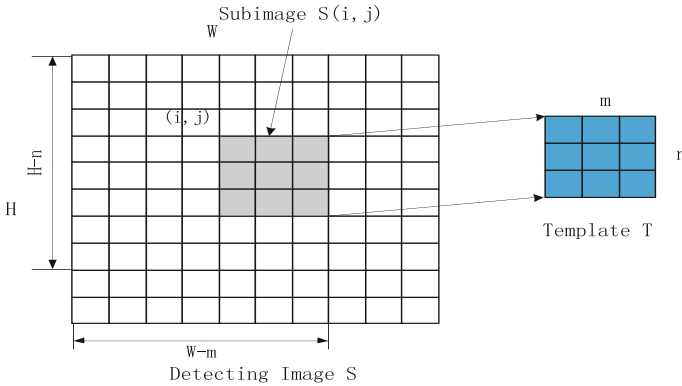


Fig. 85.1 Template matching

a sub image in a big image. With template matching algorithm, we can locate the position of the template in the big detecting image.

Assume the size of detecting image S is $H \times W$, the size of template T is $m \times n$, template T move on the detecting image S from left to right and top to bottom with some step size. We call the subimage under the search window $S_{(i,j)}$, the i, j is the top left coordinate of $S_{(i,j)}$ in S . The range of i, j should be $1 \leq i \leq W - m, 1 \leq j \leq H - n$, we calculate the correlation at each search point between the template image T and subimage $S_{(i,j)}$, then we get a result matrix $R_{(i,j)}$ of size $(H - n) \times (W - m)$. The maximum value of $R_{(i,j)}$ indicates the position where template T best matches S [5, 6]. The match process can be described as Fig. 85.1.

The formula to calculate the $R(i, j)$ shown as follows:

$$R(i, j) = \frac{\sum_{m=1}^M \sum_{n=1}^N [S^{i,j}(m, n) - \bar{S}^{i,j}] \times [T(m, n) - \bar{T}]}{\sqrt{\sum_{m=1}^M \sum_{n=1}^N [S^{i,j}(m, n) - \bar{S}^{i,j}]^2} \sqrt{\sum_{m=1}^M \sum_{n=1}^N [T(m, n) - \bar{T}]^2}} \quad (85.1)$$

In the formula, $R(i, j)$ is the correlation coefficient between S and T at (i, j) , $S^{i,j}(m, n)$ is the pixel value of S at $(i + m, j + n)$, $T(m, n)$ is the pixel value of T at (m, n) , $\bar{S}^{i,j}$ is the average pixel value of subimage $S(i, j)$, \bar{T} is the average value of template T .

The advantage of template matching is insensitive to the brightness change, so it is robustly compared with other algorithms. Furthermore, it deals with pixel directly, we do not have to preprocess the image first, so it is good to avoid to bring in the random error in preprocess of the origin image. Another advantage of template matching is that it uses the priori knowledge of the template, because we get the template by hand before we use it, so it is a half-supervised pattern recognition method, it's very useful to solve the image process problem such as having a given example to find the similar repeatedly.

In the alignment system of the PCB printer, we need to give a threshold to tell whether the template is found in the detecting image, only when the maximum value of the result matrix greater than the given threshold then the search is success, or the template cannot be found in the detecting image. The principle to set the threshold is to ensure no error matching while keeping the flexibility to allow some variety of the PCB registration holes. No error matching means when there is more than one similar result we should remove the distracter and keep the best result; keeping the flexibility means when the target is not identical from the template we can still get the right result. Obviously, it is contradictive of the two part of principle, but we can still get threshold after lots of experiments. We take experiments at part four of this paper.

85.3 Design of PCB Printer Alignment System

85.3.1 System Architecture

The machine vision-based alignment system in PCB inkjet printer is a device containing computer technology, mechatronics technology, and computer vision theory. The fundamental is: first, to get all the registration holes information by parsing the PCB design document, then by converting the above coordinate through “Gerber coordinate–Physical coordinate”, we get all the registration hole’s position on the PCB board, we move the CCD on to the registration hole by sending command to the move control module, after the CCD in position, CCD grabs one picture from the PCB, and send it back to the computer, then the computer detects the position of the registration hole in the picture by template matching algorithm. Then we convert the result by PCB offset algorithm and “Image coordinate–Physical coordinate–Gerber coordinate”, then we revise all the coordinates in the Gerber file according to the result above, we can get a new Gerber file fitting with the PCB’s practical position. After that, we can raster the new Gerber file and print it onto the PCB.

The basic module of the PCB inkjet printer consists of move control module, image collecting module, print module, and a computer. The architecture can be shown as Fig. 85.2.

85.3.2 Alignment

We can divide the whole process into three parts, as described in Fig. 85.3.

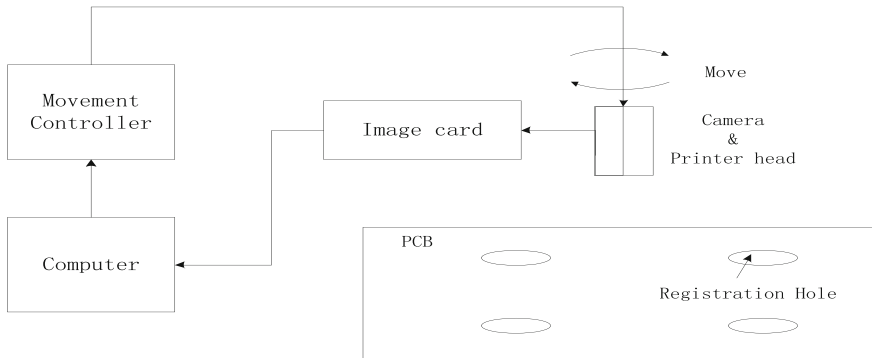


Fig. 85.2 System architecture

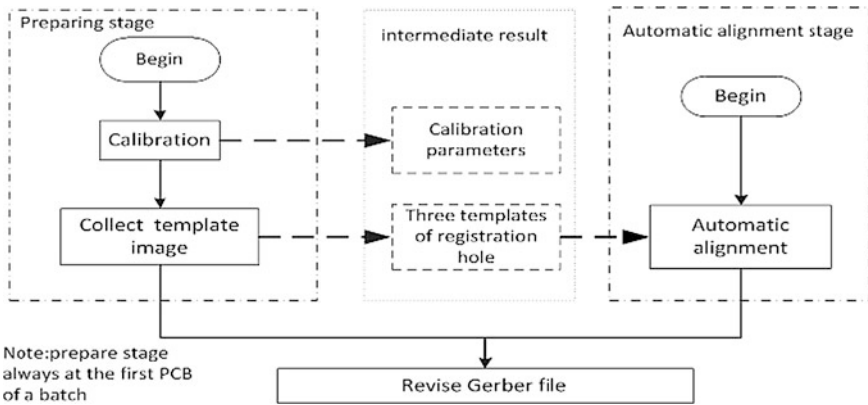


Fig. 85.3 Flow chart

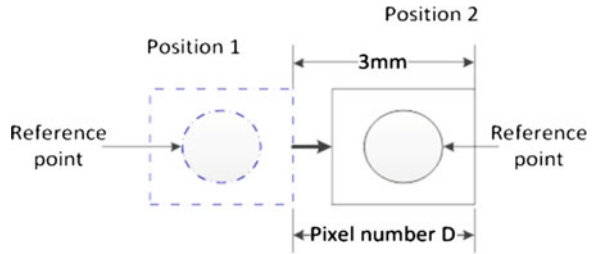
85.3.2.1 Calibration

We need to know the proportional relation between the image pixel obtained from CCD and the physical length, so the first step should be Calibration. The basic idea is that we select a reference point in the visual field, situate it to the center of the visual field, then we send a command to move the CCD to the left for θ mm, then we calculate how many pixels (named pixel distance D) have the reference point moved, then we get the proportional relation A , the formula is:

$$A = \text{pixel distance } D / \theta \text{ mm} \tag{85.2}$$

Also, the schematic diagram of calibration shows as Fig. 85.4.

Fig. 85.4 Schematic diagram of calibration



85.3.2.2 Collect Template Image of the Registration Hole

In this stage, we collect template image of the registration hole manually for next stage. Because we can ascertain a plane by three points, so we only need three templates for the registration hole on the PCB and then we can get the position of whole board.

85.3.2.3 Automatic Alignment

Once we get the result of the above two stages, then we can use template matching. Because we parsed the Gerber file previously, we have all the positions of the registration hole, all we need is to check whether all the registration holes are at the position designed, if not, we get the offset of each registration hole by template matching algorithm one by one. The schematic diagram can be shown as Fig. 85.5.

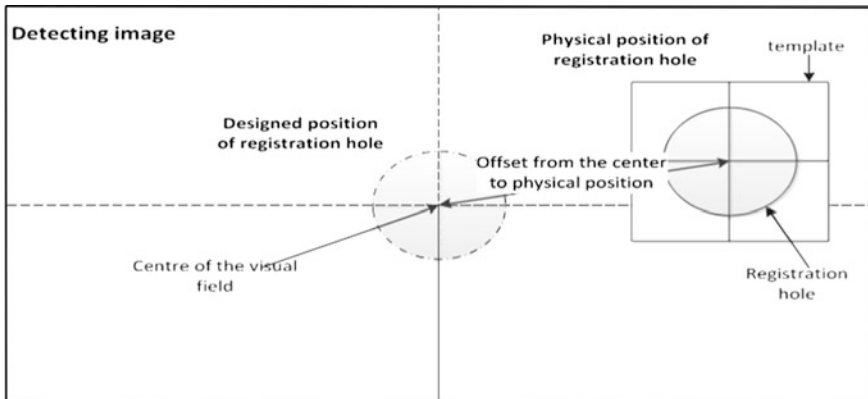


Fig. 85.5 Usage of template matching

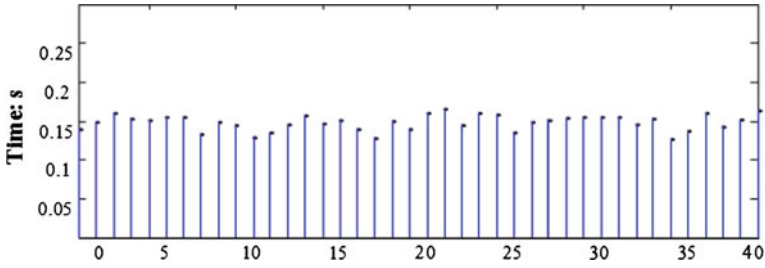


Fig. 85.6 Time cost

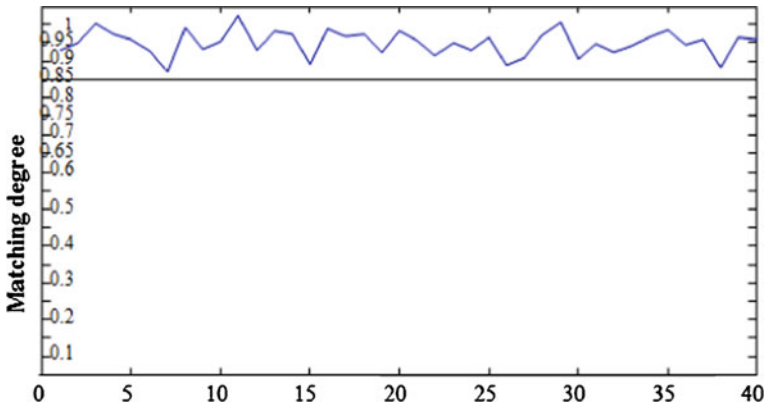


Fig. 85.7 Matching degree

85.4 Experiments and the Conclusion

To test the feasibility of the template matching algorithm, we conduct experiments in three aspects: Time cost, Threshold value, and Precision. Similarly, we have some settings previously. In the experiments, the size of detecting image is 640×480 pix, template size of 200×200 pix, we collect 40 detecting images and 10 templates.

85.4.1 Time Cost

We choose one from the 10 templates randomly, using NCC template matching algorithm to match it in the 40 detecting images, the time cost was shown in Fig. 85.6, as the result shows, it need about 0.15 s to finish the matching process, it is acceptable for the application in the PCB inkjet printer.

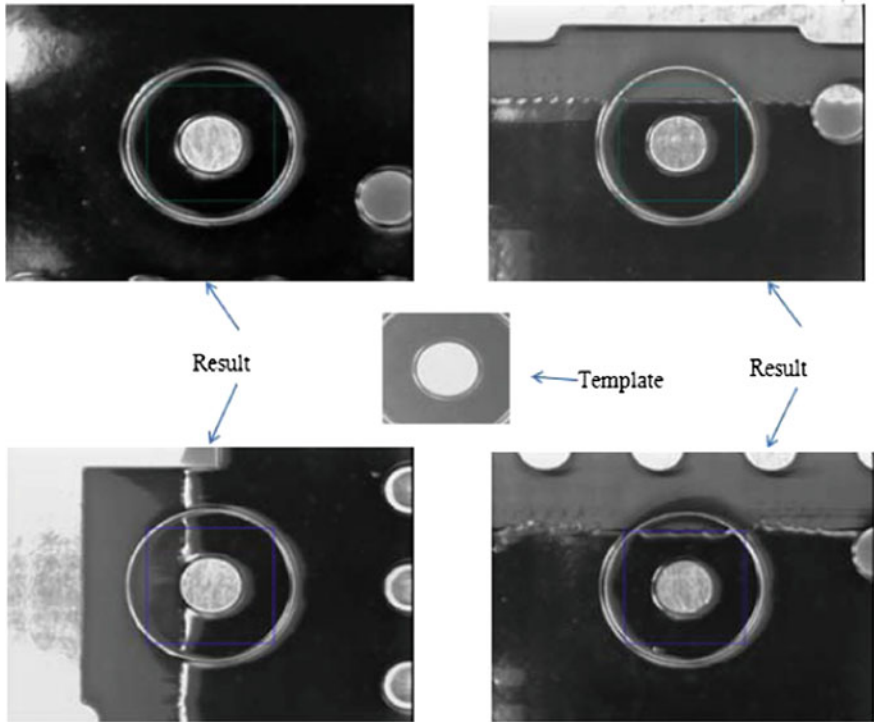


Fig. 85.8 Precision

85.4.2 Threshold

We choose one from the 10 templates randomly, using NCC template matching algorithm to match it in the 40 detecting images, the matching degree was shown in Fig. 85.7, we can see all the matching degrees are above 0.8, so we set 0.8 as the threshold, only when the maximum value of the result matrix greater than 0.8 the template matching is successful, or the template matching is failing.

85.4.3 Precision

Based on the nature of template matching, the result accurates to pixel level, so the accuracy of the system is in positive proportion with the CCD's imaging precision. We can get higher accuracy by using better CCD. The result of the template matching was shown in Fig. 85.8.

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Chapter 86

Survey of Image Mosaics Technologies

Lansu Nie, Yan Tang and Qin Xu

Abstract The image mosaic is an increasingly popular field of research. It is normally used to make up a seamless and high resolution image with a set of partial images. In general there are three steps in image mosaics, image preprocessing, image registration, and image fusion. This paper introduces the main technology of image mosaic, and compares the advantages and disadvantages of each technology.

Keywords Image preprocessing · Image registration · Image fusion

86.1 Introduction

In people's life and work sometimes there is a need for wide angle and high resolution panoramic images, which the ordinary camera equipment cannot reach. However, the whole scene, professional photographic equipment, high price of maintenance convenient for operation, lack of technical personnel, and unsuitability for general use, is not feasible, hence the image mosaicing technique has been put forward. Currently, the image mosaicing technique has become the popular computer graphics research, such as computer graphics, computer vision, photographic drawing learning, image processing [1]. Image mosaicing is receiving the increasing attention of people, and is widely used in space exploration, remote sensing image processing, medical image analysis, video compression and transmission, and virtual reality technology.

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Image mosaicing is a group of overlap images through digital image processing technology, linked to a high resolution and wide viewing Angle of panoramic images [2]. Image mosaicing technique mainly includes image preprocessing, image registration, and image fusion. The image registration algorithm is a key part of image matching. In 1975, Kuglin and Hines put forward the relevant registration algorithm phase [3]. In 1982, Rosenfeld proposed the cross-correlation registration algorithm [4] and [5] ratio method, template matching method, and the grid registration algorithm [6]. In recent years, image characteristics as the main detection means of registration method of has become a hotspot.

86.2 Image Mosaicing Steps

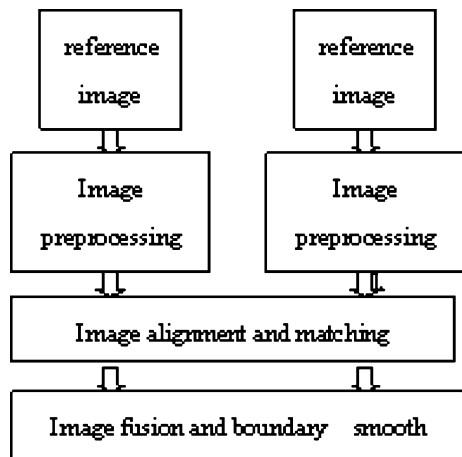
The image mosaicing technique mainly includes image preprocessing, image registration, and image fusion. An image mosaicing flowchart is shown in Fig. 86.1.

Image preprocessing is done to guarantee the quality and effect of pictures joined together. It includes denoising and geometric distortion correction. The pretreatment of the commonly used method include Gaussian smoothing filter [7], median filter, and histogram equalization.

Image registration algorithm of image matching is the most important step, which directly influences the image mosaicing effect quality and efficiency. Image registration refers to the image of the matching between information extraction, and then it searches for the best match in information extracted, the complete image alignment between, and then corresponding points arising.

Image fusion refers to the image after mosaics fusion processing and eliminates the joining together of overlap between images in gray information differences, making joining together more natural. Image fusion algorithm includes the average method, weighted average method, and multi-resolution sample groups.

Fig. 86.1 Image mosaicing flowchart



86.3 Image Preprocessing

Due to the influence of the acquisition environment, there is often noise and not enough contrast in the pictures. So we should take some measures to deal with them. Denoising can take wavelet decomposition [8] and reduce high frequency noise. It makes the image information reduce to a quarter of the original, and increase processing speed. Due to the different light conditions, the image contrast is different, and it is easy to produce the joining together errors. The initial image equalization processing [9], used to balance the effects of light conditions, is done using the following transform formula.

$$S_k = T_{r_k} = \sum_{j=0}^k \frac{n_j}{n} \quad (86.1)$$

n is the sum total of the image pixels, n_j is gray level for the number of pixels r_k . From the formula, the input image gray level for each pixel mapped to the r_k output image gray level for S_k corresponding pixel, which can reduce the different illumination conditions there is not enough contrast between bring image, can better realize image mosaicing.

86.4 Image Registration

86.4.1 Based on Gray Level Information Image Registration Algorithm

Based on gray level of information image matching method is to use some greyscale statistical information of the images to measure the image similarity degree, and then find the matching point. This method does not need to do image complex pretreatment, so as not to affect the image of gray information. This method is simple, easy to realize, but lacks image distortion being nonlinear robust. It includes the template matching method and ratio method.

Template matching method [10] is in the reference images from a rectangular frame size area as a template, and searches for joining together the corresponding area in the images. We calculate the correlation of the two pictures. The largest is the correlation matching position. This method is of high precision but with more calculation.

The ratio method [11] is to point to the reference image and joining together to image of a certain distance between coincidence. It is to select two columns of the ratio of the pixels of the match as a template, and then to search the image mosaics ratio of close to two columns of pixels. We find and benchmark the corresponding image of two columns, so as to determine the position of the overlapping mosaic. The method reduces the computational complexity, but robustness is not strong.

86.4.2 Based on Phase-Related Image Registration Algorithm

Phase-related method [12] is based on the frequency domain registration algorithm; it refers to the image after the Fourier transform.

Hypothesis $f_2(x, y)$ is $f_1(x, y)$ in the x and y directions translation x_0 and y_0 respectively, the images. They are related by

$$f_x(x, y) = f_1(x - x_0, y - y_0) \quad (86.2)$$

If f_1 and f_2 corresponding Fourier transform respectively is $F_1(u, v)$ and $F_2(u, v)$. They are related by

$$F_2(u, v) = F_1(u, v)e^{-j2\pi(ux_0+vy_0)} \quad (86.3)$$

The image $f_1(x, y)$ and $f_2(x, y)$ mutual power spectrum formula is as

$$\frac{F_1(u, v)F_2^*(u, v)}{|F_1(u, v)F_2^*(u, v)|}F_2(u, v) = e^{-j2\pi(ux_0+vy_0)} \quad (86.4)$$

F_2^* is complex conjugate of F_2 , above to mean Fourier inverse transform. We can get impact function such as

$$\delta(x - x_0, y - y_0) = F^{-1}\left[e^{-j2\pi(ux_0+vy_0)}\right] \quad (86.5)$$

The type 5 of the maximum impact function position can determine the two images roughly displacement.

86.4.3 Characteristics of Image Registration Algorithm

Among the characteristics of image registration, the most important is the image registration methods. It uses the obvious characteristics of images to estimate the transformation between images. The feature points represent some of the characteristic curve, edge, and angular points, all of which can be as feature points intersection image registration.

86.4.3.1 Susan Corner Detection Algorithm

Susan corner detection algorithm [13] was proposed by Smith based on the gray image corner detection algorithm at the University of Oxford in England in 1997. It is through the judgment of the main idea of a pixel domain in the presence of the surrounding window and their similar gray value of pixel domain in the total pixel to determine the proportion of corner, algorithm theory as is.

Fig. 86.2 Susan corner detection operator schemes

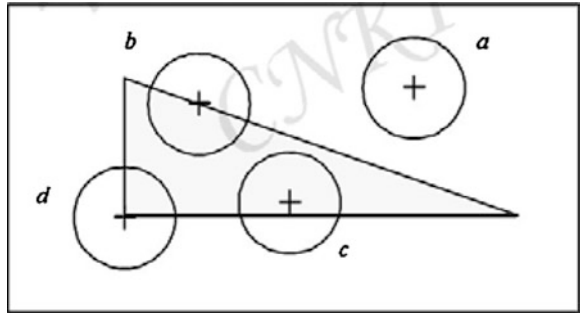
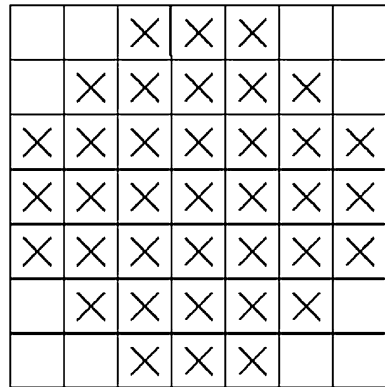


Fig. 86.3 Susan corner detection operator schemes



As shown in Fig. 86.2, the triangle area pixel gray values are the same or similar. The four circles represent the same circular template in the graph. Let templates do sliding. a, b, c, d present the central position in the image. $f(a), f(b), f(c), f(d)$ represent the image round circle gray value variations. Circle on the outside of the triangle is a . All the pixel gray values varying with the $f(a)$ are similar. b at the edge of the circle triangular position, about half of the pixel gray variation values are similar $f(b)$. In the flat round c triangle area, most of the pixel gray value variations are similar $f(c)$. Round the triangle vertex positions in d , about a quarter of the pixel grayscale value and $f(d)$ are similar.

Now select as shown in Fig. 86.3, the template instead of circular template, with the selection of 3.4 pix radius of the circle including 37 pix. Let the template do sliding window handle.

Templates of each pixel (x, y) and center (x_0, y_0) the grey value are compared as

$$C[(x, y), (x_0, y_0)] = \begin{cases} 1 & f(x_0, y_0) \leq T \\ 0 & f(x_0, y_0) > T \end{cases} \quad (86.6)$$

For the grayscale difference of T the threshold, then the circular template ω area and center position close gray values of the total number of pixels as

$$N = \sum_{x,y \in \omega} [C[(x,y), (x_0,y_0)] = 1] \tag{86.7}$$

Again with the round N calculation within the template pixels total value of the ratio β, β as point (x_0, y_0) interest value

$$\beta = N / \sum_{x,y \in \omega} [C[(x,y), (x_0,y_0)] = 1 \& \& C[(x,y), (x_0,y_0)] = 0] \tag{86.8}$$

Match (86.9) corresponding pixel is considered feature point.

$$\frac{1}{4} - \varepsilon < \beta < \frac{1}{4} + \varepsilon \tag{86.9}$$

Here with β dynamic range to determine the ε fluctuating range. It mostly chooses value ranging of 0.01.

86.4.3.2 Harris Corner Detection Algorithm

Harris corner detection [14] is a feature extraction based on signal point operator. It is using the image pixels around the correlation of pixels and discrimination flat area, edge domain and angular point. Through the judge a point to any direction is small migration can cause a big change of gray, so that is closest to the corner. Analysis of the surrounding area since the pixels of correlation function correlation matrix to determine the characteristics of a point whether any direction to small migration. Gray gradient value will produce a drastic change. The autocorrelation function defined as

$$C(x,y) = \sum_w [f(x,y) - f(x + dx, y + dy)]^2 \tag{86.10}$$

The dx, dy respectively is point (x, y) in the x and y direction of small displacement. The $f(x, y)$ is (x, y) pixel grayscale value on. The $f(x + dx, y + dy)$ is the grey value after the migration. After Taylor function expansion is

$$C(x,y) = [dx \quad dy] M \begin{bmatrix} dx \\ dy \end{bmatrix} \tag{86.11}$$

The value of the M is

$$M = \begin{bmatrix} \sum_w f_x^2(x,y) & \sum_w f_x(x,y)f_y(x,y) \\ \sum_w f_x(x,y)f_y(x,y) & \sum_w f_y^2(x,y) \end{bmatrix} \tag{86.12}$$

$f_x(x,y)$ and $f_y(x,y)$ respectively is image x and y directions of gradient value. M is a real symmetric matrices, make λ_1 and λ_2 for two of the matrix eigenvalues. The λ_1 and λ_2 reflex point (x,y) in the image characteristics. If λ_1 and λ_2

is very small, then the points (x, y) is located in the image smooth area. If λ_1 and λ_2 only one of value is bigger, then the point (x, y) is located in the image edge area. If λ_1 and λ_2 are very big, then the points (x, y) is located in the image corner position.

The practical application of we use response function to calculate corner, as

$$R = Det(M) - kTrace^2(M) \quad (86.13)$$

$$Det(M) = \lambda_1\lambda_2 \quad (86.14)$$

$$Trace(M) = \lambda_1 + \lambda_2 \quad (86.15)$$

k is a revised of general value 0.04–0.06. We set a reasonable threshold T . If the calculated R is a value greater than threshold. Then we find a corner for corner candidate. All the R value calculation, after the maximum suppression method to select the maximum interest in local area corner candidate as the final corner.

86.5 Image Fusion

After image registration, the overlap of image will be light and shade degree and the deformation degree of difference because of different time and environment. So, we need fusion processing after mosaics of images. Common fusion methods [15] are average method, weighted average method and multiresolution sample groups.

86.5.1 Average Method

The point (x, y) is image coordinates. We make $f_1(x, y), f_2(x, y)$ and $f(x, y)$ for reference images, for joining together images and fusion of pixels gray value varies. Their relationship as

$$f(x, y) = \begin{cases} f_1(x, y) & (x, y) \in R_1 \\ \frac{1}{2}(f_1(x, y) + f_2(x, y)) & (x, y) \in R_2 \\ f_2(x, y) & (x, y) \in R_3 \end{cases} \quad (86.16)$$

R_1 represents in reference images and joining together to not coincide image regions. R_2 represents reference images and joining together to the image of the overlap regions. R_3 represents the reference images mosaics not overlap areas. This method is fast and simple, but there may be apparent ribbon feeling in the overlapping area.

86.5.2 Weighted Average Method

The weighted average method [16] calculates the weighted average after first pixel takes the method, the corresponding equation as

$$f(x, y) = \begin{cases} f_1(x, y) & (x, y) \in R_1 \\ k_1(f_1(x, y) + k_2f_2(x, y)) & (x, y) \in R_2 \\ f_2(x, y) & (x, y) \in R_3 \end{cases} \quad (86.17)$$

R_1 and R_2 are two images of the overlap regions corresponding pixel weights. They need to meet the $R_1 + R_2 < 1$, and select the appropriate weight. The overlapping area can make a smooth transition, eliminate joining together of different phenomenon produces. This method can make the superposition region of the pixels excessive more gentle.

86.5.3 Multiresolution Sample Method

Multiresolution sample groups [17] is the image into different frequency of a group of images in the frequency of each decomposition, will overlap boundary weighted averaging image, then all of the frequency of sub image merging together. The method of frequency domain in need all in dealing with the region near the border, the effort is bigger, but the quality of the fusion is very high.

86.6 Conclusions

This paper introduces the main image mosaicing steps. It includes image pre-processing, image matching, and image fusion. Each step of the technologies are discussed, and the advantages and disadvantages analyzed.

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Chapter 87

Real-Time Rendering of Forest Scenes Based on LOD

Hao Li, Fuyan Liu and Shibo Yu

Abstract Using the stochastic L-system for modeling the trees. Modeling the trees includes two sides, the trunk is modeled by using multi-level Levels of Detail (LOD) models, and the leaves use billboard technology. In order to achieve real-time rendering effect, we divide the LOD dynamic according to the location between the trees in space and viewpoint. Finally, we compare the rendering efficiency of different methods. Experiments show that this method can simulate the real forest scene, and also can achieve real-time rendering effect.

Keywords Tree modeling · L-system · LOD technology · Real-time rendering

87.1 Introduction

In recent years, large-scale forest scenes modeling and rendering technology has been a hot research field of computer graphics. It was widely used in wartime simulation and game simulation. Many scholars dedicated to how to draw more efficiently forest scenes and achieve real-time effects. They use many methods, such as simplifying the modeling of trees, optimizing the generation algorithm,

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and changing management of the scene. We use the stochastic L-system for modeling trees. In order to achieve real-time rendering result, we divide the levels of detail (LOD) dynamically according to the location between the trees in the space and viewpoint, for different levels of detail, we use different tree models to render. Then we generate large-scale forest scenes by using instance technology. Experiment shows that the method can achieve real-time rendering effect. In Sect. 87.2, we introduce the related research. Section 87.3 describes the method of modeling trees. Section 87.4 presents the technology of LOD for forest scene rendering. Section 87.5 describes the experiment and analysis. We conclude this paper and describe the future work in Sect. 87.6.

87.2 Related Research

At present, trees in 3D modeling and rendering methods are mainly divided into two categories, the rule-based modeling and image-based modeling. Lindenmayer's L-system [1] and Reeves's particle system [2] stand for the rule-based modeling. The rule-based modeling approach can be a fine description of the organizational structure of trees with a strong sense of reality, but the rendering expenditure of time and space is huge. Billboard image-based method is the most commonly used method. It pastes the image to the billboard by the texture mapping method, that not only simplifies the calculation, but also improves the rendering efficiency. Many scholars have been working on the problem by generating large-scale forest efficiency through improving the tree modeling methods. ZhangShu and others improve the plant modeling method based on the L-system [3], so that the modeling of plants is more concise and efficient. Decaudin [4] and others achieve real-time rendering of forest scenes by using volumetric textures. Fuhrmann [5] simplifies the Billboard Clouds algorithm, using 15–50 texture polygons to generate tree models and also achieve real-time rendering. For rendering, tens of thousands of triangle faces in the L-system algorithm, as well as billboard realistic performance is not high status, we use a mixture tree modeling approach. The trunk models use multi-level LOD models, and the leaves use billboard technology. In order to achieve real-time rendering, we divide the LOD dynamically according to the location between the trees in space and viewpoint combined with OpenGL.

87.3 Tree Modeling

In 3D modeling of the trees, trees are composed of several separate unit spaces. The basic unit is divided into several parts, such as leaves, branches. Although the plants have many different forms of style, the external form reflects the internal form of control mechanism. Here we will introduce the expression mechanism of trees L-system, and generate trees on the basis of stochastic L-system.

87.3.1 Trees Branching Pattern

Branch of trees is generally divided into uniaxial branch and sympodial branch. The trunk of uniaxial branch has top edge, the lateral bud grows and generates collateral, and so on. The spindle is thicker than the collateral obviously. Sympodial branch does not have the obvious advantage of the top, after a period of growth, the trunk and lateral branches stop growing slowly, and then generates a new bud, instead of trunk and branch growth, to form a tortuous trunk. In this paper we uses the structure of the sympodial branch.

87.3.2 Random L-System

The early L-system is an ordered triples $L = \langle V, W, P \rangle$, V means the alphabet; V^* is a collection of all words defined in the V ; $W \in V$ is non-empty word called axioms; $P \in V \times V^*$ is a limited production rule set. If $(x,y) \in P$ is a generation rule, that is for each $x \in V$, there is only one $y \in V^*$, we call L-system identified. Because of the certainly rules, the image which is generated to determine L-system is single, and do not reflect the natural phenomena of the forest, so we use a random L-system.

Stochastic L-system can be expressed as a four-tuple.

$$L = \langle V, W, P, F \rangle \quad (87.1)$$

V is the set of characters; W is the axiom to determine the string's initial iteration rule; P is the production rule set; the function F makes the production rules set subject to the probability distribution (0,1]. For example, a simple stochastic L-system is as follows:

$$\begin{aligned} W &: A[+A][-A] \\ P1 &: A - > AA[+A]A[-A] : 2 \\ P2 &: A - > A[+A]A : 3 \\ P3 &: A - > A[-A]A : 5 \end{aligned} \quad (87.2)$$

As shown in Fig. 87.1, the meaning of the expression “+,-”, is shown in Fig. 87.2, graphical representation for the string “AA [+A] A [-A]”. In expression (87.2), $P1$, $P2$, $P3$ rules of probability are as follows:

Probability ($P1$) = $2/(2 + 3 + 5) = 0.2$;

Probability ($P2$) = $3/(2 + 3 + 5) = 0.3$;

Probability ($P3$) = $5/(2 + 3 + 5) = 0.5$. So according to the rules, $P3$ has the maximum probability.

Fig. 87.1 The meaning of the expression “+,-”

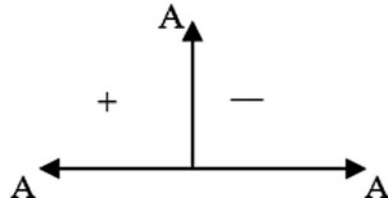
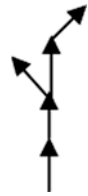


Fig. 87.2 Graphical representation for the string “AA[+A]A[-A]”



87.3.3 Expression of the Tree L-system

We use stochastic L-system, according to the formula (87.1), (87.2) in 3.2, can get the expression of tree L-system. The modeling trees by using stochastic L-system are shown as follows. As shown in Fig. 87.3.

By controlling the number of iterations, we can generate tree models of different fine degree. When the number of iterations is 5–6 times, we can describe the general characteristics of a tree. When the number of iterations is more than ten times, we can describe the tree fine.

87.4 Forest Rendering

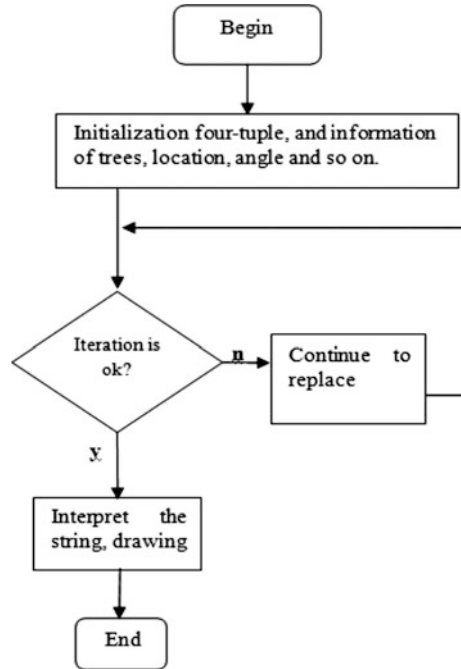
There are many trees in a forest scene which are generated by using random L-system. In order to achieve real-time rendering with the large amount of data, and show good rendering effect when the viewpoint is moving, this is a large conflict between the physical hardware devices. Therefore, we also need to use the forest accelerated algorithm.

87.4.1 Forest Rendering Algorithm

Forest scene rendering is divided into the following phases:

- Drawing the tree models.
- Adding the leaves placeholder, and output multiple LOD tree model.
- Leaves pretreatment, and the placeholder is replaced with the billboard.

Fig. 87.3 The process of 3D tree modeling



- Leaves texture to texture space.
- Selecting the LOD model in accordance with the viewpoint.

87.4.2 Forest Rendering Based on the LOD Technology

As already mentioned, we need to accelerate the forest algorithm for real-time rendering. The first can be improved by the invisible region of the scene, we do not need to draw this region. In addition, we can also determine the viewable area; the block part within the viewable area cannot be drawn.

Within the frustum, forest rendering efficiency has something with the number of iterations and the viewpoint position. According to the current viewpoint and the scenery location calculate a measure, and select an appropriate LOD details. We usually choose the distance from the object to the viewpoint as shown in Fig. 87.4.

θ is the perspective size of the viewpoint; D is the actual size of the object; d stands for the object size which is projected to the screen; R is the distance between the viewpoint and trees; r is the distance of the viewpoint to the screen; and W is the width of the viewpoint. According to the geometrical relationship, we know the following:

$$\tan \frac{\theta}{2} = W/2r \quad (87.3)$$

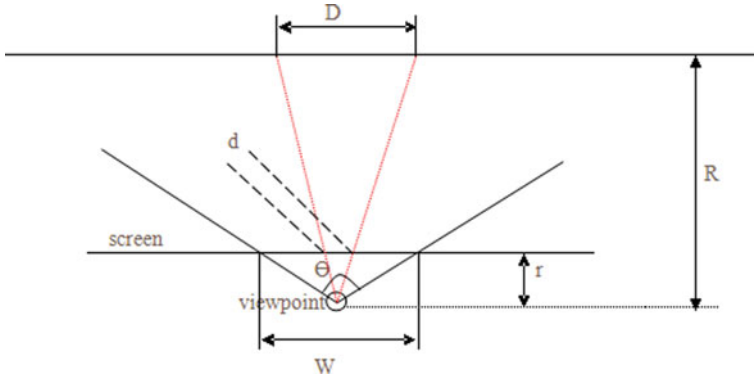


Fig. 87.4 The relationship between the viewpoint and the scene

$$R = \frac{D}{d} \times r = \frac{D}{d} \times \frac{W}{2 \tan \theta/2} \tag{87.4}$$

Therefore, we need to make a grading for the distance from the viewpoint to the subject based on R, and set R1 and R2 to divide the forest into distant, medium, and close.

For the distant subject, we need to use the Billboard map. In order to make the subject more lifelike, cross method is employed to get better rendering effects. For the middle distance subject, we can improve the rendering efficiency properly by adjusting L-system modeling the iteration number of trees. The close subject can be shown in elaborate trees model to be more vivid.

87.5 Experimental Result and Analysis

According to the methods above, the author made a successful real-time rendering of forest scene on the PC with the help of VS2010 and OpenGL. Three-dimensional real-time rendering of forest scene was completed based on a Microsoft Windows 7 Professional 32-bit operating system, Intel(R) Core(TM) i3-380M 2.53 GHz CPU, 2,048 MB RAM (Hynix DDR3 1,333 MHz), Nvidia GeForce GT540M VIDEO CARD (1,024 MB) and a 5,400 rpm ST9500325AS 500 GB hard disk. As shown in Fig. 87.5.

In order to prove the good effect, we compared the simplex L-system trees with the combination between L-system and LOD technology in the same hardware conditions. Results are shown in Fig. 87.6. The horizontal axis showing the number of trees and the vertical axis showing rendering efficiency (frames per second). L-system is shown in green while the combination between L-system and LOD technology is manifested in red.

Fig. 87.5 The forest scene rendering effect

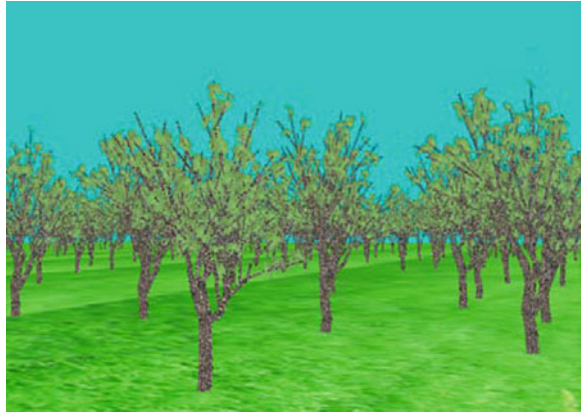
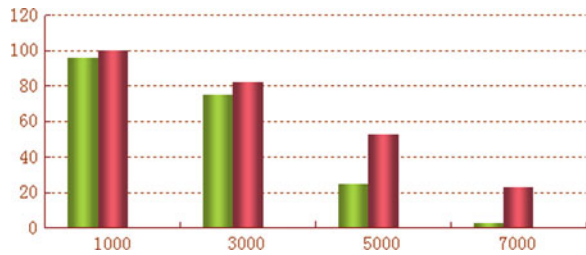


Fig. 87.6 Rendering efficiency comparisons



From the figure, we can see why we render only a few trees. Both the methods have a relatively high rendering efficiency. But with the growing number of trees, the rendering efficiency of simplex L-system begins to fall. When the number of trees reaches a certain scale, the efficiency is quite low. The latter method achieves real-time rendering effects.

87.6 Conclusions

In the above the method of random L-system and combining LOD technology, according to the position of the trees scene and viewpoint, he dynamically divide the level of detail, realizing the forest scene of the real-time drawing. The future work is to further strengthen the efficiency in the render; we can pass the modeling method of fine trees and optimize the scene management, using the technology CPU parallel processing to improve the rendering efficiency.

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Chapter 88

An Improved Method Based on Quaternion and Planar Segmentation Fit in 3D Registration

Hongke Wang

Abstract In this paper, we present a method of planar segmentation technique based on Quaternion for 3D registration. First, an existing neighborhood definition, which is based on the co-normality and co-planarity of the planar, is adopted. The neighborhood of a given point is defined as neighboring points that belong to the same planar segmentation. Then we compute the transformation using Quaternion between the two coordinate systems and achieve the registration of these two range images.

Keywords Planar segmentation · Quaternion · Planar fit · 3D registration

88.1 Introduction

3D registration is the process of transforming different sets of data, from different sensors, from different times, or from different viewpoints into one coordinate system [1]. 3D registration is necessary in order to be able to compare or integrate the data obtained from these different measurements. Two topics dominate work in range image registration: matching of features in the images to be matched and minimization of distances between all points on the surface represented by the two images. 3D registration from multiple views plays an important role in computer vision with many applications, such as robot navigation, reverse engineering, digital cinematography, virtual reality.

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The depth information in the image has an important role in 3D registration [2]. Depth Images are viable representations that can be computed from the real world using cameras and/or other scanning devices. However, owing to different modality of depth estimates achieved through stereo, different treatment of the disparity segmentation problem is necessary [3, 4]. Disparity-based spatial segmentation has been addressed by some researchers.

Nowadays, there are some different methods in image segmentation. These methods are based on extracting some invariant features between every range image in order to find the correspondences between them. Most common features are based on points, curves, segments, and surfaces. When some pair of correspondences is determined based on features, it is possible to compute the rigid motion iterating until convergence. In 1992, Zhang [5] codified curves with respect to the tangent direction of every point in the curve. In 1997, Krsek [6] computed the inflection curves of the surface and then tried to match these one between both range images. In 1996, Jiang and Bunke [7] proposed a scan line segmentation methodology which first splits each scan line into straight line segments and merges them with segments of adjacent scan lines. In 2003, Sithole and Vosselman [8] adopted and modified this methodology while grouping points on scan lines based on proximity in 3D.

The goal of this paper is to propose a method of planar segmentation technique in 3D registration considering that there often exist a large number of planes in real scenes. First, we segment each range image to extract the planar features. Then, planar features in two range images are performed to search out corresponding. By doing so, we can compute the transformation between the two coordinate systems by Quaternion and achieve the registration of these two range images.

This paper is organized as follows: After reviewing the prominence of the planar segmentation based on 3D registration the definition and method of range image segmentation is given and derives the algorithm of range image segmentation by introducing a metric of co-normality and co-planarity in [Sect. 88.2](#). And then we achieve the registration of these two range images with computing the transformation by Quaternion between the two coordinate systems in [Sect. 88.3](#). [Section 88.4](#) concludes.

88.2 Planar Segmentation and Planar Fit

We know that the image segmentation has been one of the key technologies of 3D construction and 3D registration. Through the image segmentation, the image can be segmented into different regions, and all points on the same region, which have some importance for image registration [9]. When many surfaces of many objects are present, it is necessary to organize pixel to image regions that correspond to individual objects or surfaces, and then apply higher level algorithms to the isolated image regions. The fundamental, complementary issues in organizing image

pixels into regions are similarity and difference. This has motivated us to use the spatial coherence of the data to organize pixels into meaningful groups.

We group the 3D point's clusters of neighboring points which correspond to the same planar surface. Planar patches in a disparity space are expected to be spatially continuous. Using this prior knowledge an appropriate prior distribution can be designed. As mentioned previously, planar surfaces can be split into multiple spatially continuous regions in the initial stages of the algorithm. Some of these might represent the correct planar surface while others might be incorrectly assigned. As it is not known whether region is correctly assigned or otherwise, all these regions should be treated as hypothesis for underlying planar surface.

We easily acquires the coordinates of dense sets of 3D points from the surfaces of real world objects, which are called the point cloud. In such applications the point cloud is often processed by a segmentation algorithm that uses a geometrical constraint to group points into regions representing plane surfaces. Planar segmentation is thus defined as the problem of identifying points that belong to the same plane. And then, we introduce a metric of co-normality and co-planarity of two planar patches to merge planar patches [10, 11].

A planar surface in 3D space is given by

$$v = ax + by + c \quad (88.1)$$

where v is disparity, (a, b, c) are the plane parameters in the disparity space, (x, y) are image coordinates.

Planar patches in a disparity space are expected to be spatially continuous. Using this prior knowledge an appropriate prior distribution can be designed. So be determined as

$$D_i = \arg \min_j [v_i - (ax_i + by_i + c)]^2 \quad (88.2)$$

We may depict the following formula using the matrix form:

$$D = \sum_{i=1}^N ((v_i - m) \cdot n)^2 \quad (88.3)$$

The next step is to merge the initial list of clusters and to create a minimum number of clusters of maximum size. The cross-covariance matrix of sets P is given by

$$A = \sum_{i=1}^N ((v_i - m)^T \cdot (v_i - m)) \quad (88.4)$$

We have

$$D = n^T A n \quad (88.5)$$

and

$$n^T n = 1 \tag{88.6}$$

Minimizing D

$$\frac{\partial}{\partial n} (D + \lambda(1 - n^T n)) = 0 \tag{88.7}$$

We have

$$D = n^T \lambda n = \lambda n^T n = \lambda \tag{88.8}$$

Through the above formula, we get that the smallest eigenvalue of the matrix D expresses the deviation of the points v_i from the fitted plane. And then we introduce a metric of co-normality and co-planarity of two planar patches [12, 13]. The two planar patches are considered to be part of the same planar surface if both conditions are met. The first condition is that the patches have identical orientation that is the angle $\alpha = \cos^{-1}(n_1 \cdot n_2)$ is smaller than a threshold a_{thresh} ; the second condition is that the patches lie on the same infinite plane. The distance between the two patches is defined as $d = \max(|r_{12} \cdot n_1|, |r_{12} \cdot n_2|)$. This distance should be smaller than a threshold d_{thresh} , where r_{12} is the distance between the projections of P_1 and P_2 onto their corresponding local planes. The theory of evolution is one of the great intellectual revolutions of human history [5, 6]. The duplication of a gene results in an additional copy that is free from selective pressure. One kind of view is that this allows the new copy of the gene to mutate without deleterious consequence to the organism. This freedom from consequences allows for the mutation of novel genes that could potentially increase the fitness of the organism or code for a new function.

88.3 Registering on Quaternion

The registration between the coordinate systems of the two image is done when a set of 3D features of the two image are given. The planar feature is represented by the pair of vectors $(n; p)$, where n is the direction of the planar and p is a point on the planar. It is possible for the rotation and translation when at least two planar matches are given. The minimization of the error function [14].

$$E = \sum_{i=1}^k w_i \|n'_i - Rn_i\|^2 \tag{88.9}$$

This problem can be solved in closed form by expressing the rotation as a quaternion [15], by linearizing the small rotations [16, 17], Here, we exploit quaternion.

Let q be a unit quaternion corresponding to R , and we get

$$Rp = q \wedge p \wedge \bar{q} \quad (88.10)$$

where p is 3-vector, \bar{q} is the conjugate of q , \wedge denotes multiplication of two quaternion. Then

$$E = \sum_{i=1}^k w_i \|n'_i - q \wedge p \wedge \bar{q}\|^2 = \sum_{i=1}^k w_i q^T A_i^T A_i q \quad (88.11)$$

where A_i is a 4×4 antisymmetry matrix

$$A_i = \begin{bmatrix} 0 & (n_i - n'_i)^T \\ -(n_i - n'_i) & [n_i - n'_i]_{\times} \end{bmatrix} \quad (88.12)$$

Writing $v = (x, y, z)^T$

$$[v]_{\times} = \begin{bmatrix} 0 & -z & y \\ z & 0 & -x \\ -y & x & 0 \end{bmatrix} \quad (88.13)$$

where given

$$\sum_{i=1}^k w_i A_i^T A_i = A \quad (88.14)$$

where A is a symmetry matrix? Conduct

$$E = q^T A q \quad (88.15)$$

as q is the unit normal, we have

$$q^T q = 1 \quad (88.16)$$

Minimizing E with Lagrange multiplier method

$$\frac{\partial}{\partial n} (E + \lambda(1 - q^T q)) = 0 \quad (88.17)$$

and then, we have

$$Aq = \lambda q \quad (88.18)$$

We get

$$E = \lambda \quad (88.19)$$

So the minimum value of E is actually minimum eigenvalue of A . We can compute the transformation between the two coordinate systems and achieve the registration of these two range images.

88.4 Discussion

Planar segmentation approaches have been suggested since the importance of 3D was recognized. Planar segmentation model can be conveniently incorporated into 3D registration. In this paper, we present the complete process: 3D model acquisition, planar segmentation 3D registration. Considering that there often exist a great number of planes in scenes, we have presented an algorithm for planar segmentation and planar feature-based registration methods of data from 3D point clouds; we extract the planar features from the range image using a metric of co-normality and co-planarity of two planar patches. Then, we can compute the transformation between the two coordinate systems and registration of the two range images by quaternion. Future research will focus on analysis of the spatial geometric relationships among segmented planar patches. It will lead to more accurate detection of surface based on differential geometric properties.

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Chapter 89

Research on Integration of Multi-Information of Digital Mine Based on VR Technology

Miao Yu, Jianping Chen, Feng Liang, Pingping Yu and Lili An

Abstract The ore-field has accumulated rich geologic prospecting information during many years of study, geological exploration, and mining process. However, problems such as information isolation and user group technical limitation, etc., that have been caused by incompatible data types and formats exist. This study has provided a scheme integrating application of 3S technology, 3D graphic modeling technology, introducing the Virtual Reality new technology, providing digital mine multivariate information. It has constructed a digital mine integrated study platform taking Gejiu City, Yunnan Province as an example to realize integration and merging of multivariate data, promoting integration of achievements and integrated studies of various geological disciplines and providing new ideas and means for digital mine construction, mineral resource prediction, and evaluation studies.

Keywords Digital mine · Multi-information · Virtual Reality

89.1 Introduction

With the diminishing of outcrop mines and that of shallow-seated mines, the increasing difficulty in geological prospecting and the decreasing prospecting effect, the extensive use of new technology in searching for deep-seated and concealed mines has become the focus of the current prospecting work [1, 2]. At present, through years of studying, exploration, and exploitation of the mining

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areas, geologists have accumulated a wealth of geology and mineral resource survey results and prospecting data. In the 1980s, GIS technology was introduced into geological prospecting, which has been mainly used for integrating the geological, physical, chemical, and remote sensing two-dimensional (2D) information to predict and evaluate the mineral resources and has achieved remarkable results [3, 4]. Deep level prospecting requires understanding the composition, texture, structure, and other geological information of deep underground substances. As geological information and geological phenomena is 3D in essence, geological problems need to be studied more thoroughly from a 3D perspective. In recent years, many scholars have built strata, rock, ore body, and other 3D geological models and have carried out mineral prediction and research around the mining areas by using different professional modeling software combined with the results and materials of their own disciplines [5, 6]. The above studies have shown that in geological prospecting and mineral prediction, basic information is the prerequisite and guarantee, and comprehensive analysis of the multi-information is an effective means. However, the problem is that the results of different professional fields have different expression and multivariate data formats are not compatible, which leads the data of different types to be isolated and scattered, especially the 2D data and the 3D solid model cannot be displayed and operated simultaneously in a single platform. In addition, the geological personnel requires a higher level of computer skills, thereby preventing the overall management and the comprehensive analysis and study of the mine. The key to solving the above problems is to build a platform which can integrate and combine all types of data and information organically as well as achieve convenient interactive operation and comprehensive analysis, thus further digging out the prospecting information. Wu [7] believes that the development trend of the 3D visualization of the geological data is to realize the integrated 3D visualization of the collection, storage, management, processing, and integrated application of the ground and underground, geographical and geological data. Yu [8] has proposed a well-established ground and underground true 3D integrated digital solution for large-scale mines. But there are very few studies in this field. Therefore, based on 3S technology, 3D visualized modeling technique and Virtual Reality technology, the author has proposed an integrated solution for multiple digital information of the mine, and has explained with example applications the feasibility and effectiveness of the resolution.

89.2 Problem and Solution

The purpose of this study is to realize integration of multiple information sources of the mine, including the types of data information, what technical means should be introduced to be compatible with all types of data, how to make the platform constructed present the information contained intuitively and be used by researchers of non-computer majors and also used to assist ore-field management, geological research, and ore prospecting prediction.

89.2.1 Data Type

For multivariate data integration, first it must be classified. According to different spatial locations, it can be divided into surface and subsurface data; according to different fields of study, it can be basically classified into geological data (geological maps, drilling holes, profiles, middle section planes, etc.), geophysical data (seismic, gravity and magnetic profiles, aeromagnetic images, etc.), geochemical data (element abnormal distribution, etc.), remote sensing data (surface images, digital images, gravitational-magnetic profiles, and aeromagnetic images, etc.); according to different data formats, it can be classified into vector format, raster format, solid model format, image format, and document format.

89.2.2 Technology and Platform

The 3S technology has great advantages on surface information acquisition and spatial analysis. It is based on the 3D visual modeling technology that can accurately and vividly establish a 3D geological model of the study area, showing the 3D spatial distribution and relationships of a variety of geological bodies. However, for different software platforms and data structures, the data formats generated cannot be displayed and operated in the same background. Therefore, under the basis of understanding all data types, considering compatibility of data formats, the Virtual Reality (VR) technology is introduced in the study.

VR is a comprehensive integration technology covering fields in computer graphics, simulation technology, human-computer interaction technology, sensor technology, artificial intelligence, etc. It is a high-tech simulation system generated with computer technical assistance. VR has features of Multisensory, Immersion Sense, Interactivity, Imagination, etc. It is used to realize functions of 3D object modeling, free browse, real-time, and interactive operation as well as system integration, etc. Currently common professional VR software platforms include Vega, Quest3D, Web3D, Virtuuous, VR Map, VRP, etc. This study adopts VRP software as a development tool. The software can be integrated with 3DSMAX seamlessly, holding the highest real-time rendering image quality, supporting automatic roaming, manual roaming with high-efficiency and high precision collision and detection algorithms, supporting SDK secondary development, and it has favorable extensibility.

Therefore, the solution for the multivariate information integration problem of a digital mine is as follows: first, unify 3D-solid models, vector data, raster data and photos, etc., into 3Ds format. The 3Ds format is a universal format for saving 3D models. It is often combined with VR platform seamlessly. It can be realized through 3DsMax modeling, format conversion, maps, etc. Dynamic inquiry for information of properties and report documents can be realized through database storage or hyperlinks. Under this basis, establish a system platform using VR

software and import above data, using the powerful integration function to integrate various types of data into a whole according to the unified space coordinates and provide great convenience for the research work.

89.3 Application

The numerical mine multivariate information integration scheme proposed by this study combined with 3S technology, 3D modeling technology, and Virtual Reality technology, etc., has been practiced in Gaosong field, Gejiu City, Yunnan Province, China, and good results have been achieved.

89.3.1 Model Integration

Gejiu City, Yuannan Province is a Tin City with one thousand years of tin production. Rich information of geology and mineral resources has been accumulated through long-term exploration and mining in the ore-field. The model and data information of the system include surface model which is generated for the superimposition and integration of the DEM elevation data with 30 m resolution and the World View 2 remote sensing images with 0.5 m resolution, reflecting topography and surface features and terrain distribution of the ore-field; surface geological model which is formed for the natural superimposition and integration of the 1:10,000 geological map (or surface geochemical exploration anomaly map) and the DEM elevation data; underground formation, rock mass, and ore body solid model which are established based on the cross-sectional model of ore-field prospecting lines (or seismic, gravitational-magnetic geophysical profiles), middle section planar graphs, engineering deployment diagrams, etc., clearly reflecting regional metallogenic geological settings, faulted structure patterns, rock mass forms, ore body occurrence, and distribution as well as their spatial relationships; alley models which are extracted and modeled from the adit planar maps, reflecting actual exploration and mining deployment of adit engineering; ore-field architectural models which are established based on the actual data of architectures acquired by laser altimeters combined with photos collected in the field, realizing a real 3D model inside solid remarkable architectures.

89.3.2 Developing Functions

After importing the data, functional development for the system is carried out, providing information involved as complete as possible to the user. Currently, the main functions of the system include the following three parts (Fig. 89.2). Display

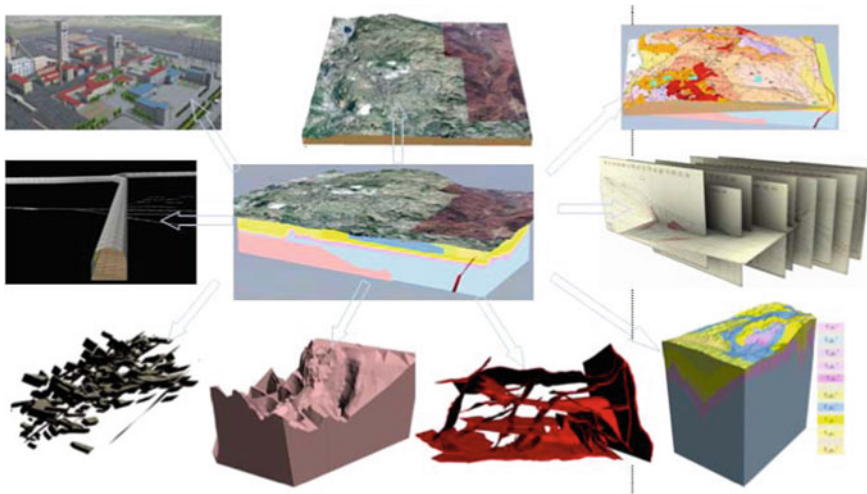


Fig. 89.1 Digital Gejiu Gaosong field integrated research platform as well as its multivariate data and model involved

function: superimposition, linking, and integration of the multidimensional data can be realized by controlling display/hide/display in semitransparent state independently of the control data model; Query function: detailed introduction on property information and photos, etc., of the model can be inquired; cross-sectional cutting function: by cutting sections of the 3D model, geological profiles of any direction can be acquired for assisting ore prospecting and geological survey studies.

Figure 89.2 is the natural integration of a translucent geological map, remote sensing images and a surface elevation model, or penetrating expression of a translucent geological map and underground 3D fault solid model; demonstrate of formation model property enquiry and a stope surface photo; is a 3D geological solid model cross section cutting diagram and the 2D cross section map generated.

It is apparent from Figs. 89.1 and 89.2 that this study has integrated multisource data information, such as surface information, underground and deep-location geological, and ore deposit information of the mine, various geological, physical, chemical, remote sensing, exploration information, etc., into a whole comprehensively, realizing real 3D integration of surface and underground information, unified management, display operation of 2D geological data and 3D geological models, providing a convenient and effective work platform for the development and construction, integrated information management as well as geologic prospecting integrated study of the mine.

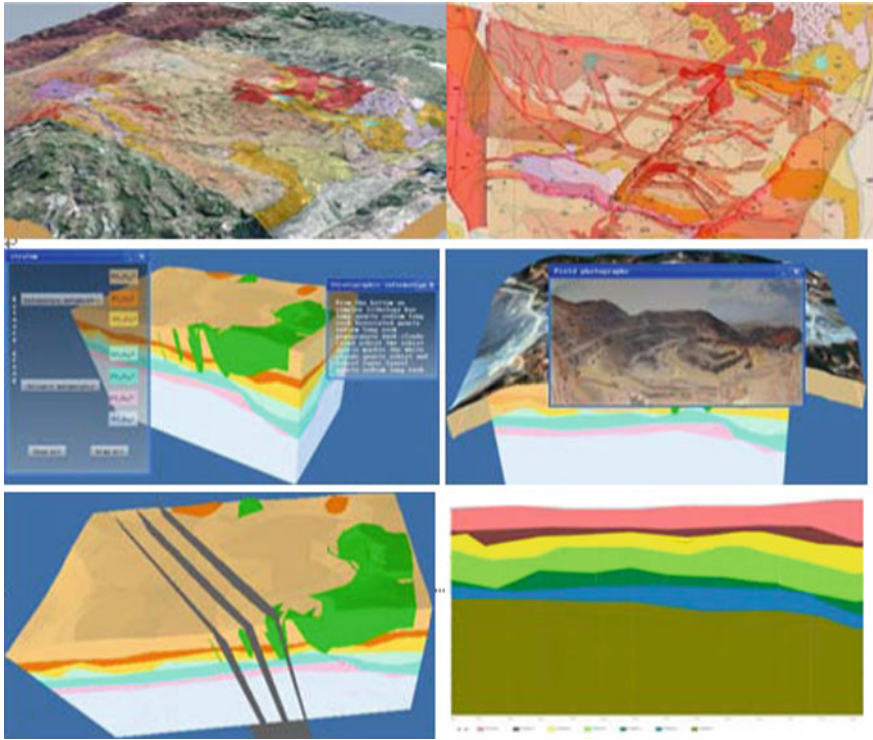


Fig. 89.2 The natural integration of a translucent geological map

89.4 Conclusion

This study has integrated 2D data information on production, management, and scientific research (geological, mineral, physical, chemical, remote sensing information) as well as 3D geological models that have been established into a comprehensive study platform using 3S technology, 3D graphic modeling technology, and Virtual Reality technology. It has solved problems such as information isolation caused by old incompatible data formats as well as user group technical limitation, promoting achievement integration and integrated studies of various geological discipline fields, providing new ideas and means for digital mine construction, mineral resource prediction, and evaluation studies.

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Chapter 90

An Active RFID Indoor Positioning System Mechanism Based on Sleep Mode

Jian-bin Xue, Wen-hua Wang and Ting Zhang

Abstract The defects in the LANDMARC indoor positioning system were analyzed and a new indoor positioning system mechanism based on sleep mode which made some improvements to overcome the drawbacks of LANDMARC system was proposed. Experimental tests show that our positioning mechanism can improve precision, decrease redundant calculation, reduce power consumption as well as prolong the service life of the positioning system.

Keywords RFID · LANDMARC · Indoor positioning · Positioning algorithm

90.1 Introduction

Indoor positioning technology is to track the target under indoor environment and the positioning error within the permitted scope [1]. With the development of mobile telecommunication, more applications need to know the information of the location of objects, so people pay more and more attention to wireless location. Location services have an important application not only in general science service, military service, and commercial activity, but also in emergency rescue and disaster relief effort. Mobile positioning technology has become an important research direction in present life. The most famous and popular positioning system is the global positioning system (GPS) [2]. But, GPS cannot provide positioning service with enough precision in these complex scenarios [3]. Hence, it is not

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suitable for indoor positioning. The electromagnetic wave propagation environment is more complicate in the indoor environment compared with outdoor environment. Researchers have developed numerous indoor positioning technologies and application services, like infrared ray, ZigBee, Ultrasonic, RFID, etc., in order to meet people's growing demand in location services.

At present, the radio frequency identification (RFID) is the most widely used positioning technology in the indoor environment. RFID uses radio frequency through electromagnetic field to realize no-contact two-way communication to identify and achieve non-contact automated data exchange. RFID location technology provides another approach which utilizes received signal strength indication (RSSI) to track moving target tags [4]. RFID location technology has several advantages, such as nonline of sight, non-contact, high speed performance, promising transmission range [5], etc. At present, it has been widely used in many fields, such as production, logistics, transportation, medical care, etc., and has a wide application prospect in location tracking, automatic scanning, and other unmanned automated management areas [6]. The most widely used positioning system is the location identification based on dynamic active RFID calibration (LANDMARC). The biggest advantage of LANDMARC system is its creative introduction of the concept of reference tag with known locations to adapt to the dynamic environment in order to improve the overall accuracy of locating objects [7], and then by comparing the RSSI values of target tags with those of reference tags we can get the coordinates of target tags.

In this paper, we develop a modified system based on the sleep mode. Furthermore, on the basis of theoretical analysis, an active RFID indoor positioning system mechanism based on sleep mode is proposed to enhance the performance of the LANDMARC positioning system. The algorithm solves the problem of the battery energy's consumption of reference tags and the redundant calculation caused by some reference tags without any role in the location. Extensive simulation results show that the mechanism can improve the power consumption significantly and reduce redundant computation.

90.2 Related Work

90.2.1 System Description

LANDMARC system includes a sensor network and a wireless network which is used for communication between equipments and the internet. The sensor network mainly comprises readers and tags. The wireless network is a bridge which connects the sensor network and other parts of the system and makes more and more readers and tags communicate with one another. Once target tags move to the detection range of the readers, the readers will read the signal strength information

between the readers and the target tags and send the information to the server through the wireless network for processing [8].

LANDMARC indoor positioning system is a dynamic identification system based on active RFID. k-nearest neighbor's algorithm is used and the distance between tags is represented by the size of the signal intensity differences. The positioning accuracy is heavily dependent on the number of reference tags and the obstacles. First, some reference tags are arranged as a foundation for positioning according to certain way in substantial environment; second, readers measure the RSSI values of target tags and reference tags respectively; finally, the database is established for processing. In the real-time measurement phase, the RSSI values of target tags are compared with those of reference tags, and then the coordinates of target tags can be obtained by using k-nearest neighbor's algorithm [9].

90.2.2 Defects in the LANDMARC Approach

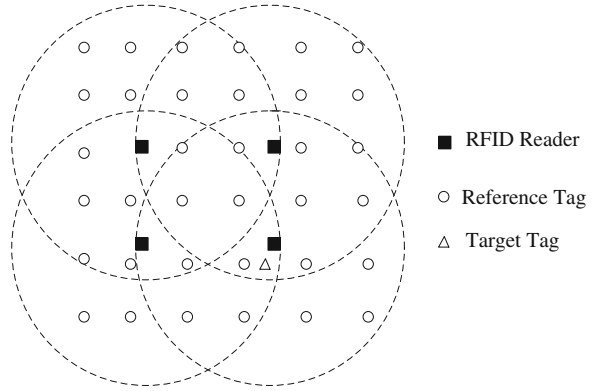
In the LANDMARC approach, RFID readers need to identify the reference tags constantly and work in a continuous work mode, which leads to high energy consumption, moreover, the reference tags are bulk active tags and the battery life is limited [10]. What's worse, the effective identification range gradually decreases with the consumption of the battery power.

When choosing neighbor tags, all reference tags have to be considered which will cause redundant calculations. In specific calculation, the LANDMARC approach uses formula (90.1) and compares different E values to calculate the signal strength distance of all reference tags and target tags, though some reference tags are at best useless for positioning. As shown in Fig. 90.1, readers #2, #3, #4 can detect target tag, while reader #1 cannot detect target. In theory, the k-nearest neighbor tags will be chosen from reference tags within the detection range. So the four reference tags which are located in the upper left corner of the reader #1 cannot be used as the nearest neighbor tags. However, according to formula (90.1), all the four reference tags will be involved in the calculation. Thus, the LANDMARC system will lead to redundant calculations, increases the server workload, and influences the real-time for positioning tags, exits unnecessary delay [11].

90.3 An Improved LANDMARC Indoor Positioning System

Before further discussion, we introduce a modified system based on the sleep mode which has some improvements on the structure and the algorithm of LANDMARC indoor positioning system.

Fig. 90.1 Reader's detection range and redundant computing schemes



90.3.1 An Improved Structure

The modified system structure mainly includes three parts: positioning unit, data collection terminal, and server-side. The positioning unit constitutes the basic structure of positioning system, includes several RFID readers and reference tags. Data collection terminal is responsible for collecting all the data in the positioning unit. The server-side includes the location service server-side and the tracing and tracking server-side.

When there is no target tag within the detection range of some readers, the positioning unit (all of the readers and reference tags) works in the sleep mode. Once target tags appear in some reader's detection range, the target tags will send active RFID signals and wake all the readers in the effective range up. At the same time, the readers transmit radio frequency signals to all reference tags within the detection scope and make them enter into work state. Awakened positioning units will send some localization information like the RSSI values of target tags and reference tags to the data collection terminal through wireless network. The information can transmit to location service server-side for processing and then the location service server-side will send location information, target status, and other information to the trace and tracking server-sides. The trace and tracking server-side will collect the location information of target tags from every positioning unit and monitor the actions of target tags. In addition, it can provide prompt information, alarm services, etc., to system administrators [3].

90.3.2 An Improved Algorithm

Specifically algorithm is as follows: Suppose we have n RFID readers along with m reference tags, and u target tags.

The number of readers, awakened by target tags can be recorded as p which is the number of readers that can detect the target tags. Then, $n-p$ readers cannot detect the target tags, and put these readers into sleep mode.

The numbers of reference tags within the coverage of readers which can detect target tags can be recorded as q , so there are $m-q$ reference tags outside the coverage, and put these reference tags into sleep mode too.

We define the signal strength vector of a target tag as $\bar{\alpha} = (\alpha_1, \dots, \alpha_p)$, where $\alpha_i = (\alpha_{i,1}, \alpha_{i,2}, \dots, \alpha_{i,u})$ denotes the signal strength of the target tag perceived on reader I , where $i \in (1, p)$. For the reference tags, we denote the corresponding signal strength vector as $\bar{\beta} = (\beta_1, \beta_2, \dots, \beta_q)$, where $\beta_i = (\beta_{i1}, \beta_{i2}, \dots, \beta_{iq})$ denotes the signal strength of the reference tag perceived on reader i , where $i \in (1, q)$.

For each target tag x , $x \in (1, u)$, the Euclidian distance in signal strength between a target tag and a reference tag can be defined as:

$$E_j = \sqrt{\sum_{i=1}^p (\beta_i - \alpha_i)^2}, \quad j \in (1, q) \tag{90.1}$$

where E_j denotes the location relationship between the reference tags and target tags. The smaller the E_j value is, the nearer the reference tag is to the target tag.

By comparing the size of the E_j value, choose reference tags with smallest E_j values as the nearest neighbor tags, the serial number of tags which is defined as K . The LANDMARC approach defines the weight value of the k th nearest neighbor tags as:

$$w_i = \frac{\frac{1}{E_i^2}}{\sum_{i \in K} \frac{1}{E_i^2}} \tag{90.2}$$

And then the location coordinates (x, y) can be obtained by the following equations:

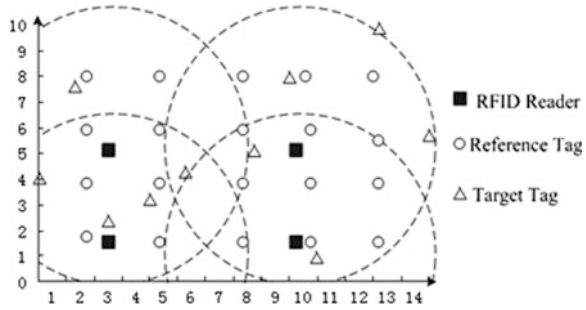
$$(x, y) = \sum_{i=1}^k w_i(x_i, y_i) \tag{90.3}$$

where the coordinate (x, y) denotes the coordinates of the target tags and the coordinate (x_i, y_i) denotes the coordinates of the nearest neighbor tags.

We define the location estimation error, e , to be the linear distance between the tracking tag's real coordinates (x, y) and the computed coordinates (x', y') , given by:

$$e = \sqrt{(x - x')^2 + (y - y')^2} \tag{90.4}$$

Fig. 90.2 The basic layout model of the location test



90.4 Experimental Results

In this part, the system was deployed in a laboratory with an area of 14.00 * 10.00 m. We set up four RFID readers in the positioning area, and arranged 20 reference tags in a fixed position, in order to improve the system positioning accuracy. We selected 10 random test points and arranged target tags. The basic layout model of the location test is shown in Fig. 90.2.

We chose different parameter values as: $q = 3, k = 4$ [12] and had 300 times position determination on 10 target tags, and got the coordinates of the target tags in turn. We can define the coordinates as: $(x_{m,n}, y_{m,n})$, where $m \in (1, 10), n \in (1, 300)$, the known coordinates of the target tags are (x', y') .

Positioning performance of positioning system is represented by the location estimation error, given by:

$$e_{m,n} = \sqrt{(x' - x_{m,n})^2 + (y' - y_{m,n})^2} \tag{90.5}$$

The system average location estimation error is

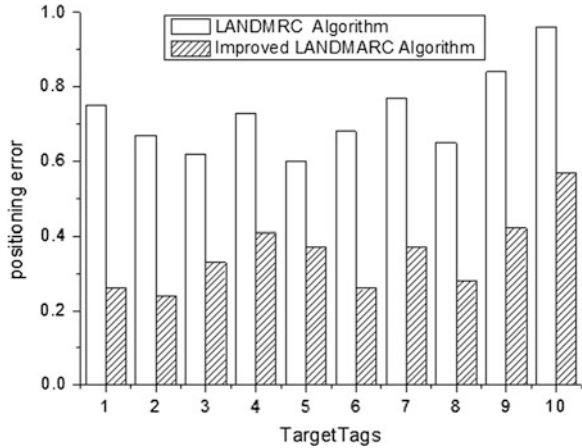
$$\bar{e} = \frac{1}{10} \left[\sum_{m=1}^{10} \left(\sum_{n=1}^{300} e_{m,n} \right) \right] \tag{90.6}$$

In this experiment environment, we calculated the system average location estimation errors of LANDMARC indoor positioning system and the improved LANDMARC approach. The results are shown in Fig. 90.3.

We can find that our improved algorithm provides a better performance when compared with LANDMARC approach. The average location estimation error of LANDMARC is 0.72 m and the maximum error is 0.96 m; while the error of our algorithm is 0.34 m and the maximum error is 0.56 m. The new algorithm, compared with LANDMARC algorithm, can get a better positioning accuracy and can reduce calculation and can also decrease delay in the experiment.

Influenced by the battery life (usually 3–10 years), the ideal life time of active RFID tags is only less than a decade. And a part of active tag’s battery power is used as electric energy which is required at work by tag’s own deceives. A part of

Fig. 90.3 Experimental result



battery power is converted to be radio frequency signal which is used for communication between tags and readers [13]. The proposed sleep mode put reference tags which were not involved in positioning into sleep mode and need not constantly transmit signals, furthermore, according to the frequent occurrence of the tags we can determine the reference interval launch, which helps to deduce the part of battery energy which is used for communication between tags and readers. Therefore, effectively reduces the energy consumption of the active tags, and extends the life time of the positioning system.

90.5 Conclusion

In this paper, the defects of the LANDMARC approach have been investigated and an improved LANDMARC indoor positioning algorithm based on sleep mode has been designed. The sleep mode we put forward in this paper is the especially innovative point. The experiment shows that the mechanism not only effectively reduces the power consumption of active tags, prolongs the positioning system’s working life, but also reduces redundant computations and gets a better positioning accuracy.

Acknowledgments This work was supported by Project 61062002 and 60972078 of the National Science Foundation of China and 1014ZTC109 of the Master Student Tutor Fund Education Department of Gansu Province.

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Part X
Intelligent Evolutionary Algorithms

Chapter 91

Explorations on Experimental Teaching Reform of Mechatronic System Design Curriculum for Local University

Hongsheng Hu and Jian Cao

Abstract The existing problems of talent cultivation mode in mechatronic compound subject of local universities are first analyzed. In this paper, the flexible manufacturing system equipment and Fisher creative combination model are respectively selected and designed as the curriculum experiment and practical training projects. Integrated design ability, analysis ability, creative ability, practical ability, and cooperation spirit for talents engaged in mechatronic products could be well cultivated using the flexible manufacturing system equipment and Fisher creative combination model. The practice has proved that explorations on experimental teaching reform of mechatronic system design curriculum would provide a good and significant example for local university's reforms in talent cultivation mode and curriculum system.

Keywords Experimental teaching reform · Mechatronic system design · Local university

91.1 Introduction

In recent years, the mechanical manufacturing industry and electrical manufacturing industry have rapidly developed in the bay of annulus Hangzhou sea and the Yangtze River delta region. Contents of science and technology in production

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areas have improved, which have driven enterprises to demanding a large number of compound mechatronic talents. The mechatronic system design curriculum is a comprehensive, practical course in machinery design manufacture, and automation speciality. It is related to a wide range of knowledge, and plays an important role in mechatronic talent cultivation [1–3]. Mechatronic system design curriculum has been set from the year 2000 for department of mechanical and electrical, Jiaying University, and teaching reform on this curriculum has been explored and researched for the past 10 years. Some useful experiences have been achieved. However, considering the traditional teaching concept, the limited teaching and experimental conditions of local university, mechatronic system design curriculum have emphasized theory knowledge, teaching, and set few experimental and practical training projects. Therefore, it has been an urgent task for the mechatronic system design curriculum to solve the existed teaching problems and reform teaching contents [4–7]. A new teaching mode for mechatronic system design curriculum has been explored in Jiaying University to develop theory teaching, project training, and production practice into an experimental teaching mode in order to improve college student's learning interest and enthusiasm.

91.2 Problems of Engineering Application Talent Cultivation for Local University

In recent years, theory research on cultivation mode of engineering science and technology talents and innovation of practice teaching system for local university has lagged behind. The guiding ideology, talent cultivation aims, and pattern of local university are all influenced by the traditional university and the researching university, which result in many problems for application engineering talent cultivation [1]. The higher engineering education of local university has failed to consciously strengthen innovative consciousness and innovative ability throughout the course of talent training. Its shortcomings are as follows:

Education ideas and teaching modes lag behind. The talent cultivation in mechatronic discipline still focuses on knowledge teaching and ignores ability training for local university because it was influenced by the traditional education ideas and teaching mode. In other words, teaching theory is pay attention, practice teaching is despised, which result in that the educator's project practice ability and innovation ability is ignored.

Defects exist between course setting and curriculum structure. At present, talent cultivation in mechatronic discipline for local university is mainly divided according to the discipline and its curriculums are also set according to the professional, which result in that there exists in a strong rigidity and high uniformity for professional teaching plan and course system.

Experimental teaching for engineering practice is not highlighted. The training of engineering practice for local university does not really combine enterprise

production practice, and the perceptual knowledge from engineering practice could not be really achieved, including professional's engineering significance and value. At present, there set many practical courses during talent cultivation in mechatronic discipline of local university, such as comprehensive experiment, course design, cognition practice, production practice, graduation design. However, there exist many problems in practical links, practice time practice content and other aspects because of the knowledge teaching type natural education idea's shackles, such as disconnection of engineering practice, lack of enlightening and creative. Besides, more teachers pay more attention to the scientific research because of the current teachers' performance evaluation system. And the practice teaching content and method lag behind.

The above-mentioned factors make graduate's engineering consciousness and ability weaken, employment period of adaptation extension, which also block creative talents' cultivation and growing up [5–7]. Although, the number of the engineering graduates has relatively substantially growth in recent years. The caused result is that the engineering technical talents with more strong innovation ability who are qualified for research, development, design, plan and other works are still very shortly supplied. Many graduate's practical work ability does not meet the requirements of the advanced engineering and technical personnel. It has been an urgent and important problem for local university to cultivate student with the application excellence engineer talent's knowledge, ability and quality. Therefore, the application excellence engineer talent training in mechatronics subject field for local university should be based on the practical engineering background, the training of application ability as the main line. The application excellence engineer talent training mode reform should combine the regional advantage characteristic industry structure characteristics, characteristics. Besides, the optimization of curriculum system and teaching content, reform of teaching method, perfecting teaching management system, cultivating the teachers' ability of practice and innovation are all achieved by through the combination of industry society, enterprise jointing school.

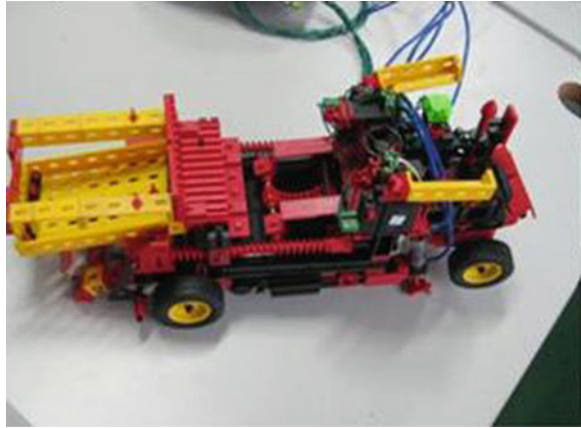
91.3 Experimental Teaching Reform of Mechatronic System Design Curriculum

Its development of local university has a direct relationship to the development of regional economy, and there exists an inevitable influence to local university's development during local social has a response to the financial crisis and promote industrial structural adjustment. Regional advantage characteristic industry development results in a great demand on the electromechanical integration professionals. As an important course in specialty, mechatronic system design curriculum has an important role in cultivating college students' creative design ability and practical ability. Considering this curriculum is involved in wide

knowledge, many points of knowledge and its strong synthesis and application, this curriculum is difficult to learn.

In order to solve problems of engineering application talent cultivation for local university, some measures has been taken in theory and experimental teaching of mechatronic system design curriculum. For example, in theory teaching aspects, design method of mechatronic products has been taught to college students in order to make them understand and master its principle scheme design and demonstration of mechatronic products and the process from the implementation of each system to system assembly. In experimental teaching aspects, in order to improve practical ability and engineering conscious of college students from local university, experimental teaching contents and teaching projects has been adjusted. For example, the flexible manufacturing system equipment and Fisher creative combination model are respectively selected and designed as the curriculum experiment and practical training projects in order to strength their overall understanding of mechatronic products and cultivate their creative and comprehensive designing ability. The flexible manufacturing system equipment is made up of three modules, including the unified information control system, the material storage and transportation system, and a group of digital control processing equipment. College students could determine the technological process according to the group object processing, select the corresponding NC processing equipment and parts, tools and other materials storage and transportation system, and control the above equipment by using the computer. Therefore, a variety of work piece's efficient production could be automatic adjusted and realized, which could play an important role in improving college student's innovation ability. Fisher creative combination model has been selected as the teaching tool to train college student's innovation ability since the year of 2000. In 10 year's exploration and practice, a series of open experimental projects have been designed. There are various models and specifications of the parts in Fisher creative combination model, including connecting rod, gears, motor, turbine, cylinder, compressor, engine, clutch, even heat (light, touch, magnetic) sensor, signal conversion switch, computer interface, etc. The truth degree of parts from Fisher creative combination model could realize any complex action process and large of design for mechatronic products, which could improve college student's practical ability. The main tasks of curriculum design of mechatronic design in Jiaxing University are to train college students design, manufacture and control a new mechatronic product, and complete the designed mechatronic product's test. In controlling modules, PLC, MCU and ARM could be applied as the controller and be realized into controlling the transmission module, motor, etc. In mechatronic system lab, a good practical platform could be provided for college students. At present, in order to deal with challenges of the financial crisis, Yangtze river delta and Hangzhou bay region are to speed up adjustment of economic development strategy. Interest relationship among local university, government and enterprise has been increasingly converging, and contact more widely. A new mechanism has been appearing that teaching and researching have been directly facing sociology. Therefore, a new application excellence engineer talent training mode for local university should be

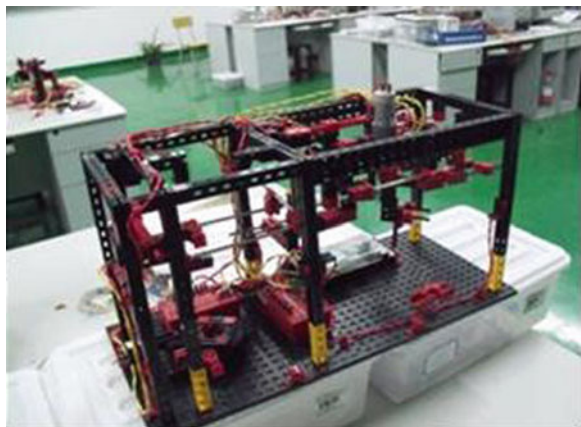
Fig. 91.1 Multi-function child carriage



actively explored, which would also produce important influence and significance to regional economic and social development. In this new mode, to strengthen engineering ability and innovative ability cultivation, to create a new talents training mechanism of jointing local university and industry, to make enterprise change from the employing unit into the joint training unit, to design the training objectives and develop the training plan by both of university and enterprise would all be included. For example, college students from Jiaying University make a series of mechatronic products in mechatronic design curriculum by using Fisher creative combination model, and parts of products could be helpful for local enterprises new products' research and development. Figures 91.1 and 91.2 show Jiaying University's works in Fifth National Undergraduate Mechanical Innovation Design Competition.

The above-mentioned works were designed by college students after their internship in Jiaying small household electrical appliances enterprises. Because of the rapid development of modern mechatronic technology, the technology level of

Fig. 91.2 Ultraviolet sterilizing cabinet



teaching equipments for local university's engineering laboratory is difficult to be adapted with the technology development. Jiaxing University keeps a close connect with many small enterprises located in the industrial park, and a communication platform is also established, where a new technology and new products exhibit activities, providing free information and related training, and other activities make college students to have a taste of the different styles and different levels of technology, produced from the world's most advanced mechatronic fields.

91.4 Conclusion

Through the above analysis, it could be proved that explorations on experimental teaching reform of mechatronic system design curriculum for local university plays an important role in cultivating application excellence engineer talent in the mechatronics field. The flexible manufacturing system equipment and Fisher creative combination model provide a new practical teaching mode in cultivating college student's innovative spirit and ability. In addition, practical teaching content is linked to the engineering practice, which is helpful in cultivating college student's engineering consciousness and engineering quality, and providing a good basis for graduation design and actual work. The teaching quality of this curriculum has been obviously improved, which would explain that reconstruction of teaching content, improvement of teaching mode, and training of application ability have been inevitable requirements of application excellence engineer talent cultivation.

91.5 Author Biography

Hongsheng Hu was born in Shucheng County, Anhui Province, China in 1976. Now he is an associate professor in the Department of Mechanical and Electrical, Jiaxing University. His research interests include vibration control, signal processing, and fault diagnosis.

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Chapter 92

PID Parameters Tuning Based on Self-Adaptive Hybrid Particle Swarm Optimization Algorithm

Dongsheng Shan, Chao Li, Xiaobo Qiu and Wei Wei

Abstract A new particle swarm optimization algorithm based on the self-adaptive adjustment to inertia weight is proposed to overcome problems of slow convergence velocity for ending and easily plunging into the local optimum. This algorithm can dynamically adjust inertia weight by introducing conception of particle distance which can reflect aggregation level of particles. Meanwhile, we used chaotic map to initialize particle swarm, which can solve blindness at the searching initiate and reduce probability of plunging into local optimum. To test the availability of advanced algorithm, we applied it to PID parameters' tuning of control systems. The simulation results in this paper reveal that system control performance is superior with normal particle swarm optimization and genetic algorithm which proves its availability and reliability.

Keywords Self-adaptive convergence velocity · Chaos · Particle swarm optimization

92.1 Introduction

PID control has the advantages of simple construction, practical and good robustness, which is widely used in the industry control field [1, 2]. Through proper linear combinations with proportion, integral, and differential of control error, PID can achieve the expected objective. Therefore, parameters tuning is significant for the system performance. Since Ziegler and Nichols put forward the

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method of PID parameters tuning, new technologies were widely applied such as neural network [3] and genetic algorithm [4]. While neural network needs more practice time, it is weak in global searching and easy to step into local optimum; Genetic algorithm is complex in encoding and decoding and needs more calculation, which cannot satisfy rapidity

Particle swarm optimization (PSO) algorithm is a kind of random optimization algorithm based on the intelligent swarm iteration, which originated on the research of birds foraging act [5]. PSO which can solve the optimization problems of nonlinear, non-differentiable and multimodal function has the advantages of solving multi-parameter optimization problem.

Simple arithmetic, rapid convergence is easy to achieve with less adjustable parameter and has widely been applied in fields, such as industry, communication, and biological. Combining the thought of Chaos [6], this paper put forward an improved PSO algorithm and applied it to PID parameters tuning. After research with simulation, this algorithm has proved its availability.

92.2 PID Control Principles

Figure 92.1 is a normal PID control system principle chart and the system consists of PID controller and controlled object. Control error is formed by control input and practical output and to achieve the control objective, controlled variable composed of the proportion, integral, and differential of control error will be worked on the controlled object.

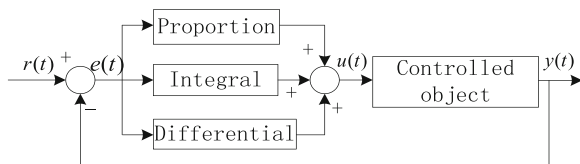
PID control law is $u(t) = K_p \cdot e(t) + K_i \int_0^t e(t)dt + K_d \frac{de(t)}{dt}$, where K_p proportion is, K_i is integral, K_d is differential. Selecting the three parameters suitably, can the system achieve the requirements of rapidity and low overshoot?

92.3 Particle Swarm Algorithm

92.3.1 Normal Particle Swarm Optimization Algorithm

PSO [7] can be regarded as a group of particles search positions which fit the objective function fitness value in N dimension space. At the start of researching,

Fig. 92.1 PID control system principle chart



every particle will be initialized and each particle will get its initialization speed and position. During research, particles speed and position will self-adjust dynamically according to experiences of itself and optimal particle and fit has been estimated whether it is excellent or not until the optimal position is found out. In every iteration, each particle speed and position is changed by two extremum values: particle history optimal position, i.e., individual extremum value $pbest$; and group history optimal position, i.e., global extremum value $gbest$.

We suppose that the number of particles is n , $x_j^{(t)} = (x_{j,1}^{(t)}, x_{j,2}^{(t)}, \dots, x_{j,N}^{(t)})$, $v_j^{(t)} = (v_{j,1}^{(t)}, v_{j,2}^{(t)}, \dots, v_{j,N}^{(t)})$ is the position and speed of particle j , and update formulas of the d generation are as follows:

$$v_{j,d}^{(t+1)} = \omega \cdot v_{j,d}^{(t)} + c_1 \cdot rand() \cdot (pbest_{j,d}^{(t)} - x_{j,d}^{(t)}) + c_2 \cdot rand() \cdot (gbest_d^{(t)} - x_{j,d}^{(t)}) \tag{92.1}$$

$$x_{j,d}^{(t+1)} = x_{j,d}^{(t)} + v_{j,d}^{(t+1)} \quad j = 1, 2, \dots, n \quad d = 1, 2, \dots, N \tag{92.2}$$

where ω is inertia gene, which can reflect the current particle influence degree to the next particle. While ω is greater, particle searching will speed up, which can find the global optimal position rapidly; while ω is lesser, particle can achieve searching in a small range, which is used for local searching. c_1, c_2 indicate respectively the understanding and social factors. Often, we suppose $c_1 = c_2 = 2$. $Rand()$ is random in $[0, 1]$. To reduce the probability that particles fly out of searching space, we can limit $v_{j,d}^{(t)}$ to $[V_{min}, V_{max}]$. Where $V_{max} = k \cdot v_d^{max}$, $0.1 \leq k \leq 0.5$ decides the maximum distance, v_d^{max} means the maximum speed of the d generation particle. To balance global and local searching, we usually adjust ω linearly:

$$\omega = \omega_{max} - \frac{\omega_{max} - \omega_{min}}{iter_{max}} \times iter \tag{92.3}$$

where $iter_{max}$ is maximum iteration? $iter$ is current iteration, and $\omega_{max} = 0.9, \omega_{min} = 0.4$

92.3.2 Improved PSO

92.3.2.1 Chaotic Map

The normal PSO often use random in searching space to initialize particles, which has inferior ergodicity and can lead to the low convergence efficiency or group plunge into global optimum, because this random operation may make particles far from or outside optimum position, and particles distribute is nonuniform. While

chaos is a nonlinear phenomenon, which is random but inside exit some law. It can experience all state in a fixed range without repeat and has the advantages of randomness, ergodicity, law and sensitiveness. This paper uses logistic map to produce chaos sequence and following is its change law:

$$z(i) = \mu z(i - 1) \cdot (1 - z(i - 1)), z(i) \in (0, 1) \tag{92.4}$$

where, μ is control variable ($0 < \mu < 4$), which can influence chaotic state degree. While $\mu = 4$, $0 < x(i) < 1$, $z(i) \notin \{0.25, 0.5, 0.75\}$, system will be chaotic state completely [8]; $z(i)$ means chaotic variable value in i generation, $i = 1, 2, \dots, N_1$, $N_1 > m$.

The fundamental idea is that through formula (92.4) we make a random c for N_1 iteration, and get N_1 full map $z(i) \in (0, 1)$ ($i = 1, 2, \dots, N_1$) for the m particles in N dimension space. Then we can magnify those particles to $[x_{\min}, x_{\max}]$ through the following map:

$$x_j = x_{\min} + (x_{\max} - x_{\min})z(j), \quad j = 1, 2, \dots, N_1 \tag{92.5}$$

We calculate fitness values of above particles and select m particles in the top m optimum as the initial position. Using this operation can increase search efficiency and decrease probability of plunging into the local optimum some degree.

92.3.2.2 Self-Adaptive Inertia Weight

The normal PSO adjusts inertia weight by using method of linear degression, which can increase algorithm performance some degree. But ω is only related to iteration number which could have rapid speed at the beginning of searching while slow at ending and particles diversity will be inferior. And it is a constant in the same generation. There are different effects with a same ω in different dimensions, which may not get the optimum solution.

Considering above problem, this paper introduces particles distance to adjust ω dynamically, that's

$$\omega = 1 - \left[1 / \left(1 + e^{(-2 \cdot (disk_{\max} - disk(i,j)) / disk_{\max})} \right) \right]^k \tag{92.6}$$

$$disk(i,j) = \sqrt{\sum_{i=1}^m (gbest_x(j) - x_{i,j})^2} \tag{92.7}$$

where, $disk(i,j)$ is the distance from particle i to optimum position in j generation, $disk_{\max}$ is the maximum distance in $disk(i,j)$, and k is used to control the changing rate of exponent.

When particle is far from optimum position, the value of ω is greater leading particle to fly rapidly to optimum position which has better ability of global

searching; when particle is close to optimum position, the value of ω is lesser and particle has better ability of local exploring.

92.3.2.3 Improved PSO Algorithm Flow

Step 1—Population initialization, including population scale, space dimension, maximum iteration and so on. Then initial speed and position should be set according to the formula (92.4) and (92.5);

Step 2—Calculating fitness values of each particles and update $pbest$ and $gbest$;

Step 3—Update particle’s speed and position according to the formula (92.1), (92.2), (92.6) and (92.7);

Step 4—Algorithm will be stopped while end condition is fit and $gbest$ will be export or algorithm will run Step 2.

92.4 PID Parameters Tuning Based on Improved PSO

An applicable fitness function should be selected first while PSO is used for parameters tuning. This paper regards time integral of error absolute value as the minimal objective function and square of control input is added to function to prevent large control variable. The objective function is as follows:

$$J = \int_0^{\infty} (w_1|e(t)| + w_2u^2(t))dt + w_3t_u$$

where $e(t)$ is control error; $u(t)$ is controller output; t_u is rise time; w_1, w_2, w_3 is weight.

To avoid overshoot, the paper used punishment measure. While overshoot is appeared, the function will change to the following:

If $e(t) < 0$

$$J = \int_0^{\infty} (w_1|e(t)| + w_2u^2(t) + w_4|e(t)|)dt + w_3t_u \quad (w_4 \gg w_1)$$

where, $\omega_1 = 0.999, \omega_2 = 0.001, \omega_3 = 2, \omega_4 = 100$.

To test the availability of improved PSO, this paper made comparison research with normal and GA under Matlab7.0. We suppose that system transfer function can be described as follows:

$$G(s) = \frac{400}{s^2 + 50s}$$

System input is set as unit step signal and the range of K_p, K_i, K_d are $[0, 60], [0, 1], [0, 1]$ respectively. The number of particles N is 20; the maximum iteration is 50 and k is 3.2. After simulation, we obtained the following charts of objective

Fig. 92.2 Convergence curve of ACPSO and GA

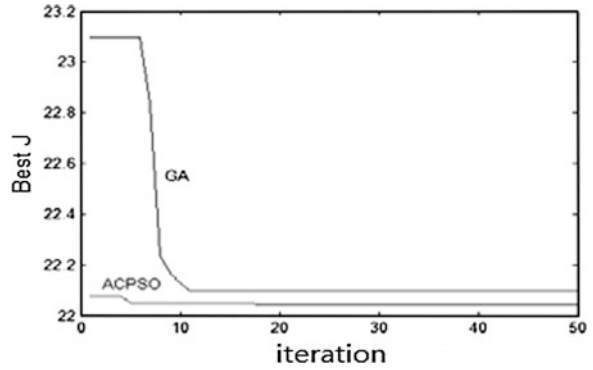


Fig. 92.3 Convergence curve of normal PSO

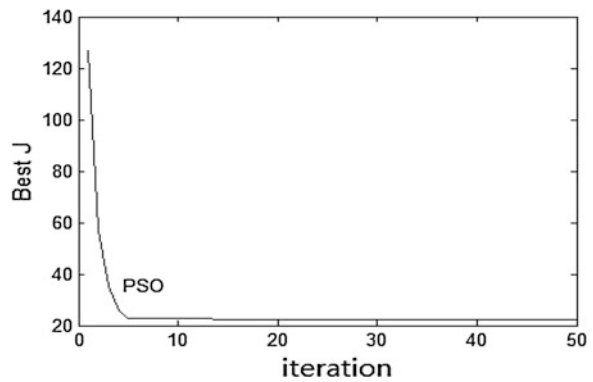
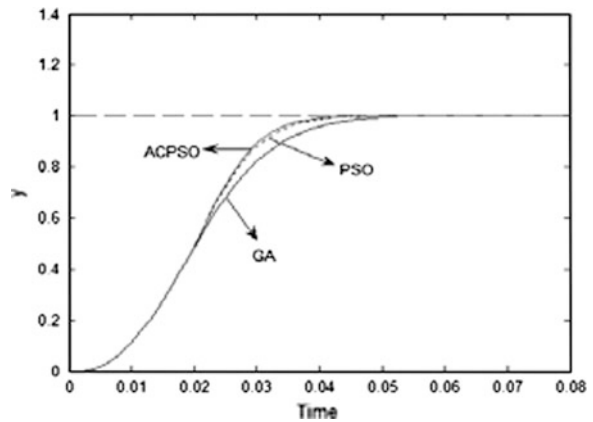


Fig. 92.4 Step respond curve with different algorithms



function and step response curve with three different algorithms, as well as the result of PID parameters tuning. As shown in Figs. 92.2, 92.3 and 92.4.

From the above simulation results, it can be seen that all the three algorithms can get a satisfying effect. Though the comprehensive performance of ACPSO is

Table 92.1 Tuning result with three algorithms

Method	K_p	K_i	K_d	Best J
GA	52.7859	0.4662	0	22.0974
PSO	55.9534	0.2437	0.4808	22.0812
ACPSO	60	0	0.4987	22.0439

better than the other two algorithms regardless of the rise in time and convergent speed. Research shows that a mix of Chaos and PSO is an effective method, which can obtain good initial particles and reduce the blindness of searching. Cooperating with self-adapt adjust inertia weight, PSO can bring its merit into full play.

From Table 92.1, we can see that the objective function value of ACPSO is minimum, which means ACPSO has better precision than other algorithms.

92.5 Conclusions

This paper put forward an improved PSO algorithm, which mixes the idea of chaos and particle distance. In the beginning, using chaos to initialize particles can get uniform distribute initial particle. Then the algorithm will adjust inertia weight dynamically to improve particle speed and position until the optimum position is found. We applied this improved algorithm to PID parameters tuning. In this research, a better effect is obtained when contrasting with two other two algorithms (normal PSO and GA), which means the algorithm has the availability. We will apply it to practical PID control system to further improve the performance.

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Chapter 93

Fuzzy ART-BP Algorithm Based on Intelligent Ink Presetting Technology

Minjie Wang, Min Wang and Tao Zan

Abstract It is a comprehensive problem to accurately set the ink key opening of every ink zone for a specific press according to the color coverage of the graphical content which will be printed on the sheet. In this paper, a new-type neural network is proposed to preset the key opening of the ink zones, which combines the fuzzy ART neural network and BP neural network, and is with the capability of half-incremental learning and good generalization. The actual qualified printed sheets are used as training samples to train fuzzy ART-BP network, so that the nonlinear mapping relationship among graphic digital information, printing conditions, and ink key control parameters is established. The experimental results indicate that the fuzzy ART-BP network algorithm could effectively shorten adjusting time of the ink key setting and improve printing efficiency.

Keywords Ink presetting · Fuzzy ART · BP neural network · Half incremental learning

93.1 Introduction

With rapid development and wide application of the digital printing workflow, the ink presetting technology as an important part of digital printing workflow has been developed vigorously. Therefore, the traditional printing industry is facing more and more pressure of market competition and technology today. The digital ink presetting technology is applied widely in printing industry.

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The presetting of ink is happened between the prepress and printing, according to the information of layout of a printed page. The prepress and printing process is connected by ink information, which realizes the datamation and standardization of printing industry like the digital management of printing process [1]. The ink presetting technology directly reads the data of the graphic analytic RIP before the printing, every ink key control parameter is preset by neural network algorithm of ink preset technology, and then the out ink amount of every ink zone is controlled, such that the effect of printed sheet is best [2].

93.2 Ink Presetting Principle

The PS/PDF layout information is formed by the digitized original file, and then the 1-bit Tiff file is formed after the imposing, color separation, and screening by RIP. That file is divided based on the structure of press, the amount of ink key, and the color plate, and then the monochrome dot area percentage of every region is calculated lastly. Besides the monochrome dot area percentage may be directly obtained by job definition format (JDF) work subpoena [3, 4]. According to the nonlinear mapping relationship between the dot area percentage and ink key control parameters, the ink amount of every key is calculated by the neural network algorithm. The ink presetting file is produced by an interpreter, and transmitted to the printing press's console by the data switching exchange (DSE), in order to ensure that the inking-up quality of press sheet is consistent with press proof as much as possible [5, 6]. The 1-bit Tiff file may be also directly pressed after the stencil making. The ink presetting workflow is shown in Fig. 93.1.

93.3 Fuzzy ART-BP Neural Networks Algorithm Model

From a structure of networks perspective, the fuzzy ART neural network is using to classify input vector in this paper, then BP neural network is using to accomplish nonlinear mapping for the classified input vector and output vector by the fuzzy ART neural network. Fuzzy ART neural network is a resonance network of bottom-up competition learning and top-down stability mechanism and no

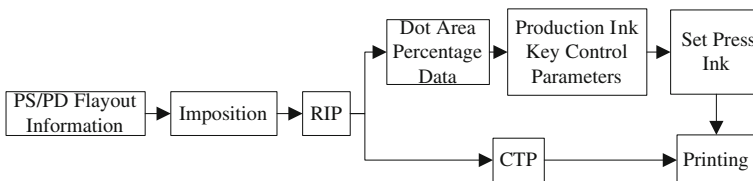


Fig. 93.1 Ink presetting workflow chart

supervision and adaptive, which includes input layer, comparing layer and category layer, and neural units (nodes) in each layer are n , n , and m , and some of the three layers of control connection variables, by means of adding two bounds, the proposed network had a bidirectional matching on the clustering of input patterns and used output of comparing layer to calculate the degree of similarity. Fuzzy ART structure is expounded in Ref. [7]. In this paper, the BP neural network includes input layer, hidden layer, and output layer, and the lower each node connects the upper each node, each layer between each node is not connected, BP structure is expounded in Ref. [10].

The training process chart and the prediction process of the hybrid fuzzy ART-BP algorithm are shown in Fig. 93.2, where ε denotes the sum-squared error goal value. Complement coding uses both on-cells and off-cells to represent an input pattern. The complement coded input I to input field is the $2N$ -dimensional vector.

$$I = (a, a^c) = (a_1, \dots, a_n, \dots, a_n^c) \tag{93.1}$$

where $a_i^c = 1 - a_i, 1 \leq i \leq n$

From a neurobiological perspective, complement coding uses both on-cells and off-cells to represent an input pattern, and preserves individual feature amplitudes while normalizing the total on-cell and off-cell vector. From a functional perspective, the on-cell portion of the prototype encodes features that are critically present in category exemplars, while the off-cell portion encodes features that are critically absent. Features that are occasionally present in a category’s input exemplars lead to low weights in both the on-cell and the off-cell portions of the prototype. Finally, from a set theoretic perspective, complement coding leads to a more symmetric theory in which both the MIN operator and the MAX operator of fuzzy set theory play a role [7, 9].

When the complement coded inputted I to input field, nodes of category output field are activated in varying deg-Rees, the choice function reflects the degree to which the weight approach vector W_j the choice function $T_j(I)$ is defined by:

$$T_j(I) = (I \wedge W_j) / (\alpha + |W_j|) \tag{93.2}$$

where α is called choice parameter, W_j is the weight vector.

The category choice is indexed by J ,

$$T_J = \max(T_j: j = 1, \dots, m) \tag{93.3}$$

where J is the number of output nodes

Resonance occurs if the match function of the chosen category meets the vigilance criterion; that is, if

$$T_k(I) = |I \wedge W_j| / |I| \geq \rho \tag{93.4}$$

where ρ is a vigilance parameter, $0 \leq \rho \leq 1$.

When learning ensues, the weight vector W_j is updated according to the equation.

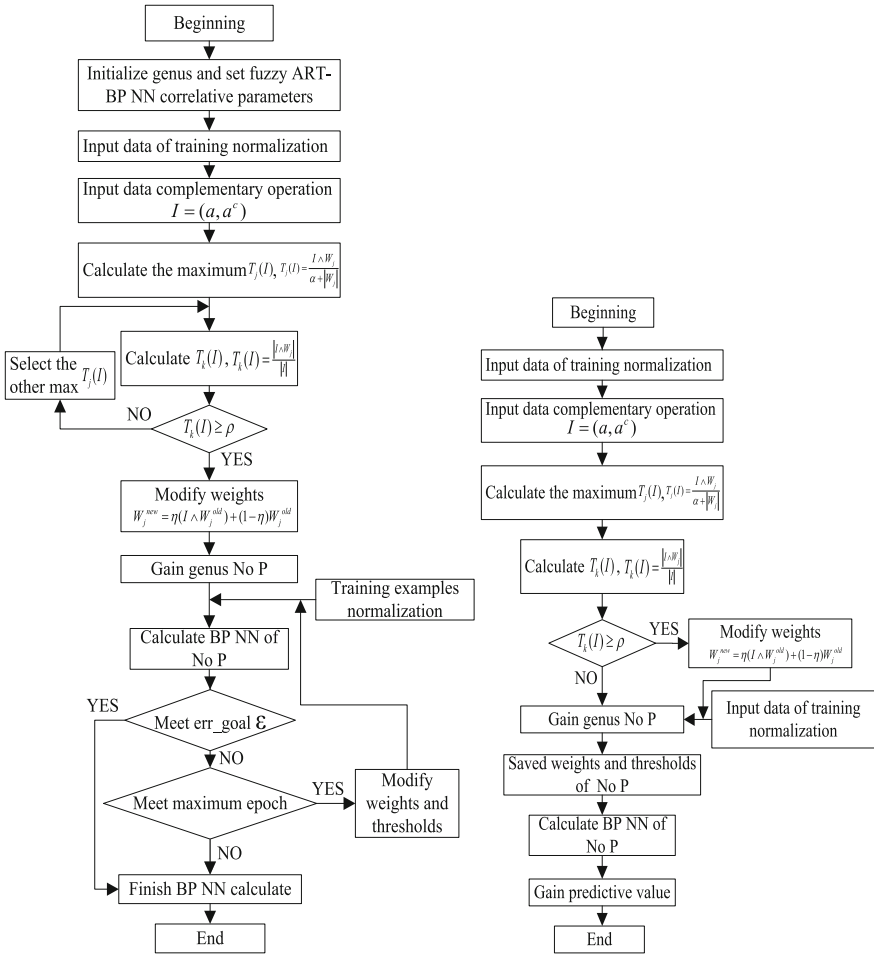


Fig. 93.2 Training process and prediction process chart of the hybrid fuzzy ART-BP algorithm

$$W_j^{new} = \eta(I \wedge W_j^{old}) + (1 - \eta)W_j^{old} \tag{93.5}$$

where η is a learning rate parameter.

93.4 Application of the Fault Pattern Recognition Based on Fuzzy ART-BP Neural Networks

The vigilance parameter value of Fuzzy ART network is 0.96, and the training error of BP neural network is 0.0001, with learning rate 0.15 and momentum factor 0.7. Thinking of the actual printing conditions, such as temperature, air

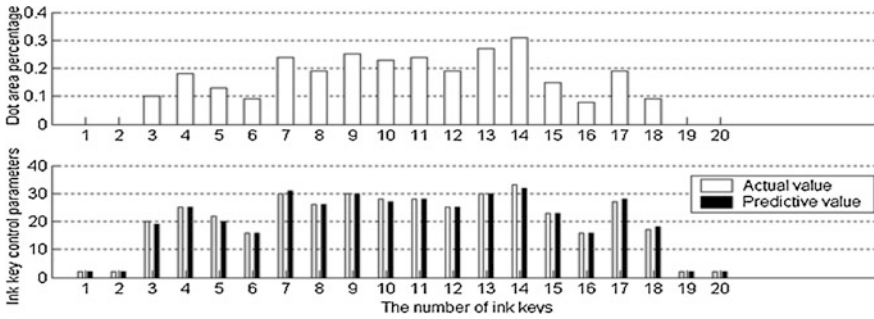


Fig. 93.3 The prediction result of the hybrid fuzzy ART-BP algorithm

humidity, and revolving speed of the offset press, the input node of BP neural network is set to 23, since the offset press has only 20 ink keys. The number of output layer, namely the number of output layer node, is same as that of ink keys. Because that this system performance is optimal with the number of hidden layer node in the range of 22–25. In this paper, the number of hidden layer node is 25.

The ink presetting data is from the data based on digital printing process system of the offset press. Because that this algorithm needs more data in order to verify its incremental learning ability, a part of data is from the Monte Carlo simulation. Since the units of collected data are disaccord, the input characteristics need to be normalized in order that the result is convergent apace. So does the output characteristics. After the initialization of BP neural network, the normalized input and output characteristics are assigned to the input and output of BP neural network. The iterative computation does not finish until the training error is less than 0.0001.

First the Fuzzy ART-BP neural network should be debugged. Taking 20 samples with same parameters such as temperature, air humidity, and revolving speed of the offset press for example, the debugging process are as follows. First of all, Fuzzy ART neural network classifies the input vector, getting the classification number of current sample. Second, the BP neural network corresponding to the classification number begins operating. The debugging process is completed when the training error is less than 0.0001. The prediction result of the hybrid fuzzy ART-BP algorithm is shown in Fig. 93.3.

The Fig. 93.3 illustrates that in two ink key control parameters, the prediction of ink key control parameters is similar to the actual result with same trend. It is shown that this method is effective in the prediction of ink key control parameters before the starting up.

93.5 Summary

The fuzzy ART-BP neural network is with the merits of the Fuzzy ART and BP neural networks Fuzzy, but overcomes their shortcoming. The Fuzzy ART neural network is used to classify the input samples into several categories with fuzzy classification principle. Then, the BP neural network is used to establish the nonlinear mapping for the samples of every category. Compared with the other ink presetting methods, the advantages of this method are as follows:

1. This new-type network adopts a kind of half-incremental learning strategy. When learning new sample data, only the weights of the category to which the new sample belonging are modified. So, it is especially suitable for the implementation of ink presetting of the printing task in small batch.
2. Because the fuzzy ART-BP network has self-adaptive classification capability and establishes the nonlinear mapping for every category, the training accuracy of the network can be evidently increased. As a result, the accuracy of ink presetting can be improved.
3. The ink presetting technology with high efficiency and high accuracy is the important key technology for the implementation of the digital printing workflow in a large printing enterprise. So, this ink presetting method proposed in this paper obviously increases the automation level, improves the printing quality, and reduces the production cost.

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Chapter 94

PID Parameter Tuning Based on Multi Universe Parallel Genetic Algorithm

Xianghua Sun

Abstract For complex industrial process control requirements for diversity, control parameters are difficult to adjust for a problem, this paper proposes PID controller parameters tuning of multi universe parallel genetic algorithm. Using multi universe parallel method as well as immigration and cross two strategies to improve the standard genetic algorithm (GA) in PID control parameter setting process of slow speed of convergence, stability is poor, easily falling into local optimal problems. The simulation results show that, based on the design method of PID parameter tuning to obtain a good effect can better solve the complex industrial process control parameter tuning problem.

Keywords: Industrial control · Genetic algorithm (GA) · PID parameter

94.1 Introduction

The proportional integral differential control (PID) is a simple algorithm, with good robustness and high reliability, and is currently the most widely used of control modes. Tuning of PID controller parameters is the key problem in PID control. Parameter selection directly affects the control effect and system security, and economy moves have inseparable relations. Thus the study of PID parameter tuning method has very important practical significance for engineering. In the field of industrial control PID is still the most important regulator structure; the

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most prominent feature is that it does not depend on the accurate mathematical model of object, so it can solve the difficulty of precise modeling in industrial process [1]. However, as a result of increasing industries devices are becoming more complex with more control circuits, PID parameters are often difficult to set and the running effect is not satisfactory. The PID parameter tuning method has a lot of [2] forms such as: indirect optimization method, gradient algorithm, hill climbing, and in the thermal system of simplex method. Although they have good optimization characteristics, there are some drawbacks. The simplex method is sensitive to initial value, easy to fall into local optimal solution, causing the search to fail. The expert set rules require much experience, different objective functions corresponding to different experiences, and the organized knowledge base is a long-time project [3].

Genetic algorithm (GA) [4] is a kind of natural selection based on the principles of genetics and genetic group optimization search method. Through fitness function it decide the optimization direction of control object, the prior knowledge of less. At the same time for the fitness function, it does not require continuous, also do not require differentiability. Therefore, the actual control is an ideal PID parameter tuning methods [4, 5]. GA in the optimization of multivariable function, neural network parameter optimization, and electrical equipment power feedback and voltage control has been applied successfully to [6]. But the traditional GA in PID control parameter setting process in the presence of slow speed of convergence, stability is poor, easy to fall into local optimal problem [5]. This paper presents a new PID control parameter setting method. Using multi universe parallel method to improve the standard GA; the independent evolution of the universe, between the optimal migration and crossover to exchange information, improve the efficiency of the algorithm. Experiment based on the encoding parameters, select the appropriate fitness function, crossover and mutation rate, parameters of PID controller setting, designed a new PID control parameter setting method, which can achieve good dynamic and static performance.

94.2 Multi Universe Parallel Genetic Algorithms

94.2.1 Genetic Algorithm

GA simulates biological evolution process of the survival of the fittest rules and groups within chromosome information exchange mechanism for a class of complex optimization problems a new method [3]. It uses a coding to represent the complex structure, and each code called an individual or chromosome. Algorithms maintain a certain number of code set, known as the population, through to the population of each individual to carry some of the genetic operation to simulate the biological evolution, to finally get some high performance index coding. GA using genetic operations are crossover, mutation and selection, which is in accordance

with the probability of changing chromosome variation in a gene, simulation is a natural biological aberrance of heritable materials; cross is in accordance with the probability in two individuals were randomly paired, simulation is in the process of sexual reproduction of chromosome exchange process; it is simulation of natural survival of the fittest process, GA in various areas of optimization has been widely used and become the interdisciplinary research hot spot. However, GA in practical application there exist some shortcomings and limitations, as more iterative times, slow convergence speed, easy to fall into local extremum and premature convergence [3]. To overcome the selection pressure of competition and how to pass the crossover and mutation to GA diversity of population is maintained in order to improve the search performance of GA, GA is always the research and application of the problems to be solved in [2].

94.2.2 Multi Universe Parallel Genetic Algorithm

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The migration and cross two strategies to realize information exchange through the universe. The universe between immigration and cross reflects the interaction between the universes, i.e. a universe within the information changes, the information interaction, caused a rapid change in the information of other universes. The universe based on learning mechanism of migration and crossover strategy exchange of different evolutionary environment excellent individual and outstanding model, can effectively overcome the premature convergence, the efficiency of search and search capability has been further improved, migration

operation and cross operation of these two types of operation can be realized the information interaction, but the two different migration. Operation is the best individual is determined according to the topological structure and migration strategy, in the universe transfer; crossover operator is the evolution of the universe through cross way to interact. The combination of the two methods can make the whole system can speed up the convergence rate, operational efficiency, and can effectively avoid the algorithm premature convergence.

Immigration is the operation of parallel GA based on coarse-grained model [6] in the information interaction, is the key to immigration, immigration and emigration strategies cycle scale selection. Migration strategies include “one-to-many” and “one-to-one”. Migration period in favor of the universe between fusion, makes excellent individual can spread to other universes, but at the same time will increase the communication overhead, and some excellent individuals in the universe’s reign would reduce the diversity of individuals in the universe. The general immigration cycles can be selected once every few generations of immigrants. Mass migration is conducive to the best individual in multiple universes in transmission and convergence speed, but also can increase the communication overhead, and leads to the universe of individual diversity declined, losing parallel algorithm in multiple directions at the same time search features.

94.3 Genetic Algorithm Tuning of PID Parameters Design

94.3.1 Parameter Encoding and Decoding

The binary coding of simple and easy operation, and is convenient to realize cross, mutation operation, so we have to be optimized parameters with a binary number to express, parameters of n changes in the range of $[a_{\min}, a_{\max}]$, using m bits, b said, their relationship.

$$a = a_{\min} + \frac{b}{m^2 - 1} (a_{\min} + a_{\max}) \quad (94.1)$$

All the parameters of the binary number are connected to form a long binary string. The string of every 0 or only 1 two value. The string is the algorithm can manipulate objects. This process is the process of encoding, decoding process for anti.

94.3.2 Initial Population Selection of Its Size

Initial population selection adopts the stochastic method. The population of the greater number of strings, eventually evolved into the optimal solution is more

likely, but will result in the increase of computing time. So the number of choices is not too big for general 10–50. The initial population is respectively divided into n universe (each one (1) individual) and m (k individuals of each universe universe).

94.3.3 Determine the Fitness Function

In the GA, value of the objective function used is adopted to evaluate the fitness of individuals to reflect. In order to solve the calculation period easily produced near the optimal solution swing problem, uses the literature [4] proposed adaptive value selection method.

94.3.4 Immigration Policy and Genetic Operators are Determined

The “one-to-one” immigration strategy, immigrants from the scale of the number of individuals in the universe 15 %, immigration cycle from every 4 generation immigrants once; between groups for every 5 generation immigrants once. GA with three operators: selection probability probability pc , The probability of selection pn , Mutation probability pm . Crossover probability decided to cross too small and too large to search remain stagnant; also can make high allocation structure is destroyed. Therefore, the general selection of crossover probability mutation probability between 0.25 and 0.8, pm for 0.001–0.1. So the assembly has unstable, too small to find global optimal solution.

This paper is set in the cross selection probability of 35 %, mutation probability is 5 %. In order to make in the evolutionary process to produce the excellent individual to retain as much as possible into the next generation of groups, the elitist strategy evolution model for the survival of the fittest, namely in the current population of the highest individual does not participate in the crossover operation and mutation operation, but use it to replace the population after cross, mutation operation after the fitness of individuals with the lowest.

94.3.5 Algorithm Framework

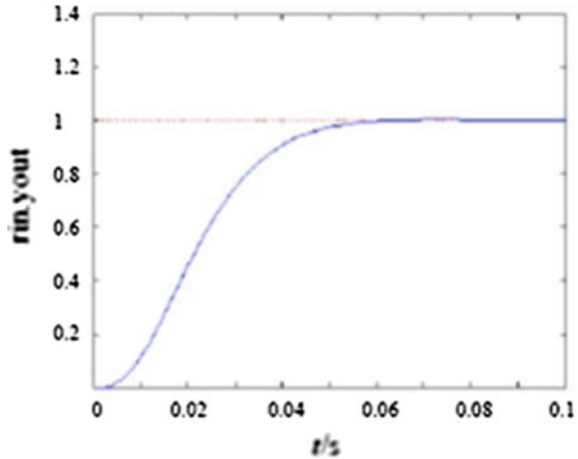
Multi universe parallel GA:

According to topological structure, Initial population $Q_m(t)$, $t = 0$, Where the subscript m universe;

The measurement of the universe $Q_m(t)$, Get status $P_m(t)$;

Of the universe $P_m(t)$ to evaluate the fitness;

Fig. 94.1 Multi-universe parallel GA tuning



Into a loop

While not the end do

Begin

$t = t + 1$

In the universe of operation:

Measuring the universe $Q_m(t)$, In order to get state $P_m(t)$;

The state of the universe $P_m(t)$, to evaluate the fitness;

Choice, cross;

Selected to satisfy the size of individual;

Variation

Update of the universe $Q_m(t)$;

The universe is determined in accordance with the migration period immigration and optimal reservation operation.

End

End

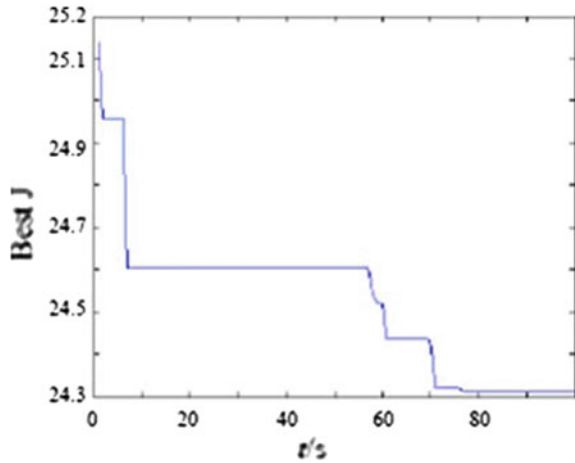
94.4 The Experimental Results and Analysis

In the industrial process control, with pure time delay of first order, two order object is very common, the object to the two order transfer function.

$$G(s) = \frac{400}{s^2 + 500s} \quad (94.2)$$

Sampling time is 1 ms, input instruction for a step signal coded in binary mode, with a length of 10 bits of the binary coded string to denote three decision

Fig. 94.2 Cost function value J , the process of setting PID after the step response



variables k_1, k_2, k_3 . The parameter k_1 value range of $[0-20]$, the parameters k_2, k_3 value in the range $[0-1]$. The setting of multi universe parallel genetic algorithm PID step response as shown in Fig. 94.1, in setting process cost function J changes as in Fig. 94.2.

Through the simulation, we can see multi universe parallel GA in PID parameter optimization speed and effectiveness with traditional GA methods have great advantages, it not only can quickly search to the satisfaction of value, and continuously improve the satisfaction degree, therefore, based on the algorithm optimization PID controller is very suitable for for the demand of real-time high actual production process to achieve satisfactory control.

94.5 Conclusion

This paper puts forward a reasonable multi universe parallel idea of integration in the standard GA. Constructing a high-performance PID setting strategy can teach good solution to the parameter estimation and controller parameter tuning problem. The simulation results show the advantage of the hybrid strategy and have a good optimization effect and exploring performance. Through comparison with traditional GA, it can be seen that the algorithm can obtain better solution and system performance is also improved. The algorithm is simple and easy to implement, easy to generalize to other complex control system parameter optimization problems. it is an effective PID controller parameters optimization in engineering technology, and has good application prospects. Because of the importance of the problem PID is used. Further studies will be aimed to solve estimation and tuning problems online.

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Chapter 95

A Clustering Method of Combining Grid and Genetic Algorithm in Wireless Sensor Networks

Jun Zeng

Abstract This paper presents a clustering method of combining grid and genetic algorithm (GA) based on grid and global optimization in wireless sensor networks (WSN). The algorithm first partitions grid based on node's location, then computes clustering center of grid using membership degree of GA, and then introduces dimensionality reduction pretreatment of the high-dimensional samples mapping into the two-dimensional space and optimum maintaining strategy. Simulation results show that the method in this paper can reduce iteration times and clustering accuracy is higher.

Keywords Wireless sensor networks (WSN) · Grid · Genetic algorithm (GA) · Clustering

95.1 Introduction

Wireless sensor networks (WSN) are made up of a large number of wireless sensors nodes which can compute, perceive, and wirelessly communicate through network of self-organization, it can independently complete monitoring, target detection, tracking, and other tasks according to the environment [1]. WSN had become a new computing platform, each node has sensing within environment, data processing, and wireless communication ability. WSN are data-centric network, if we search some data needs in a number of perceived data, the clustering technology is one of key technologies. However, in wireless sensor network,

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sensor nodes have low computing power, small storage capacity, slow communication, and so on, which makes wireless sensor network itself cannot complexly and timely process a large number of sensor data within a short time. So how to make full use of limited energy and storage capacity to design efficient querying and processing technology is a hot research currently.

95.2 Clustering Based on Grid

Grid technology is a technology of distributed computing in recent years; grid can connect high-speed computers, large databases, and storage devices together, and provide users a unified grid service. Using grid for data fusion, it can play advantages of a huge amount computing and storage resources in grid, and process, analysis, and store to collect a large amounts of data in the wireless sensor network, and make data more fully treated in WSN. Data fusion using grid in WSN also allows integration of multiple wireless sensor network systems, shields heterogeneity of data in WSN, and data from a wireless sensor network can be used by multiple grids to improve utilization of data. It simplified operation of user in WSN, and provided a unified interface of data. In grid, we can obtain new knowledge from technology of data mining, data fusion, distributed database, and so on. Grid computing in which independent user group dynamically shares computer resources in the high-speed networks, and meets computing needs of changing. It can make full use of idle resources in the network, sharing resources and providing value services. Resources are main objects in grid, it has a wide range of different functions, and makes them very difficult for organization and management, and reasonableness of organization will directly affect efficiency of grid system. Grid computing will be able to significantly reduce costs of computing and increase availability and utilization of computing resources across sectors and organizations.

Clustering analysis is one of the most important technologies of data mining. Cluster can divide data objects into classes or clusters, so that objects in same clusters are highly similar, and objects in different clusters are highly distinct. Clustering analysis is a statistical and analytical method of finding data and useful information. It classifies the samples according to inherent structure of data and similarity among samples in the case of absence or no sample type to achieve similar resources clustering.

Clustering algorithm based on grid are using a network data structure of multi-resolution, it quantifies object space into limited number of units, and forms a network structure. All clusterings are operating in this grid structures. The typical algorithms are STING algorithm, CLIQUE algorithm, and WAVE-CLUSTER algorithm. STING algorithm [2] is a clustering technique of multi-resolution based on grid, it partitions space region into rectangular units. For the different levels of resolution, they usually have rectangular units of multiple levels, these units form a hierarchy, each unit of high level is divided into some lower units, properties,

and statistical information of each grid unit are computed and stored in advance. CLIQUE algorithm [3] can automatically find the highest dimensional subspace and high-density clustering existed in these subspaces. The algorithm is not sensitive to input sequence of data, and do not suppose any normative data distribution. It varies with the size of input data and linear expansion. When the dimensionality of data increases, it has good scalability. However, clustering results may reduce due to the simplified method. WAVE-CLUSTER [4] is a multi-resolution clustering algorithm, it first add a multi-dimensional grid structure to collect data in the data space, and then use a wavelet transform to transform the original feature space, and found dense area in the transformed space. In this method, each grid cell aggregated a group of information of mapping to the unit. This aggregated information is suitable for multiple resolution wavelet transform in memory, and for the subsequent cluster analysis.

Clustering algorithm based on grid, its advantage is not processing data directly, so the algorithm is not affected by order of data, and it is suitable for various types and attribute of data. The basic idea is as follows.

Set data set $X = \{x_1, x_2, \dots, x_n\} \subset R_s$, where n is the total number of X . The k element in X is a vector of dimension s , $x_k = \{x_{k1}, x_{k2}, \dots, x_{kn}\}$, the X contains different kinds of c , and $p_i = \{p_{i1}, p_{i2}, \dots, p_{is}\}$ is class center of the i . The u_{ik} is the membership degree of element k to class center i . The matrix of membership degree is $U = \{u_{ik} | 1 \leq i \leq c, 1 \leq k \leq n\}$, class center of c are clustered into $P = \{p_i\}$. The U has the following properties:

$$u_{ik} \in [0, 1] \tag{95.1}$$

$$\sum_{i=0}^c u_{ik} = 1 \tag{95.2}$$

$$0 < \sum_{k=0}^c u_{ik} < n \tag{95.3}$$

From Eq. 95.2 we can see the summation of membership degree for all the class is one to each point; from Eq. 95.3 we can see that the summation of membership degree for element number of n shall be less than n .

The target function is defined as:

$$J_m(U, P) = \sum_{k=1}^n \sum_{i=1}^c u_{ik}^m d_{ik}^2(x_k, p_i) \tag{95.4}$$

In which, m is called weighted index, that is the smoothing parameter. The distance $d_{ik}(x_k, p_i)$ is determined according to the actual clustering distribution of solving the problem. The clustering is to find minimum $J_m(U,P)$ of target function under the constraint of the formula 95.1–95.3.

95.3 Genetic Algorithms

The basic principle of genetic algorithm (GA) was first proposed by J.H.Holland in 1962. According to Holland, many complex structures can be represented by a binary code bit, but can also be gradually improved by some simple transformation rules, and make it to the right direction of evolution. The GA is an algorithm to search for the optimal solution from simulating natural genetic mechanism and the theory of biological evolution. Holland has demonstrated that under certain conditions, the GA can converge the global optimal solution on searching space. It is a process that membership degree is the target function, and use genetic to operate the kinds and individual, and then achieve restructuring of group, so get overall optimization through iterating. It solves the complex problems without modeling and complex calculations, and do not need that the target function can be differentiable. It only needs to code the problem into gene sequence, and then constructs the suitable fitness function and genetic operators, then you can use the general GA to solve problems, thus demonstrate its strong versatility and unrelated to the solving problems. The GA does not rely on specific areas of problems, and has very strong robustness to species of problems, so it is widely applied in many subjects, such as optimization, machine learning, automatic control, scheduling problem, and social and economic fields [5–9].

95.4 Clustering Method of Combining Grid and Genetic Algorithm

The algorithm first make the data set of high dimension for degradation and regional division, so that data space can be quantified into a finite number of nonoverlapping grid; then dynamically clustering according to the GA and the grids' membership degree on the logic space and obtain clustering centers of grid; according to changing data of sensors, continue to calculate clustering centers of grid, and dynamically modifies clustering center; finally the cluster centers in grid of various types of class are transited to the base station and then the output [6].

95.4.1 Divide Sensor Grid and Initialize Sample

First, we make the data set of high dimension for degradation and forming a two-dimensional (2D) space [7, 8], in which we avoid that data in the same kind are divided into different grids; and then the wireless network area is divided into square area of $p * p$ size, each area is a grid, all clustering operations are on the grids' set.

Within a grid randomly given to a coordinate (a_i, b_i) for each sample, in which $a_i, b_i \in [0, 1], i = 1, 2, \dots, n$. Coordinate value is a gene and adopting the 8 bits coding schemes, where there are gene number of n . All genes in grid are connected together to form into chromosome, the length of chromosome $L = 8n$, therefore can form into chromosome of N and constitute the initial group S .

95.4.2 Establish Fuzzy Similar Matrix

When number of clusters c is given, randomly selected clustering center and randomly generated u_{ik} to establish fuzzy similar matrix U .

95.4.3 Set Target Function

We simulate natural selection using target function, and evaluate relative membership degree of chromosome, which determines a variety of genetic operation. $J_m(U, P)$ is smaller, membership degree is higher, set $f_i = 1/J_m(U, P)$ as individual membership degree of i , the total membership degree is $F = \sum_{j=1}^c f_j$, average membership degree is $f = f_i/F$.

95.4.4 Select

Selecting operation of GA is used to determine which way do the individual progeny groups inherited to the parent population; it is based on evaluation of individual membership degree. Its main purpose is to avoid gene deletion and improves the global convergence and computing efficiency. Common methods of selecting operator roulette are wheel selection method, remainder method; which can retain the best individual method, uniform sorting method, and saving the optimal strategy method. In this paper, we adopt method of saving the optimal strategy, the process of concrete operation is first to identify the highest individual of membership degree as a parent in the groups, then calculate f_i of each remaining individual and summation of membership degree $F = \sum_{j=1}^c f_j$. Produce a uniform random number r between $[0, 1]$, if $r < F_1$, then select the first individual, else if k satisfies $F_{k-1} \leq r \leq F_k$, then select individual k , repeat times of j , you can select individual of number of J , constitute a group $S, S' \subset S$.

95.4.5 Cross

Cross combines a new individual, makes the offspring inherit excellent gene of father generation. Each individual in S , generates a random number r between $[0, 1]$, if $r < p_c$ (p_c is crossover probability of selected), then cross. Select a group of chromosome of crossing to pairing randomly, for each pair chromosomes produced random number e between $[0, 1]$, new chromosome after crossing constitutes subgroups S'' .

95.4.6 Variant

Variant is used to keep diversity of group. Calculate all individuals' membership degree in $S + S''$, and eliminate M individuals of the smaller membership degree, then forms new generation group S . If the individual membership degree of new generation group S gets termination conditions or reaches the maximum number of iterations G_{max} , then stops operation, the largest number of iterations G_{max} depends on complexity of sample model. Otherwise go to 1.4.4 and repeat. At the end, the new generation S of each grid is transmitted to the base station and then the output.

95.5 Simulation Experiment

In order to verify feasibility and effectiveness of this method, we used data sets related to humidity to simulating experiment in database, data source of experiments is shown in Table 95.1.

The sample number of test is 150, the condition attributes are 10, clustering numbers are 3, 55, 69, and 26, respectively. Initially, the sample is randomly assigned in a 2D plane. According to this algorithm, after 80 iterations, and the population size of $N = 150$, mutation probability $p_m = 0.5$, and crossover probability $p_c = 0.2$, then clustering convergence speed and accuracy of the sample are shown in Table 95.2.

Table 95.1 Structures of experimental data

Serial number	Attribute									
	1	2	3	4	5	6	7	8	9	10
1	15.6	2.80	0.25	5.65	1.25	3.45	1156	14.23	123	1.81
2	11.2	3.85	0.28	5.25	1.24	3.21	1123	14.25	154	1.83
3	16.8	2.05	0.36	5.41	1.02	3.74	1158	13.01	252	1.03
...
149	24.5	2.77	0.42	7.01	1.17	4.01	2011	12.99	247	1.72
150	20.0	2.66	0.19	5.22	0.99	4.03	1999	11.2	525	1.63

Table 95.2 Experimental results

Algorithm	Iteration times	Accuracy		
Kind 1	Kind 2	Kind 3 (%)		
FCM	130	94	90 %	99 %
Method in this paper	80	98	96 %	100 %

95.6 Conclusion

GA is a concurrent algorithm of global optimization, and transmits information through a variety of genetic operators and grid, and gradually converges to the global optimal solution. In addition, by introducing dimensionality reduction pretreatment of the high-dimensional samples, mapping into 2D space and optimum maintaining strategy, where the processing speed is independent of size of data set, processing speed is fast, and thus it can deal with massive and multi-dimensional data set. Simulation results show that the method in this paper can reduce iteration times and clustering accuracy is higher.

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Chapter 96

Adaptive Function of Genetic Algorithm Optimization and Application

Jiang-Bo Huang

Abstract Performance of genetic algorithms is dramatically influenced by algorithmic settings. To improve the research performance of genetic algorithm and avoid its limitation of local optimization, a new adaptive genetic algorithm is applied to optimize three standard benchmark functions selected in this paper. The comparison between the results of the present algorithm and that of the simple genetic algorithm shows that the technique has improved the performance of genetic algorithm.

Keywords Genetic algorithm · Adaptation · Optimization · Stereo matching

96.1 Introduction

Genetic algorithms, genetic operations on the convergence of the algorithm performance have a large impact. The algorithm crossover operation and mutation operation combined to form the new model, so as to continuously open up new exploration of space, easy to jump out of local optimal solution, and get the global solution. Crossover probability, the greater the algorithm in the more frequent cross operation in the optimization process, the faster the update of the gene string groups that can enhance the genetic algorithm to open up the ability of the new search area, but high-performance model was the possibility of damage which also increased. If the crossover probability is set too low, the algorithm may be too small, where new space exploration rate stagnated. Variation in the genetic

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algorithm assisted search operation, its main purpose is to maintain the diversity of the solutions group. In general, low-frequency variability prevents groups, a small number of gene loss, high-frequency variability in turn makes the algorithm tends to a pure random search [1–3].

Variation in the genetic algorithm assisted search operation, its main purpose is to maintain the diversity of the solutions group. In general, low-frequency variability prevents groups, a small number of gene loss, and high-frequency variability in turn makes the algorithm tends to a pure random search.

The genetic algorithm, search performance algorithm, and depth search algorithm in the search space, and breadth of the search for balanced decision, this balance by the algorithm parameter settings of algorithm parameters has been an important branch of this field. The traditional genetic algorithm parameters are generally taken as a fixed value, to enable the algorithm is relatively simple, but often cannot get a satisfactory search results. Genetic algorithm taking into account the essence is dynamic and adaptable, many scholars have proposed a variety of adaptive mechanisms, including the adaptive operator and parameter settings, the algorithms needed in the process of optimizing search automatic adjustment of the parameters [4–8]. In order to improve the convergence performance of the algorithm, to avoid the algorithm into a local minima in the optimization search, this article will be a new adaptive genetic algorithm for function optimization, the three common benchmark functions have been optimized, and test results with the simple genetic algorithm, where the results show that this adaptive mechanism can improve the search performance of the algorithm, and good results have been achieved.

96.2 An Adaptive Genetic Algorithm

The genetic algorithm adaptability is mainly reflected in the dynamic parameters set, where we can make the algorithm dynamic adjustment of the parameters in the optimization process according to search needs, genetic manipulation by crossover, and mutation probability automatically change control, when the optimization results to a standstill and lasted longer than a certain threshold, the algorithm will automatically increase the crossover probability and mutation probability, increases the opening of the algorithm on the new search space, to help the algorithm to jump out of the local solution, easy to find the optimal solution or quasi-optimal solution [9–12]. Specific adaptive mechanisms can be expressed as:

$$P_c = \begin{cases} P_{c0}, & N \leq N_f \\ P_{c0} + (\alpha - P_{c0}) \cdot \frac{N - N_f}{N}, & N > N_f \end{cases} \quad (96.1)$$

$$P_m = \begin{cases} P_{m0}, & N \leq N_f \\ P_{m0} + (\beta - P_{m0}) \cdot \frac{N - N_f}{N}, & N > N_f \end{cases} \quad (96.2)$$

In which, two less than the 1 constant, P_{c0} and P_{m0} the initial value of crossover probability and mutation probability, and N with the same search results for the evolution of algebra. If $N < N_f$ and optimal solution changed N is reset to 0, first set of P_c and P_m the initial the value P_{c0} and P_{m0} .

To better analysis on the type of adaptive mechanism, when $N > N_f$ is, P_c and P_m simplification:

$$P_c = \alpha - (\alpha - P_{c0}) \cdot \frac{N_f}{N} \tag{96.3}$$

$$P_m = \beta - (\beta - P_{m0}) \cdot \frac{N_f}{N} \tag{96.4}$$

Equations (96.3) and (96.4) can be seen, in which certain other parameters, P_c and P_m increases with the increase of N , in other words, when the optimal solution remains unchanged algebra over a certain value (and N_f). The crossover probability and mutation probability of groups in the evolutionary search algorithm will automatically increase and enhance the efforts to search algorithm to make it out of local minima as soon as possible. In fact, the α and β respectively represent the maximum value of P_c and P_m . That is, the maximum the algorithm in the search process changes the crossover probability and mutation probability. Figure 96.1 P_c as an example to further explain the algorithm of the adaptive mechanism, which is to assume P_{c0} and α values of 0.7 and 1.0. It can be seen that the different values of N_f adjust its strategy of P_c and P_m . Applications based on the actual determine the values of N_f .

96.3 Simulation

96.3.1 Function Optimization

In order to verify the model of the adaptive genetic algorithm to select the three commonly used standard functions for performance testing specific expression of

Fig. 96.1 P_c of the adjustment mechanism

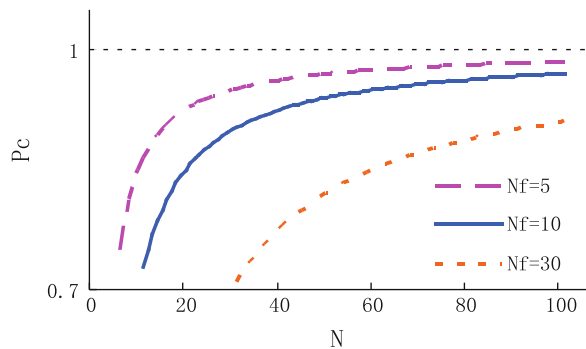


Table 96.1 Test function

Function	Solution space
$f_1(x_i) = \sum_{i=0}^{10} i \cdot x_i^2$	$-5.12 \leq x_i \leq 5.12$
$f_2(x_i) = \sum_{i=0}^9 100(x_{i+1} - x_i^2)^2 + (1 - x_i)^2$	$-2.048 \leq x_i \leq 2.048$
$f_3(x_i) = 10 \times 10 + \sum_{i=0}^{10} [x_i^2 - 10 \cdot \cos(2 \cdot \pi \cdot x_i)]$	$-5.12 \leq x_i \leq 5.12$

Table 96.2 Algorithm parameter set

Parameter	Value
Population size	50
The maximum generation	500
Selection strategy	League
Crossover operator	One-point crossover
Mutation operator	Consistent variation
P_{c0}	0.7
P_{m0}	0.01
α	1.0
β	0.2
N_f	6

the function shown in Table 96.1. These three functions are to minimize the function, the global extreme values are 0, where, f_1 is a continuous unimodal function; f_2 of the global extremum is a long-shaped valley, the more difficult convergence; f_3 is a multimodal function with many local minima, these minima increase with the increase in global extreme distance, and convergence is more difficult [13–16].

The encoding of genetic algorithms using floating-point variable coding, numerical and practical issues in order to facilitate gene-one correspondence, to improve the accuracy. Set algorithm fitness function is:

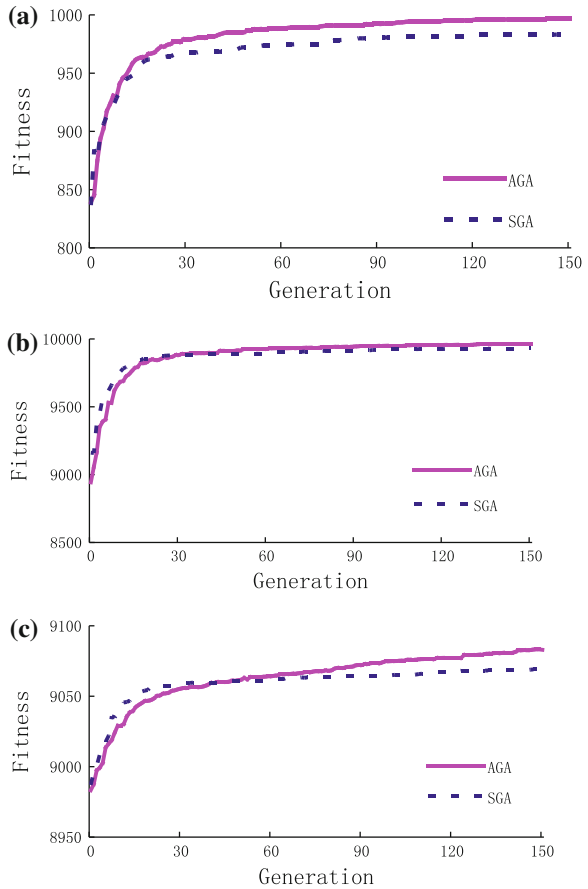
$$F_i = C_i - f_i(x) \quad i = 1, 2, 3 \tag{96.5}$$

in which, i is the serial number of the function, C_i is greater than $f_i(x)$, the normal number, and ensure that the value of F_i is greater than 0. The algorithm parameter settings are shown in Table 96.2.

Respectively, adaptive genetic algorithm (AGA) and the simple genetic algorithm (SGA) for the optimization of the three test functions, which is ten times of each simulation, taking the average of the experimental results shown in Fig. 96.2. It can be seen, that the optimization of these three standard functions, the SGA in the early stages of evolution to gain advantage, followed by the AGA more than continued until the last.

Especially in the optimization of f_1, f_2 is the slight advantage lasted only several generations after the soon to catch up, it may be because the function is relatively a simple reason. f_3 function is relatively complex, the robustness of the SGA

Fig. 96.2 The simulation results. **a** f_1 , **b** f_2 , **c** f_3



performance, is much better than the SGA search results. The whole AGA on the search performance of these test functions than the SGA, achieved good results.

96.3.2 Stereo Image Matching

Stereo image matching is to match the image formed in the two different perspectives, in order to get the depth of the stereo image is estimated in order to achieve three-dimensional reconstruction of the image. This method uses a region-based matching, image to which a reference image I_{ref} traversal of pixels in another image I , each to be the match point by the mean absolute error of the pixels within the search window to measure the degree of matching. The size of the search window can take eight different sizes: $5 \times 5, 7 \times 7, 9 \times 9, \dots, 19 \times 19$. Selected by the genetic algorithm optimization of the search window size, can achieve a better match.

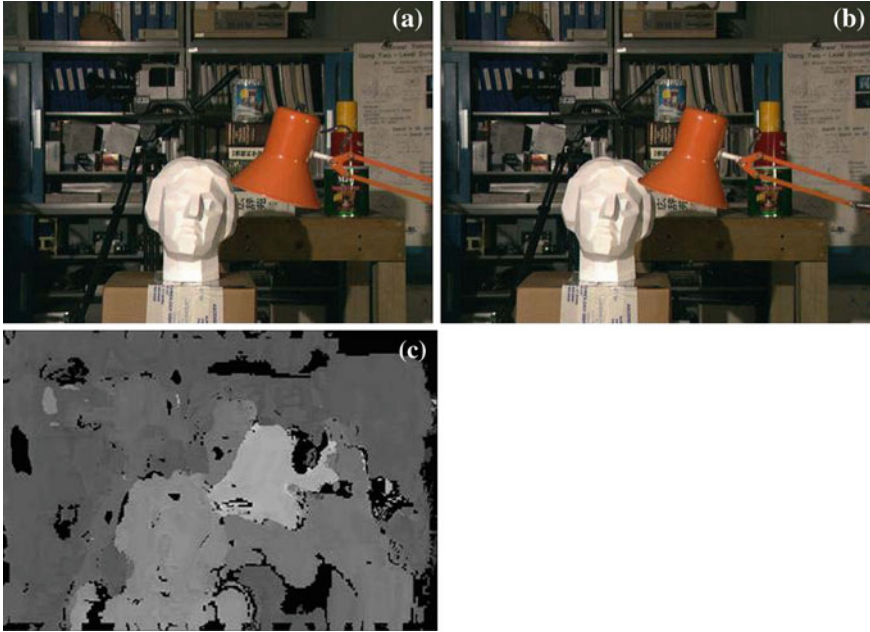


Fig. 96.3 Image matching results. **a** The left of the graphics. **b** The right of the graphics. **c** Simulation of the experimental results

Genetic algorithm to achieve the eight selected optimization objective, the encoding of the algorithm uses a binary form, its advantages are simple and easy to implement. Genetic algorithm's objective function is defined:

$$f = \frac{1}{N \cdot M} \sum_{y \in N} \sum_{x \in M} |I(x, y) - I_{\text{ref}}(x + d(x, y), y)| \quad (96.6)$$

In which x and y are the location of the matching points, d is the match point (x, y) as the difference, N and M is the number of pixels of the window. Figure 96.3 in this paper shows the adaptive genetic algorithm for Tsukuba stereo image pairs of the experimental results, in which, Fig. 96.3a is the image on the left, Fig. 96.3b is the image on the right, Fig. 96.3c is a simulation of the experimental results.

96.4 Conclusion

A new adaptive genetic algorithm for function optimization and the experimental results of the algorithm and simple genetic algorithm were compared. The balance of depth search algorithm in the search space breadth search determines the genetic algorithm search performance by the algorithm parameters, the set of

algorithm parameters will directly affect the convergence. Dynamically adjust the parameter set which can compensate for this deficiency. This adaptive mechanism adjusts the probability of genetic manipulation algorithms automatically in the search process for too long stagnation when the optimization results, the algorithm will automatically increase the crossover probability and mutation probability, increases the algorithm to the opening of the new search space ability to help the algorithm to jump out of the partial result of the operation, easy to find the optimal solution or to determine the optimal solution. Simulation results show that this adaptive mechanism to achieve a certain effect, to improve the search performance of the algorithm.

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Chapter 97

Large-Scale Interacting Particle System Simulation Using OpenGL

Fangjie Tao, Fuyan Liu and Gang Liu

Abstract To simulate large-scale interacting particle system has been a problem, which involves a lot of complicated calculations and is difficult to achieve real-time. This paper explored the possibility of parallelizing the simulation of these large-scale particle systems and offloading them to very-parallel hardware which is usually only used for rendering the video card. We use Open Computing Language (OpenCL) for parallel update of the status of every particle and apply forces onto every particle in particle system. We propose well-conceived ideas of using OpenCL achieve particle system in parallel, which greatly improved the speed of the particle system. Using GPU implement, the n-body system achieves a tenfold increase in speed than using CPU. The speed is so fast that it can achieve real-time rendering of large-scale particle system in games or scientific research.

Keywords Particle system · OpenCL · Interacting · Parallel

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97.1 Introduction

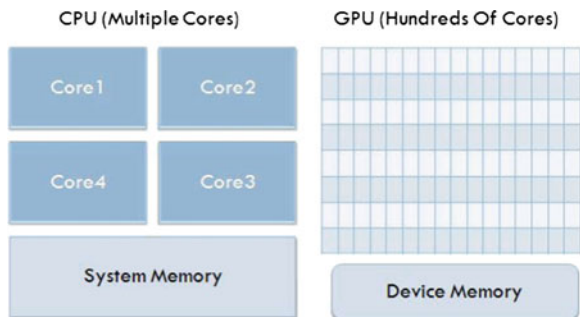
It is quite common to use General purpose computing on graphics processing unit (GPGPU) in the field of scientific research and large-scale games. GPU programming is used in scientific research when doing heavy calculations on molecular structures and protein folding etc. In large-scale games, GPU programming is used to do simulation calculations like game physics or particle systems. The reason for using GPU for such a large-scale calculation is GPU's highly parallel computing can make the program to obtain very high acceleration.

Modern GPUs have a lot of small processing units, known as stream processing unit (SPU), such as the ATI Radeon 5000 series graphics cards, there are more than 700 SPU's. The advantage of the inherent parallel architecture makes GPU computing the often used one in data-intensive tasks, such as games, 3D modelling software, and even scientific applications [1]. The running of these tasks must be highly parallel structure to adapt to the architecture of today's graphics cards. The particle system is such a task you can achieve on GPU to simulate millions of particles. Such a large-scale particle system is often used to achieve visual effects like fire, smoke, hair, cloth, and liquid (Fig. 97.1).

97.2 Related Researches

A long period of time after the release of OpenGL and Direct3D, you can only use the fixed pipeline to draw 3D graphics, so the operations you can do on graphics is very limited. Until the release of OpenGL 2.0, only a few programmable stages can use GLSL (OpenGL shading language) [2] which can support GPGPU programming. GLSL is still used to optimize the graphics and general-purpose processing, which means that the calculation you can do is very limited. In 2007, CUDA (Compute Unified Device Architecture) SDK is released and it provided NVIDIA GPGPU programming environment [3]. Using CUDA has only one big problem, that is, you have to have the NVIDIA graphics card, which greatly limits the use of CUDA. In 2008, the Khronos released OpenCL (Open Computing Language) 1.0

Fig. 97.1 CPU and GPU



specification [4], a program written in OpenCL which can be used across heterogeneous platforms, such as the CPU and GPU, and other types of processors.

CUDA and OpenCL programming is different from the use of shading language programming, which is often referred to as GPU computing, rather than GPGPU [5]. The GPGPU referees more to the general purpose use of shaders, data input and output are encoded into a texture to be processed by the fragment or pixel shader. This approach requires each element of the texture have been processed; you cannot simultaneously read and write the same texture buffer; you must have an additional output texture buffer to store the results. This will double the memory usage, so that you can only use half the memory. Using CUDA and OpenCL, we can pass on the texture and normal array buffers, so we do not assume the overhead of texture lookups and additional texture buffer.

Now the game usually do not use particle system to simulate the fluid, because the calculation is very difficult for real-time implementation, but with the introduction of GPGPU computing, the game physics engine PhysX can be a lot of real-time fluid simulation [6]. This means game engine using particle system to simulate the fluid will begin to appear. Drone [7] use GPU to simulate large-scale particle systems, including compute-intensive force like the n-body gravity. They do a simplified, so that, greatly improving the performance. They thought that the particle data do not need to return to the CPU. This means that to copy the data from the graphics memory back to the CPU is completely unnecessary, which saves time, but also the particle data are not flexible use.

97.3 Implementation

97.3.1 Particle System

The particle system is composed of many small particles as the basic elements. To simulate different natural features; you can use different types of elementary particles. Different particles have different properties, such as the initial direction of emission, the initial color and so on. Particles in the system have different properties, such as location, size, color, speed, acceleration, birth, age and so on [8]. The particle properties change over time. We abstract the law of the particles' motion in the natural scene to control the movement of particles, thus simulating the natural scene.

In addition to the properties of the particles, we also need to define the properties of emitters and forces:

```
CLASS CFORCES
```

```
    {Kernel, strength, noise, mass, particle}
    Class CEmitters
    {Birthrate, initial Velocity, particle}
```

Forces are evaluated on GPU, so we need to point out the kernel. And the force applied to which particle.


```

1  kernel void force(
2      __global PPhysicsParticle * input,
3      __global PPhysicsParticle * output,
4      __global PPhysicsNewtonian * newtonIn,
5      __global PPhysicsNewtonian * newtonOut,
6      __global PPhysicsForce * force,
7      const unsigned int count)
8  {
9      float4 fpoint, loc, accel, uv;
10     float dist;
11
12     int id = get_global_id(0);
13
14     if(id > count || input[id].lifetime == 0)
15         return;
16
17     // Load location of force and current point
18     loc = (float4)(input[id].x, input[id].y, input[id].z, 0.0f);
19     fpoint = (float4)(force->particle.x, force->particle.y,
20                    force->particle.z, 0.0f);
21     // Compute acceleration on particle
22     uv = normalize(loc - fpoint);
23     accel = force->data.normal.strength * uv;
24     dist = distance(loc, fpoint);
25     accel = accel * (1.0f / powr(dist + 1.0f,
26                             force->data.normal.falloff.strength));
27
28     // Accumulate acceleration on particle
29     newtonOut[id].ax += accel.x;
30     newtonOut[id].ay += accel.y;
31     newtonOut[id].az += accel.z;
32 }

```

Fig. 97.2 OpenCL kernel code implements a sample force from one direction to pushing particles

97.3.2 Generate Default Particles

Some particle systems will do some initial setup with particle properties, because they do not contain the emitter, or because they want to display some of the particles in the particle system start up. In our system, the only initial parameter is the number of particle. Particles random spread in the unit cube space and the initial velocity of the particles is 0.

97.3.3 Evaluate Emitters and Forces

Evaluate emitters include adding new particles in the location of existing particles, and giving initial velocity (depending on the settings of the emitter). Emitters evaluation is completed in the CPU (rather than GPU) because in OpenCL, the kernel do not adjust the buffer from inside, so there is no way to allocate space inside the kernel.

How much new space to distribute for particles is a key point to emitter evaluate. If given a constant emitter, we do not allocate the appropriate space in each frame for the new particles, because when we have a new frame we need to allocate additional space. We first allocate the space of 10 frames, about $1,024^5$ particles, to avoid the continuous redistribution of buffer.

At the phase of evaluate forces, all the particle data is copied to the GPU. Each instance of the force kernel computes its own contribution to the acceleration of the particle it affects, and added to the global acceleration of the particle. Figure 000 is a decay of force from one direction to promote particle OpenCL kernel code.

Figure 97.2 shows the OpenCL kernel code which implements a sample force from one direction to pushing particles.

97.3.4 Integrate Positions

We use Verlet integration [9], which is more stable than Euler integration, to calculate the new particle position according to the global acceleration. It needs to save the previous location of the particle

$$p_{\text{next}} = (p - p_{\text{last}}) + (a_p \times t^2) \quad (97.1)$$

t is the timestep, a_p is the global acceleration generated by all the forces.

97.4 Results

The results were taken on a machine running Windows 7 with an Intel Core i5-2450 at 4×2.53 GHz with 4 GB of RAM and a NVIDIA GeForce GT540 M at 700 MHz with 1 GB of VRAM.

We implement the n-body gravity particle system using force splatting to accumulate forces between all N particles. The result takes the output from the simulator and uses an OpenGL view to draw all of the particles as uniformly sized dots, as you can see in Fig. 97.3. This rendering is very rough but also very quick—fast enough to be real-time, in many cases.

Fig. 97.3 N-Body gravity simulation using force splatting to accumulate forces between all N particles

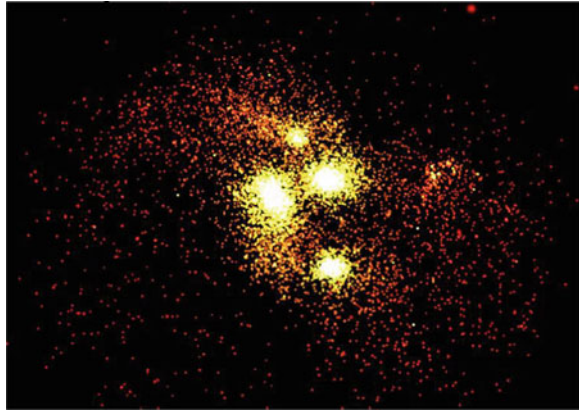
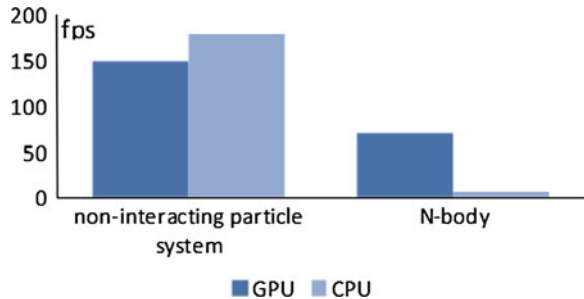


Fig. 97.4 Simulation frame-rate of two kinds of particle systems on CPU verses GPU



The n-body system simulated 16,384 interacting particles, was found using GPU implement; the n-body system achieve a tenfold increase in speed than using CPU! The reason why speed up is the interacting particle system is very suitable to use the GPU to parallel implementation, because each individual particle kernel execution time is long. In contrast, when it comes to noninteracting particle system, each individual particle kernel execution time is short so that the speed is not significantly improved because the GPU data needs to be copied back to CPU as you can see in Fig. 97.4.

97.5 Conclusion

We have introduced a feasible implementation of a very-parallel particle system simulation on the GPU. Using this technique, you can speed up the simulation of highly physically accurate, especially the high complexity algorithm, like n-body problems.

We have not done a perfect system for the simulation of particle systems. There are many missing cases, and a few conditions in which our simulation actually negatively impacts performance, but it seems that an intelligent algorithm could

certainly switch between target devices depending on the nature of the system, massively improving the performance for many cases.

97.6 FutureWork

Since it is not a perfect particle system, there are many works we need to do. For example, to render a pixel, you need to iterate to find the location of all particles to determine the pixel near the particle, its time complexity is $O(n^2)$. If you are using a kd-tree [10] to divide the space, the time complexity becomes $O(n^{2/3})$. Despite an increase in the complexity of the algorithm, it can improve performance. To improve the effect of rendering, we could use the color image buffers to show more information such as depth. Also, we can change the location of camera according to interpolator curves. This will make the effect looks more vivid. Finally, we can use ray tracing to generate shadows and other useful features between particles.

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Chapter 98

Elephant Flows Identification Based on Dynamic Multiple Filters Algorithm

Lei Bai and Jinshun Wu

Abstract Identifying elephant flows are very important in developing effective and efficient traffic engineering schemes. In the actual measurement environment, identifying elephant flows by Multistage Filters (MF) will cost large amounts of memory and present the problem of counters overflow. Moreover, by using a fixed number of bits, it results in a lack of adaptability and inaccuracy of stored information. In this paper, to reduce the storage used and avoid overflowed counters, a new packet filtering technique which named dynamic multiple filters algorithm is proposed to identify elephant flows. Multiple filters algorithm improves the performance and saves the storage from three aspects: large flows handled first, using multilayer filters to reduce memory used, and using dynamic counters to avoid overflow. The theoretical analysis and the simulation result indicate that under the condition of existing some tolerable measurement error about the length of flows, our algorithm can identify elephant flows accurately, which reduce the storage space and improve the processing speed efficiently.

Keywords Packet filtering · Elephant flow · Hash · Bloom filter

98.1 Introduction

As many measurement-based studies have revealed, flow statistics exhibit strong heavy-tail behaviors in various networks [1, 2]. This characteristic is often referred to as the elephant and mice phenomenon. In which most flows (mice flows) only

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have a small number of packets, while a very few flows (elephant flows) have a large number of packets. A noticeable attribute of elephant flows is that they contribute a large portion of the total traffic volume despite being relatively few in the number of flows. Thus, the impact of elephant flows on network performance is significant. This fact makes identifying these flows very important in developing traffic engineering schemes.

To identify elephant flows, traditionally we have to collect all packets in the concerned network, and then extract their flow statistics. As many previous studies have indicated, however, such an approach lacks scalability. In this paper, we propose and implement using multiple filters algorithm to realize elephant flows identification.

98.2 Multistage Filters Algorithm

Multistage Filters (MF) are proposed by Eestan to identify large flows in traffic [3]. It is improved from standard bloom filter. The basic idea of MF is shown in Fig. 98.1.

Each stage is a table of counters which is indexed by a hash function computed on a packet flow ID; all counters in the table are initialized to 0 at the start of a measurement interval. When a packet comes in, a hash on its flow ID is computed and the size of the packet is added to the corresponding counter. Since all packets belonging to the same flow hash to the same counter, if a flow F sends more than threshold T , F 's counter will exceed the threshold. If we add to the flow memory all packets that hash to counters of T or more are guaranteed to identify all the large flows. However, there are two problems we must take into account. First, the number of counters we can afford is significantly smaller than the number of flows, many flows will map to the same counter. This can cause false positives. In actual measurement, MF will be full-filled quickly on high-speed links. Second, the size of each counter in MF is defined before measurement, which has the static value. If the size of each counter defined too small, the MF will overflow. If the size of each counter is too large, this will waste many memories. To reduce the memory that MF algorithm is used and to avoid the counter overflow, we propose a new method.

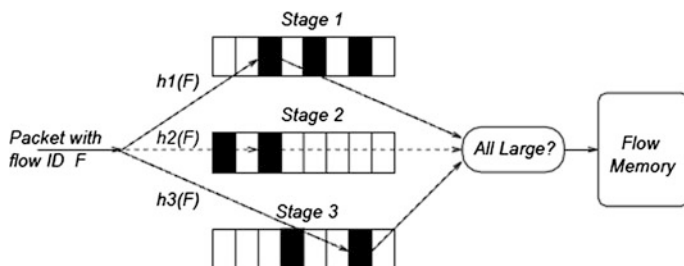


Fig. 98.1 The process of MF identify large flows

98.3 Identifying Elephant Flows by Dynamic Multiple Filters Algorithm

98.3.1 Our Algorithm

Just as the analysis of part 1.2, we improve the MF algorithm from three aspects to reduce the storage used and avoid overflowed counters.

98.3.1.1 Large Flows Handled First

For the reason of the number of memory we can afford significantly smaller than the number of flows, so the packets which belong to different flows will hash into same position. This will cause MF to make a sum of several small flows. If this position is bigger than threshold T , then MF will tag as large flow. On the other hand, some small flows will hash to large flows position, this also induces the veracity of large flows.

To avoid this situation, we propose large flows handled first, which means that we use a single Largeflow-CBF to record large flows. When a packet arrives, Largeflow-CBF will validate whether this packet is belonged to a large flow. If it is, then the counter of large flow add one, if it is not, then packet will be handled later by multilayer filters. By this way, large flows which identified before will not affect the result of measurement later, and then can improve the measurement accuracy.

98.3.1.2 Using Multilayer Filters to Reduce Memory Used

Multilayer compressed counting bloom filters are designed to improve CBF in terms of limited memory consumption [4]. It defines a counter value as the sum of its CBFV element and its potential corresponding elements in the HBV stack. A set of $k + N$ hash functions are needed. The first k functions locate the address of CBFV, the other N one for each HBV. When an operation of either inserting or deleting an element, the current counter C_i (with $i = 1 \dots k$) for each of the first k hash functions must be found. If it is already saturated (i.e., it has reached $2x - 1$), then the counter position is hashed. The obtained value is used to address a counter in HBV_1 . If its value is also saturated, the same procedure is repeated: the position in HBV_j is hashed to obtain the index for HBV_{j+1} until a nonsaturated counter is found. Hence, the actual value of the counter is the sum.

We adopt the basic idea of multilayer compressed counting bloom filters, and change the compute method before as follows: if counter C_i of CBFV is already saturated, then $C_i = C_i - C = 0$ and $HBV_1 C_{i+1}$. If counter C_i of HBV_i is already saturated, then $C_i = C_i - C' = 0$ and $C_{i+1} + 1$ (both C and C' are the cardinal

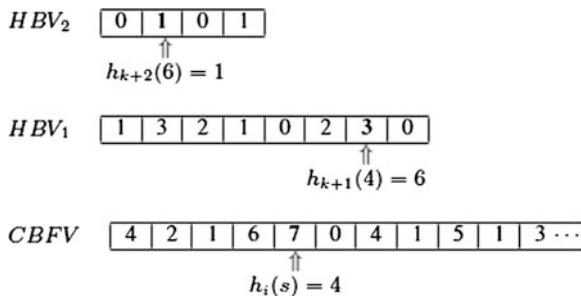


Fig. 98.2 Process of multilayer compressed CBF (with CBFV $C = 3$ bits and HBV $C' = 2$ bits). For finding a current counter for actual sum is $7 + 3 \times 23 + 1 \times 22 \times 23 = 63$. For updating a packet which belongs to the same flow, CBFV value will become 0, HBV₁ $C_6 = 0$, HBV₂ $C_1 = 2$. Sum = $0 + 0 \times 23 + 2 \times 22 \times 23 = 64$

number). The actual value of HBV counter is the sum of each $C_j \times C \times C'$. Thus we reduce the memory needs. Figure 98.2 illustrates this process.

98.3.1.3 Using Dynamic Counters to Avoid Overflow

To realize dynamic counters, we split each filter into two different vectors. The first vector is a basic CBF with each entry being a counter of fixed size $x = \log \frac{M}{n}$, where M is the total number of data elements in the set and n is the number of distinct values in the set. If we consider that the filter has m counters, the CBF vector, named CBFV, accounts for a total of $m \times x$ bits. The second vector is the overflow counter vector, named OFV, which has the same number of entries, each one including a counter that keeps track of the number of times that the corresponding entry in the CBFV suffered an overflow. The size of each counter in the OFV changes dynamically depending on the distribution of the data elements in the data set. At a certain point in time, the size of each counter is equal to the number of bits required to represent the largest values stored in OFV ($y = \lfloor \log(\max(OF_j)) \rfloor + 1$). As such, the size of the OFV accounts for a total of $m \times y$ bits. All counters in each filter have equal size of $x + y$ bits, where y varies dynamically its bit length. Figure 98.3 represents the data structure.

98.3.1.4 The Procedure of Identifying Elephant Flows by Dynamic Multiple Filters Algorithm

According to the result shown in the previous subsection, the procedure for identifying elephant flows by multiple filters algorithm is enumerated as follows.

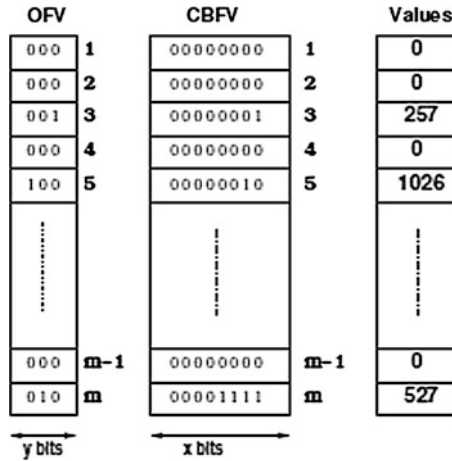


Fig. 98.3 Dynamic counters structure. Each filter is composed of two vectors, CBFV and OFV. Every vector is composed of m entries with m counters split in pair of counters. All counters have equal size of $x + y$ bits. Take the fifth counter for example, the value is 1026, corresponding to the binary number is 1000000010, if $x = 8$ defined before, y varies dynamically from its bit length, then the value of CBFV is 00000010, OFV is 100, $x + y$ is the value of this counter

Step 1: First, when a packet arrives, k independent hash functions will map a given key to one of the m buckets according to the five-tuple identity (source/destination IP addresses, source/destination port numbers, and protocol identifier).

Step 2: Second, Largeflow-CBF will validate whether this packet is belonged to a large flow. If it is, then the counter of large flow add one, if it is not, then packet will be handled by dynamic multiple filters.

Step 3: Dynamic multiple filters use the result in which Largeflow-CBF will hash, and adopt conservative update method to reduce the number of false positive. This means that dynamic multiple filters will find and update the smallest counters of k buckets normally.

Step 4: When an operation of inserting an element, the k hash functions will be found in the CBFV. Then the value of those entries will increase one. In case of a counter C_j , for any of those incremented entries, its value increases from $2^x - 1$ to 2^x , which is bigger than the static value C'_0 we defined before, the value of C_j is set to zero and the corresponding counter in OFV, OF_j has to be increased by one. In the case that the overflow counter OF_j is to be incremented from $2^y - 1$ to 2^y , before the operation can be performed, one bit must be added to all counters in the OFV in order to avoid counter saturation. If the value of OF_j is bigger than the value C''_0 we defined before, the counter position will be hashed and handled by next layer filter HBV_1 . The obtained value is used to address a counter in HBV_1 . If its value is also saturated, OFV_1 will deal with the overflow. If the value of OF_j is bigger than the value C'''_1 the counter position will be hashed and handled by next layer filter HBV_2 , etc. The same procedure is repeated until a nonsaturated counter

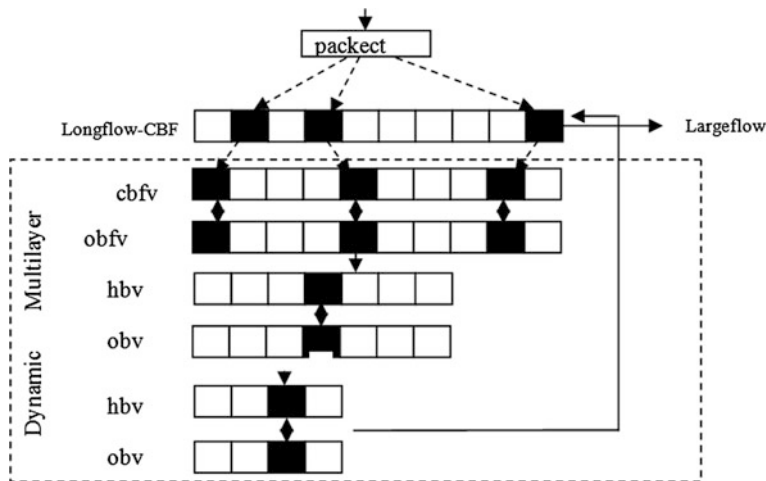


Fig. 98.4 Process of multiple filters algorithm

is found. If the sum of counter is bigger than threshold T , we will add this flow information to Largeflow-CBF.

Step 5: At last, output the flows which we recorded in Largeflow-CBF, and those flows are elephant flows. Figure 98.4 illustrates the whole process.

98.3.2 Performance Evaluation

Just as bloom filter, multiple filters algorithm has false positive also, which suggests that an element x is in S even though it is not. Giving a set $S = \{x_1, x_2, \dots, x_n\}$ of n elements is described by an array of m bits. After all the elements of S are hashed into the bloom filter, the probability that a specific bit is still 0, let $p' = (101/m)^{kn} \approx e^{-kn/m}$, $p = e^{-kn/m}$, the probability of a false positive is $f' = (1 - p')^k \approx (1 - p)^k$, $f = (1 - p)^k \approx (1 - e^{-kn/m})^k$ and $f = \exp(k \ln(1 - e^{-kn/m}))$ let $g = k \ln(1 - e^{-kn/m}) = k \ln(1 - p)$, using $p = e^{-kn/m}$, we find that $g = -\frac{m}{n} \ln p \ln(1 - p)$, from which symmetry reveals that the minimum value for g occurs when $p/(1/2)$. In this case the false positive rate f is $(1/2)^k \approx (0.6185)m/n$. For the reason of using hash functions, the cost of hash algorithm is $o(n)$. The main cost of the algorithm is finding the flows. Because the flow ID is unique, and hash result always associate with store address, we can find the flow in $o(n + \frac{n}{cm})$, C is a constant. Suppose that the max value of i th multiple filters algorithm is C_i , and n layers in total, then the bits which counter of any layer needs is $\lceil \log_2^{C_i} \rceil$. Thus the memory algorithm cost is $\sum_{i=1}^n \lceil \log_2^{C_i} \rceil \times N_i + 2 \log_2^{C_i} \times N_1$.

Fig. 98.5 Original flows distribution

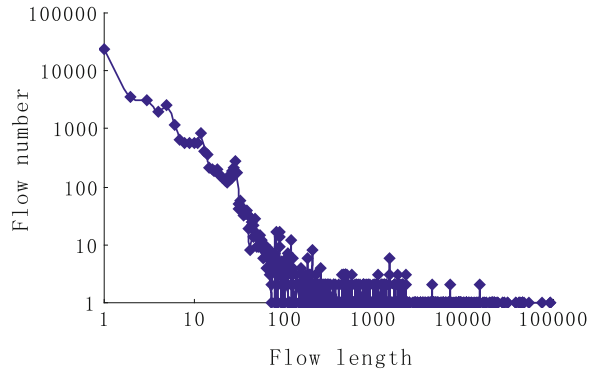
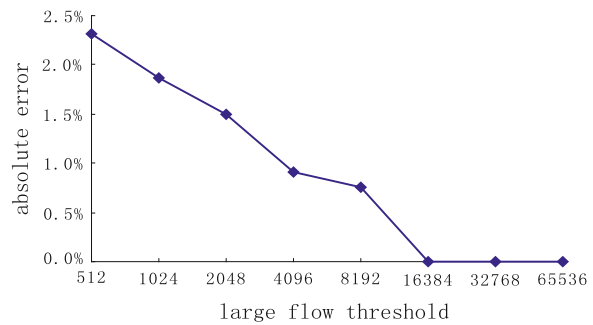


Fig. 98.6 The accuracy of multiple filters algorithm changes when large flow threshold T changed



98.4 Experimental Analysis

In this section we use actual data to test and verify the algorithm validity, and analyze the measurement accuracy. The experimental data we used has come from the Cooperative Association for Internet Data Analysis (CAIDA). There are a total of 45,038 original flows. Figure 98.5 displays the distribution of original flows.

From the picture, we can see that most flows only have a small number of packets, while very few flows (elephant flows) have a large number of packets.

Using the experimental methods and procedures proposed, we verify the veracity of our algorithm to identify elephant flows. Dynamic multiple filters have in total three layers. CBFV depends on the hash result of Largeflow-CBF, $C'_0 = 6$ bits, $C''_0 = 4$ bits. Both HBV_i and OBV_i have a single function and $C'_i = C''_i = 3$ bits. We take absolute error e_r as criterion to weight the measurement accuracy, where $e_r = \frac{|N-N'|}{N} \times 100\%$ in which N means the length of original elephant flow, and N' means the length of elephant flow that we measured in experiment.

We test the accuracy of multiple filters algorithm when large flow threshold T takes different values. Figure 98.6 shows this process.

As Fig. 98.6 showed, multiple filters algorithm can always realize elephant flow identification under the condition of some existing tolerable measurement error. Furthermore, the algorithms use 46.9 % storage space of MF approximately. Moreover, the algorithm avoids overflowed counters by using dynamic counters, which improves the availability and accuracy in the actual measurement environment.

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Part XI
Manufacturing Engineering
and Management

Chapter 99

Magnetic Studies in Complexes Derived from the Reaction of Fe(III) Salen Base Complexes and Hexacyanoferrate

Zhonghui Ye, Qing Lin, Yun He, Min Liu and Yanfang Xia

Abstract The hybrid cyanide-bridged Fe–Mn compound $[\{\text{Fe}(\text{Salen})\}_3\text{-}\{\text{Fe}(\text{CN})_6\}(\text{MeOH})_3]_n \cdot 3n\text{H}_2\text{O}$ was synthesized by the solution method. In the compound, infrared spectra with stretching vibration $\nu_{\text{CN}} = 2,118.5$ and $2,042.1 \text{ cm}^{-1}$ illustrates that there exists a bridged cyanide on the compound. Through the fitting Curie–Weiss law $\chi_m = C/(T-\theta)$, the magnetic susceptibility obeys the Curie–Weiss law with $\Theta = +5.89 \text{ K}$, $C = 7.333 \text{ emu K mol}^{-1}$. The magnetic study indicates that the bifurcation of the ZFC and FC plots below the Néel temperature of 7 K indicates irreversibility; it is concluded that the magnetic properties of this kind of layer compound is affected greatly by interlayer separation.

Keywords Molecule-based magnet · Cyano-bridged · Ferromagnetic · Hybrid · Magnetic relaxation

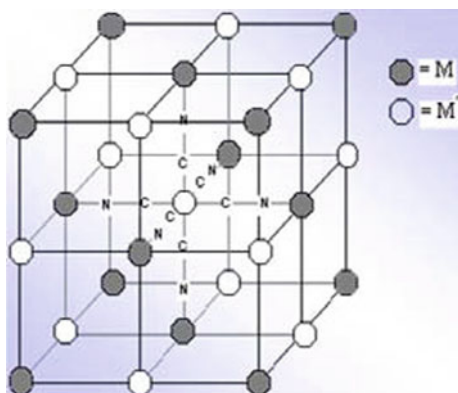
99.1 Introduction

In the recent years, investigation into the magnetic properties of molecule-based materials has become an important subject in the fields of condensed matter physics as well as materials chemistry [1–3]. People have synthesized a lot of

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Fig. 99.1 Molecular structure for Prussian Blue analogs $C_nA_P[B(CN)_6]_q \times H_2O$



Prussian Blue analogs which refer to a series of complexes with the formula $C_nA_P[B(CN)_6]_q \times H_2O$ [4] (Molecular structure of Prussian Blue analog compound as shown in Fig. 99.1), people gain different structural complexes with the hybrid method using transition metal ion complex ML^{n+} (L organic ligand) instead of simple metal ions reacting with components $B(CN)_6^{m-}$ (collectively referred as hybrid cyanide-bridged compounds). The advantages of such methods are given as follows: on the one hand because the organic groups have increased with the solubility, we easily gain the crystal expediently with magnetic and relevant study [5, 6]. On the other hand, with the transformation of the L-type organic ligand, the change of the environment around metal ions can easily regulate the lattice–magnetic interaction between the ions. In the design of hybrid Prussian Blue analog molecular magnets, we can synthesize novel, soluble, easily processing, and crystalline practical molecular magnets with organic and inorganic chemical methods through changing the organic ligand [7, 8]. While Prussian blue molecule-based magnets cannot be achieved, in this present paper, the magnetic measurements and structural measurements are performed to study the magnetic properties [9], microstructure, and magnetic coupling mechanism in molecular magnets based on hybrid cyanide-bridged compound $\{[Fe(Salen)]_3[Fe(CN)_6](MeOH)_3\}_n \cdot 3nH_2O$.

99.2 Experiment Section and Synthesis

$FeCl_3$, H_2Salen , $EtOH$, $K_3[Fe(CN)_6]$ were of analytical grade from commercial source and were used. For the characterization of the samples, we used Perkin Elmer Corporation Spectrum One FT-IR Spectrometer Fourier transform infrared spectrometer (KBr pellet), Perkin Elmer Corporation PE2400 II elemental analyses device; magnetization measurements were carried out with SOUID Design MPMS-5S magnetometer working in the dc mode.

The sample of $[\{\text{Fe}(\text{Salen})\}_3\{\text{Fe}(\text{CN})_6\}(\text{MeOH})_3]_n \cdot 3n\text{H}_2\text{O}$ was prepared by the following method: [9, 10]. To aqueous solution of $\text{Fe}(\text{Salen}) \text{Cl}$ (0.18 g, 0.5 mmol), EtOH (50 ml) was added, and then a solution of $\text{K}_3[\text{Fe}(\text{CN})_6]$ (0.165 g, 0.5 mmol) in 20 ml of water was added dropwise. The solution was stirred for 30 mins, and again the solution was stirred for some more minutes. The reaction mixture was filtered, and the final filtrate was kept open in the air. The product was obtained. Elemental analyses: Anal. Found: C, 54.43; H, 4.53; N, 13.14; Calc.: C, 54.14; H, 4.06; N, 13.53.

99.3 Characterization

In Fig. 99.2, the IR spectra for compound displays the characteristic bands of the cyanide bridging ligand at $2,118.5$ and $2,042.1 \text{ cm}^{-1}$ in the region of $2,200\text{--}2,000 \text{ cm}^{-1}$. In the meantime, broad peaks at $1,598.5$, $1,618.6$, and $1,631.9 \text{ cm}^{-1}$ that correspond to the $\nu(\text{O}\text{--}\text{H})$ of the crystal water can be seen.

X-ray diffraction experiment of the compound was carried out on $\text{Cu K}\alpha$. The X-ray spectrum for the compound is shown in Fig. 99.3 (the numbers beside the peaks are the d -values). The lattice parameter in the refinement using Full Prof software is as $a = 13.48 \text{ \AA}$, $b = 14.02 \text{ \AA}$, $c = 33.12 \text{ \AA}$, $\beta = 96.72^\circ$, $Z = 4$, in good agreement with the literature.

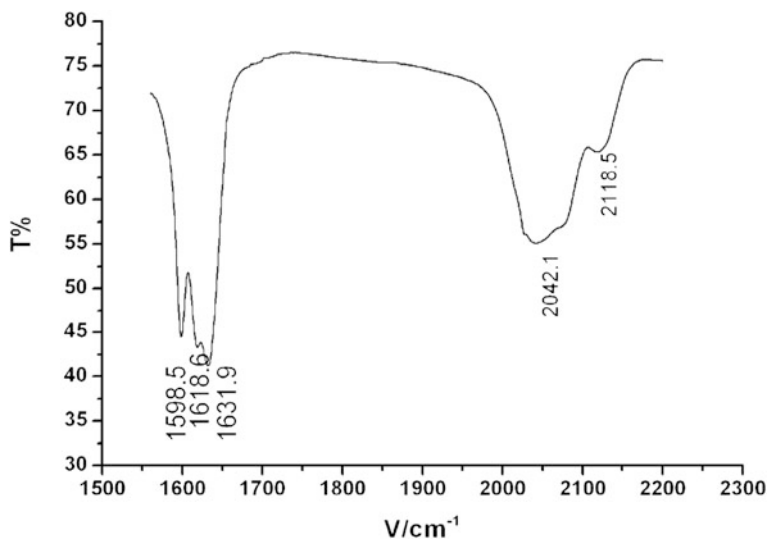


Fig. 99.2 FT-IR spectrum of the sample $[\{\text{Fe}(\text{Salen})\}_3\{\text{Fe}(\text{CN})_6\}(\text{MeOH})_3]_n \cdot 3n\text{H}_2\text{O}$

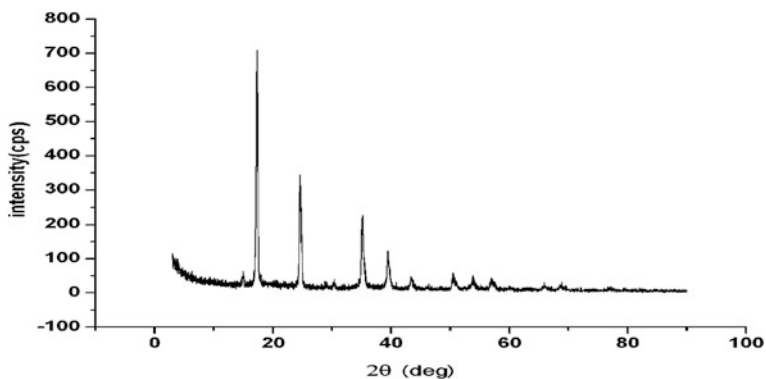
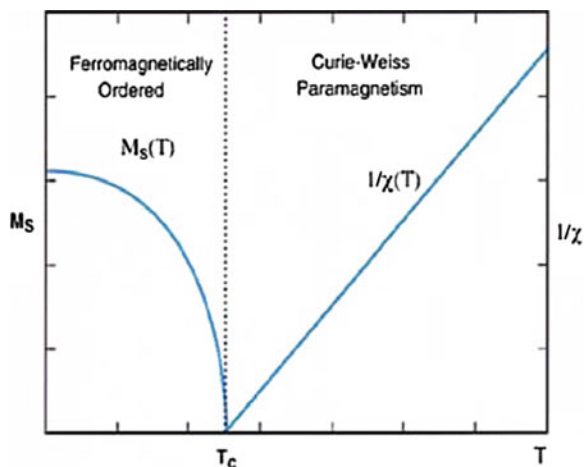


Fig. 99.3 XRD spectrum of the sample $[\{\text{Fe}(\text{Salen})_3\}\{\text{Fe}(\text{CN})_6\}(\text{MeOH})_3]_n \cdot 3n\text{H}_2\text{O}$

Fig. 99.4 The typical behavior of the thermal variation produced (Curie–Weiss law)



99.4 Magnetism Analyses

The molar magnetic susceptibilities of the sample at an applied field of 0.5 kOe are shown in the range (2–300 K). In the molecular-based magnetic, temperature dependence of χ_m^{-1} curve (the typical behavior of the thermal variation) is shown in Figs. 99.4 and 99.5. The magnetic measurements of $[\{\text{Fe}(\text{Salen})_3\}\{\text{Fe}(\text{CN})_6\}(\text{MeOH})_3]_n \cdot 3n\text{H}_2\text{O}$ is shown in Fig. 99.6.

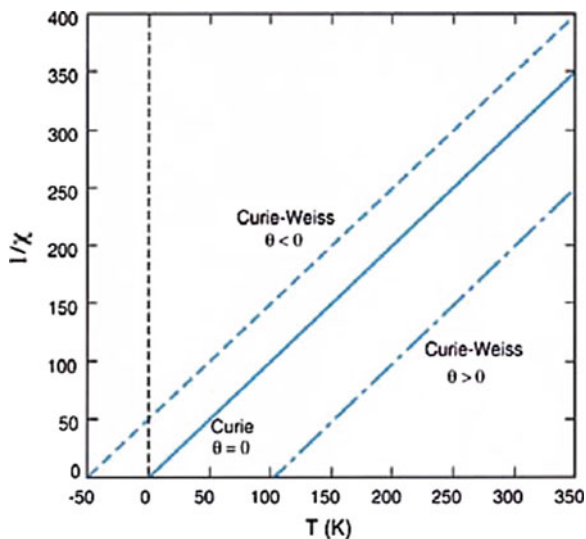


Fig. 99.5 The typical behavior of the thermal variation product (χ_m^{-1})

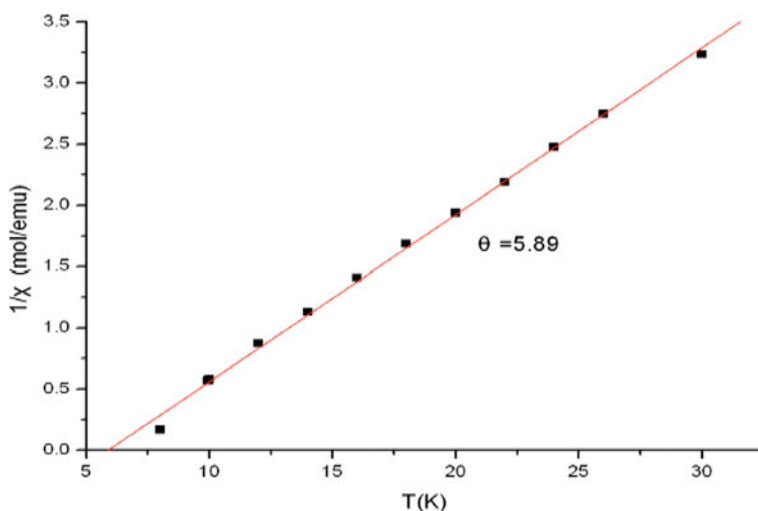


Fig. 99.6 χ_m^{-1} versus T for the sample $[\text{Fe}(\text{Salen})_3\text{Fe}(\text{CN})_6(\text{MeOH})_3]_n \cdot 3n\text{H}_2\text{O}$

χ_m value above 10 K obey the Curie–Weiss law and Weiss paramagnetic Curie temperature of $\Theta = +5.89$ K, $C = 7.333\text{emu} \cdot \text{K} \cdot \text{mol}^{-1}$. The θ suggests an overall ferromagnetic interaction in the compound [9, 11, 12].

The molecular-based magnetic, temperature dependence of FCM and ZFCM curve (the typical behavior of the thermal variation) is shown in Fig. 99.7. The Zero-field-cooled (ZFC) and field-cooled (FC) magnetization for the sample

Fig. 99.7 The typical behavior of the thermal variation produce (FCM and ZFCM)

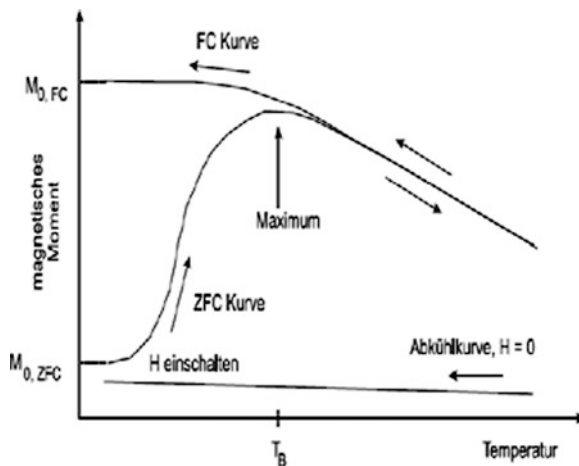
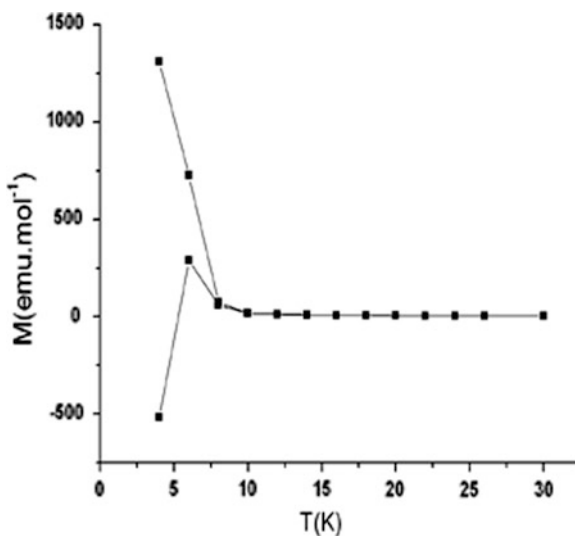


Fig. 99.8 FCM and ZFCM versus T for the sample $[\{\text{Fe}(\text{Salen})\}_3\{\text{Fe}(\text{CN})_6\}(\text{MeOH})_3]_n \cdot 3n\text{H}_2\text{O}$



$[\{\text{Fe}(\text{Salen})\}_3\{\text{Fe}(\text{CN})_6\}(\text{MeOH})_3]_n \cdot 3n\text{H}_2\text{O}$ was carried out in the temperature range 2–30 K at the external field of 10 Oe. The result is presented in Fig. 99.8, the bifurcation of the ZFC and FC plots below the Néel temperature of 7 K indicates irreversibility.

The molecular-based magnetic, temperature dependence of $x_m T$ curve (the typical behavior of the thermal variation) is shown in Fig. 99.9. Effective magnetic moment μ_{eff} versus T plots for sample is shown in Fig. 99.10.

Upon lowering of the temperature, the μ_{eff} values decrease gradually and reach a sharp maximum value of $65.5 \mu\text{B}$ at 4 K. These results indicate the presence of intracluster ferromagnetic interaction between Fe^{III} and Mn^{III} ions [11]. Comparing with the magnetic properties of two other two-dimensional network layer

Fig. 99.9 The typical behavior of the thermal variation produce ($\chi_m T$)

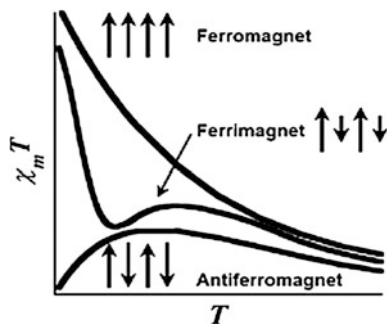
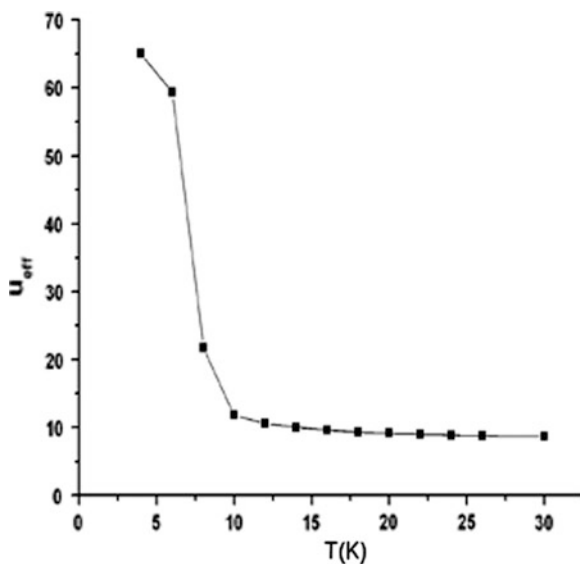


Fig. 99.10 μ_{eff} versus T for the sample $[\{\text{Fe}(\text{Salen})\}_3\{\text{Fe}(\text{CN})_6\}(\text{MeOH})_3]_n \cdot 3n \text{H}_2\text{O}$



compounds [6, 7], it is concluded that the magnetic properties of this kind of layer compound is affected greatly by interlayer separation [8, 10].

99.5 Conclusion

In this paper, the cyano-bridged complex $[\{\text{Fe}(\text{Salen})\}_3\{\text{Fe}(\text{CN})_6\}(\text{MeOH})_3]_n \cdot 3n \text{H}_2\text{O}$ has been synthesized. Through the fitting Curie–Weiss law $\chi_m = C / (T - \theta)$, the magnetic susceptibility obeys the Curie–Weiss law with $\Theta = +5.89 \text{ K}$, $C = 7.333 \text{ emu} \cdot \text{K} \cdot \text{mol}^{-1}$. The magnetic studies (field-cooled and zero-field-cooled magnetization versus T , effective moment versus T) indicate that the onset

of a magnetic ordering and the curve temperature is about 7 K. These results indicate the presence of intracuster ferromagnetic interaction between Fe^{III} and Mn^{III} ions. And we studied the magnetic interaction mechanism and abnormal magnetic behavior in the material. It is concluded that the magnetic properties of these kinds of layer compounds are affected greatly by interlayer separation.

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Chapter 100

Risk and Uncertainty in Project Portfolio Management

Na Guo and Shiwang Yu

Abstract In the new era, project portfolio management (PPM) has become popular in the world, and is being applied in many different kinds of enterprises. More and more executives gradually find that it is not enough to do the projects right. How to select and to do the right projects attracts more attention. It is very important to identify and manage the risks and uncertainties of a portfolio. In this paper, we review the history of PPM, and risk management in PPM, and then we propose a portfolio risk and uncertainty management process.

Keywords Project portfolio · Risk · Uncertainty · PPM

100.1 Introduction and Background

According to Harvey Levine, “the emergence of project portfolio management (PPM) as a recognized set of practices may be considered the biggest leap in project management technology since the development of PERT and CPM in the late 1950s” [1]. Indeed, PPM attracts lots of scholars, such as: Max Wideman, Cooper, etc. Moreover, Harvey Levine has thrown himself on PPM.

Although PPM has been widely applied in a variety of industries, such as: IT industry [2], R&D industry [3], mobile telephone communications, energy [3, 4],

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pharmaceuticals [5], toys, software [6], and foods [7], etc., it is still new and needs generations of scholars to perfect it, including its conceptions and techniques.

In the recent articles on PPM, we found that there is no clear distinction between risk and uncertainty in PPM. It seems that most of the articles neglect uncertainty. In this paper, based on lots of papers and articles on PPM, we try to find the distinction between risk and uncertainty in the PPM.

There are plenty of papers on risk and uncertainty in project management, but very rarely on PPM. Most countries are still immersed in difficult situations caused by the financial crisis. Because of this, there are much more risks and uncertainties in each portfolio, which urges people to pay more attention to risks and uncertainties. In this paper the aim is to: identify the differences between risk and uncertainty, find how to monitor and control them, and then propose a framework to manage the risks in project portfolios.

100.2 Differences Between Risk and Uncertainty

As we all know, the discipline of project risk management which has developed over the recent years is an important part of project management [8]. Concerning risk and uncertainty, different people have different opinions. So here, it is necessary to identify: what is risk, what is uncertainty, and how to distinguish risk from uncertainty.

Risk analysis and risk management had their origins in the insurance industry in the USA in the 1940s [9]. Now, risk management is playing a more and more important role in project management. With the development of the world economy and market, risks and uncertainties increased much more. For an enterprise or organization, PPM refers to not just one single project or program or portfolio, but all projects and/or programs of it.

However, till date, there is still no agreed definition of risk. When talking about risk, some people usually link it with uncertainty [10], while others may refer to opportunity [11]. Because of the distinctness of background, scholars mainly have different viewpoints in the following aspects (refer to Fig. 100.1):

1. Risk is opportunity or threat or both;
2. It may or may not be calculated;
3. If one say's risk can be calculated and predicts the result, then how to explain unknown risk?
4. What is the relation between risk and uncertainty?

Just as the answers to these questions are different, so people hold different views on risk and uncertainty.

According to The American Heritage[®] Dictionary of the English Language [12], risk is the possibility of suffering harm or loss; danger. Obviously, according to the dictionary, risk is related to the negative aspects and possibility. But it does not specify risk as uncertain or certain. In general, most scholars perceive risks as

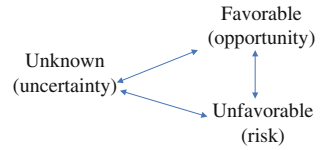
Fig. 100.1 Risk's attributes

negative issues. In the opinion of H R. Costa, risks represent uncertain events and conditions that may prevent enterprises from attaining their goals, turning risk management into a major concern, not only for project managers but also for executives involved with strategic objectives [13]. Some scholars also define risk as exposure to the possibility of economic and financial loss or gain, physical damage or injury, or delay as a consequence of the uncertainty associated with pursuing a particular course of action [14]. While other scholars focused on 'uncertain' or 'unexpected' concerning risk. In PMBOK 2008, risk was defined as 'an uncertain event or condition that, if it occurs, has an effect on at least one project objective'. The definition tells us risk has an effect on at least one project objective, not referring to whether the effect is positive or negative. In a similar vein, some scholars state that risk is exposure to the consequences of uncertainty. In a project context, it is the chance of something happening that will have an impact upon the objectives [15].

As noted by Dr. Glenn Koller, risk is a pertinent event for which there is a textual description [16]. There are at least two parameters associated with risk: probability of occurrence and consequence of occurrence. That is, we know that something positive or negative may happen, and we also know the outcome of it. We can also put it in this way; risk is expectable, rather than unexpected. So those that own at least such two characteristics can be described as risk. Risk is something similar to threat; Kim Heldman considers that threat and opportunity all belong to risk [17]. Ross thought risk was just chance, and 'the probability that a discrete event will or will not occur' [18]. Some scholars treat risk as the threat to the success of a project [19]. Risk is a condition in which there exists a possibility of deviation from a desired outcome that is expected or hoped for [20].

According to PMI, portfolio risk is an uncertain event, set of events, or conditions which if they occur, have one or more effects, either positive or negative, on at least one strategic business objective of the portfolio. In PMI' opinion, portfolio risk is described as an uncertain event, which may bewilder scholars.

Fig. 100.2 Relationship between risk, opportunity, and uncertainty



Then, what is uncertainty in PPM? How can we distinguish uncertainty from risk in PPM?

Risk can also be defined as the combination of the probability of an event and its consequences, which is given by the IRM [21]. In this definition, the author uses ‘an event’ rather than ‘uncertainty’. Wideman, former president of PMI, considered that risk was uncertainty, similar to some scholars above. According to Wideman, risk is part of uncertainty, and uncertainty also includes opportunity as well [22] (this can be explained in Fig. 100.2).

To sum up, risk has many different kinds of statements. We can classify them into three classes. The First class is pertinent to negative aspects; the second class is related to uncertain (we can also say unknown or unexpected) issues; and the third class is correlative to possibility (and result). The author sums up these different views in Table 100.1.

With the help of the discussion above, we piecemeal form our understanding of risk and uncertainty. Here, referring to the excellent scholars’ views about risk and uncertainty above, we propose our perspective on them. Similar to project risk, portfolio risk is also described as an uncertain event. Obviously, project risk management is different from portfolio risk management. The former only focuses on one project, while the latter refers to a group of projects and/or program(s).

Table 100.1 Three classes of statements of risk and uncertainty

Statements	Author(s)	Years	Relationship (risk and uncertainty)
Pertinent to negative aspects	The American heritage®	2003	Not referred
	dictionary of the english language	1991	Risk is an exposure to the consequence of uncertainty
	Chapman Kim Heldman	2005	Not referred, but saying risk contains threat and opportunity
Related to uncertain	H R. Costa et al.	2007	Risk is uncertain event
	R M. Wideman	1992	Risk is part of uncertainty which also includes opportunity
Correlative to possibility	PMI	2008	Risk is an uncertain event
	Dale F. Cooper et al.	2005	Not referred
	IRM(institute of risk management)	2002	Risk is something we know the possibility of occurrence, not
		2005	Uncertainty
	Glenn Koller J.G. Ross	2004	The same as the statement immediate above
		Not referred	

The authors believe that uncertainty (i.e. uncertain event) is one of the origin of project failure. Risk existence is the result of uncertainty. Uncertainty includes not two [20] but three consequences: the first one is good to the project (or portfolio); the second has no effect on the project result; and the last is harmful to the project's objective and success. The first consequence of uncertainty can be an opportunity for the project (or portfolio). In this way, risk is a threat for the project (or portfolio). The second consequence may be explained by something uncertain occurring in the life cycle of a project may go out of manager's expectation, but the result of the uncertain event is neither harmful nor good for the project's objective and success. Then we can say the uncertain event has no effect on the project.

The following is our definitions of risk and uncertainty:

Uncertainty: an unexpected event, if it occurs, may have either no effect or a good or bad effect on at least one of the project's objectives and success.

Risk: an uncertain event or situation, if it occurs, may have threat(s) or bad effect(s) to at least one of the project's objectives and success.

100.3 Distinguishing Risk from Uncertainty in Project Portfolio

Being aware of the exact meaning of risk and uncertainty, we now turn to risk and uncertainty (management) in PPM. As we mentioned before, PPM is playing an important part in not only the project management field, but also in the entire enterprise management. It effectively links single project and/or program management to the whole enterprise's (or organization's) strategic objectives, which is vital to the development of the entire enterprise (or organization). From the beginning of PPM, while identifying, selecting, and forming a project portfolio, scholars and practitioners have been deeply concerned about risk. But till date, there are not much scholars to show solicitude for project portfolio risk and uncertainty. We would like to point out that a project portfolio of an enterprise (or organization) is more complex than a single project (or program). In order to manage project portfolio risk and uncertainty more successfully, it is a must to confirm the exact meaning of project portfolio risk and uncertainty.

The second edition of the standard for portfolio management defines portfolio risk as "an uncertain event, set of events, or conditions which if they occur, have one or more effects, either positive or negative, on at least one strategic business objective of the portfolio" [10].

As Frank, Parth said, "Even if you are well-versed in project risk management, you may be unaware of the complexities of managing these risks across a suite of projects" [23]. Risks and uncertainties in a project portfolio are far more complicated.

Here, we define project portfolio uncertainty as an unexpected event, which if occurs, may have no effect or have at least one effect, either good or bad, on leastwise one objective of the project portfolio. In a similar vein, project portfolio risk, as a kind of project portfolio uncertainty, if it occurs, may have at least one negative effect on one or more objectives of a project portfolio.

A project portfolio includes lots of different kinds of projects and/or programs, and different departments are involved in it. So it is far more risky and uncertain in a project portfolio than just a single project (or program). People should pay more attention to this discipline.

100.4 Process to Manage Risk in Project Portfolio

In order to handle these risks in project portfolio, experts and researchers have proposed different kinds of processes. Due to the new meaning of project portfolio risk, a more actual and effective framework to cope with project portfolio risks is needed.

In order to cope with risks in a project portfolio, some scholars suggest that managers should clearly target identified risks and uncertainties [24]. Just choosing to build up a list of the ‘Top 10’ risks faced by a project is inadequate [24]. Proactive management of risk is very necessary and important [25], but is not enough.

Some scholars adopt communication to play an important role in project portfolio risk management and consider it as the key to mitigate project portfolio risk management [11]. Even the best planning goes wrong [24], so it is not enough to just use planning to reduce risks in a project portfolio. Generally, many scholars introduce multiple processes to cope with risks.

In order to manage the risks of project portfolio, the authors proposed a process as shown in Fig. 100.3:

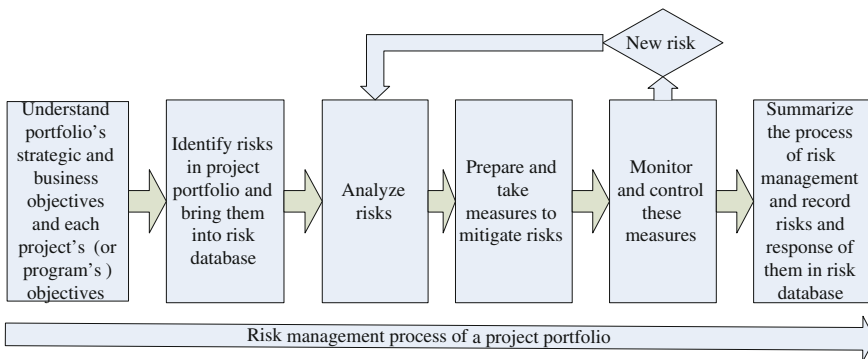


Fig. 100.3 Process of project portfolio risk mitigation

Understand project portfolio's strategic and business objectives and each project's (or program's) objectives;
Identify risks in project portfolio and bring them into risk database;
Analyze risks;
Prepare and take measures to mitigate risks;
Monitor and control these measures;
Summarize the process of risk management and record risks and their response in risk database.

100.5 Conclusion and Future Work

In this article, through analyzing different scholars' views on risk and uncertainty; we classify these viewpoints into three classes. Then we propose our definitions of risk and uncertainty from a new perspective. In order to cope with risks in project portfolio, we bring forward a process of six steps to respond and mitigate risks. However, as mentioned before it is far more complex for risks in project portfolio, and in a single project, just a process or framework is not enough. Besides, this research does not give concrete measures to mitigate risks in a portfolio. The future work will concentrate on how to mitigate different kinds of risks with different specific measures.

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Chapter 101

Test Case Generation Based on MSC

TTCN-3

Wenhong Hu and Xinxin Sun

Abstract According to the agreement, the formatted description by a certain algorithm can automatically generate test cases, but this may create invalid test cases, or test cases that cannot completely cover agreement. In order to solve this problem, we present a new approach called generating TTCN-3 test case from message sequence chart (MSC). The testers can describe the specific test scenarios with MSC, and then map TTCN-3 test cases from MSC. MSC document is used to structure the test cases, and the name of the MSC document is used as the name of TTCN-3 module. Basic MSC mainly comprises news exchange and procedure called. Advanced MSC in TTCN-3 module control section describes the execution of the test cases.

Keywords MSC · Test case · TTCN-3 · Module · Alt · Mapping

101.1 Introduction

Based on the protocol's formal description, test cases may be automatically generated using certain algorithms. However, some auto generated test cases may be invalid, or due to incomplete description of the protocol, test cases cannot completely cover the protocol. To solve this problem, tester can manually use the

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message sequence chart (MSC) to describe a specific test scenario, and then map to testing and test control notation (version 3) (TTCN-3) test cases from MSC [1, 2]. This paper studies how to generate TTCN-3 test cases from MSC.

101.2 TTCN-3

Tree and tabular combined notation (TTCN) is a standard test description language issued by the ISO/IEC [3]. The latest version issued by ITU is TTCN-3. The title and its meaning have completely changed. Compared to the previous version, TTCN-3 is more versatile, flexible, and easy to implement. TTCN-3 can be used for protocol testing, service testing, CORBA-based platform testing, and API testing in the telecommunication area. TTCN-3 is not only limited to conformance testing, but also for interoperability and robustness testing.

TTCN-3 is designed for functional, black box testing, and to describe abstract test suite (ATS) which are independent of a concrete test platform. TTCN-3 defines a variety of description formats, including table format, graphical format, core language format, and user-defined format. The core language formats can be independent of the table format and the graphical format, but the remaining three formats should all be based on the core language format.

The general structure of a TTCN-3 test system is shown in Fig. 101.1.

In short, there is an abstract test system interface (ATSI) between the SUT and the ATS. The point of control and observation (PCO) is the access point between ATS and SUT. There is a real test system interface (RTSI) that will map ATSI to SUT. TTCN-3 test configuration is done through main test component (MTC) [4]. The MTC also controls parallel test components (PTCS). At the beginning of each test case execution MTC is created by the system, while PTCS is dynamically created during the implementation of the test case.

Fig. 101.1 General structure of a TTCN-3 test system

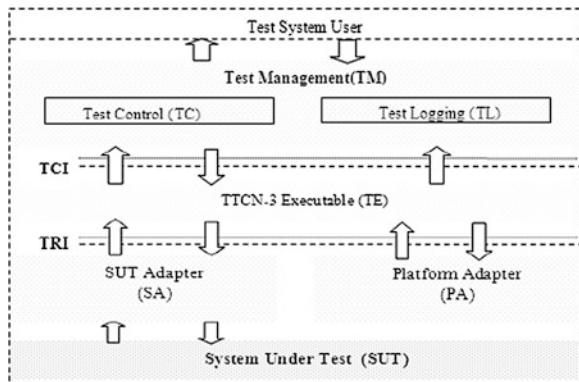
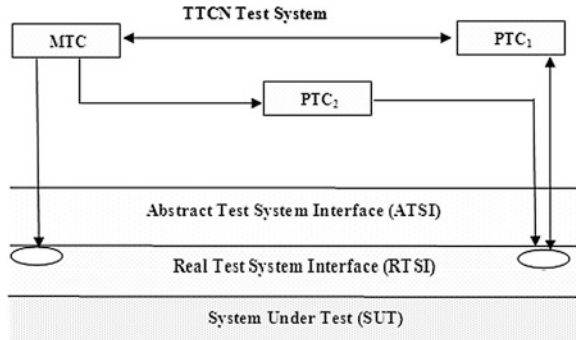


Fig. 101.2 TTCN-3 test system concept



Ports are used for the communication between TTCN-3 test components, as well as between test components and the test system. TTCN-3 supports message-based and process-based ports, or hybrid port of the two types. Figure 101.2 is a TTCN3 test system concept map.

101.3 MSC to TTCN-3 Translation

MSC is a standard graphical specification language standardized by the ITU-T [5]. MSC uses a combination of graphics and text, to describe communication behavior between system entities and their environment. Sequence charts and MSCs are used to describe the communication behavior by message exchange. It was originally used as a supplementary of specification description language (SDL), but with the MSC's development, there are more applications.

MSC began to be used independently for the purpose of testing and description of test cases. Three types of charts are provided by MSC: basic MSC, advanced MSC, and MSC document. Basic MSC describes the communication events between communication entities according to the temporal relationship. A number of basic MSCs are combined to advanced MSCs, and a number of simple scenarios form a more complete test suite. MSC documents are used to provide an associated collection of MSCs and define all kinds of instances used in the MSCs.

Basic MSC describes the communication flow between the system entities where the concept of instances and messages is used. MSC supports concepts, such as news catching up, disordered region, MSC references, embedded expressions, and so on.

In order to generate TTCN-3 from MSC, a mapping of testing systems and communication needs to be carried out. In TTCN-3, the basis of the testing systems and communication is the testing of components and ports. Testing components connect each other through their ports, and each port is modeled as an infinite FIFO queue which is used to store incoming messages or procedure calls until the components own the port. Because testing components for MSC which are based on scenarios testing are too abstract, it maps MSC instance to the port.

For example, MTC and SUT ports are used to describe test cases in MSC. PTCS is expressed by the creation of MSC's instance. In order to distinguish the port of various test components, the name of test components should be noted in MSC instance. From TTCN-3 test case perspective, if there is semantic ambiguity in a scenario described by MSC, it should generate a number of MSC TTCN-3 test cases from MSC to illustrate this situation.

101.3.1 MSC Document and Comments

MSC documents are used to structure test cases, therefore, the name of MSC document is used as the name of TTCN-3 module, and the referenced MSCs are converted into corresponding TTCN-3 test cases inside the module.

There are three comment types in MSC: note, comment, and text. Note only appears in grammar, and the comments whose note type is comment or text insert into the notes of TTCN-3. Comments associated with note type "text" or symbol can insert into TTCN-3 statement in the special position. Global MSC comments are put at the beginning of TTCN-3 test cases.

101.3.2 Basic MSC

Basic MSC is made up of the instance, message exchange, and the procedure call. MSC instance is mapped to the port and PCO. The name of instance uses the name of port, and for instances that have no names, their type is used as the name of their components. Elements associated with the MSC instance belong to the appropriate port or component. Port type may be given the name of the MSC instance.

The messages and the processes of MSC between the entity and the environment constitute the input-output relationship. This may change into the send and receive operation of TTCN-3. Output message event matches send operation, output process event matches call, reply or raise operation. Assignment and optional parameters in TTCN-3 can be given notes on the communication events in TTCN-3.

There is a blocking feature in the procedure call of TTCN-3, and it indicates whether test execution is blocked or not by returning a response or exception. Therefore, the asynchronous and synchronous transfer of MSC is used to map the non-blocking and blocking calls of TTCN-3. The message and the process of MSC represent the type or template.

To generate TTCN-3 test cases from MSC for sorting out the basic events is critical. In MSC, the order of the message must be met: The output event of any message must occur prior to the input event. In the same instance axis, the sequence of events is along the axis from top to bottom. In TTCN-3, because the sequence of events in port is sorted according to the default sort in full, the whole sequence of MSC instance can be taken good care of. If you want the other behavior to occur, it needs to use the corresponding element to remodify the order. Some sequences

between instances will make some tracks occur, some tracks do not occur, therefore, some sequence can be limited in synchronization points, send event should be executed at the earliest possible. If necessary, using graphic sequence to determine the track used. In MSC, graphic sequence runs until the end or reaches the synchronization point from left to right and from top to bottom. Synchronization point is that prior to this point, all send and receive operations are completed. Therefore, prior to synchronization point, implementation of events are forcibly completed, and events cannot be carried out after the synchronization point.

101.3.3 Structural Concepts

Coregions are used to override explicitly the total ordering of an instance axis by unordered events. Coregion in MSC can change into interleave statement in TTCN-3. Overlapping of coregions on different instance axes for the same component has to be prevented. The first event must be always a receive event. In case of non-concurrent TTCN coregions are only used on SUT axes.

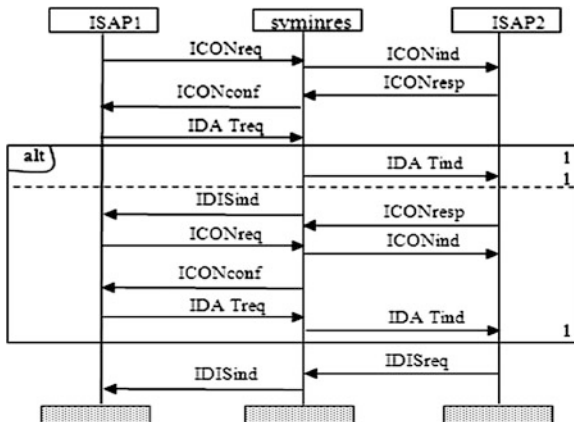
MSC reference provides the introduction of other charts which simplifies the mechanism of decomposition and reuse. However, test cases cannot be decomposed into other test cases and therefore, references are converted into function calls. To allow correct behavior of function calls by references they have to be synchronized per test component.

An appropriate translation requires synchronization before and after each inline expression to prevent cases of interleaves which cannot be solved easily. In MSC, the alternative expression can be directly mapped to TTCN-3 alternative expression behavior statement. Therefore, the first element of each alternative part has to be a reception statement according the specification of the alt statement. For each alternative of an alternative expression containing a send event as first event another test case containing this alternative is generated. The MSC optional expressions can be seen as the special case of the alternative expression with an additional empty alternative part. The empty alternative part gets realized by an else guarded empty alternative part. The loop expression can be converted onto the for and while loop statements of TTCN-3 whereby infinite loops are best mapped to while loops and finite loops to for loops.

101.3.4 Advanced MSC

Advanced MSC in TTCN-3 module control part describes the execution of test cases. MSC references including reference expression in Advanced MSC's are converted to corresponding test case execution calls and conditions and parallel frames are ignored. Each execution trace of an Advanced MSC gets collected in an own function and all functions are called in the control part. Exception expressions are used to stop further trace execution if the test case fails.

Fig. 101.3 A MSC with alt sentence



101.4 Example Study

Figure 101.3 is an MSC with an alt statement which describes the scene of the data transmission parts of INRES agreement with the network management and monitoring.

According to the method TTCN-3 test case generation based on MSC studied in the previous sections, the MSC will be transformed into TTCN-3 test as shown below:

```

testcase alt() runs on syminres{
ISAP1.send(ICONreq)
ISAP2.receive(ICONnind)
ISAP2.send(ICONresp)
ISAP1.receive(ICONconf)
ISAP1.send(IDA Treq)
alt{[] ISAP2.receive(IDA Tind)
{}
[] ISAP1.receive(IDISind)
{ISAP1.send(ICONreq)
ISAP2.receive(ICONnind)
ISAP2.send(ICONresp)
ISAP1.receive(ICONconf)
ISAP1.send(IDA Treq)
ISAP2.receive(IDA Tind)
}
ISAP2.send(IDISreq)
ISAP1.receive(IDISind)
}
}
}

```

101.5 Conclusion

Object management group (OMG) has been carrying out the research work on mapping from UML testing profile (UTP) to TTCN-3 [6]. The basic idea is to use the timing diagram and activity diagram of UML to describe the test scenario. The study shows that timing diagram can be transformed into MSC-2000, and activity diagram can be transformed into Advanced MSC. Therefore, the research on mapping MSC to TTCN-3 carries a lot more practical value. It is more direct and simpler than mapping from UTP to TTCN-3.

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Chapter 102

Risk Analysis on the Process of Energy Management Contract Project

Jing-min Wang and Liang Zhou

Abstract The energy conservation industry has played a significant role in the career of energy reduction. National policy has gradually matured in recent years, but the momentum of the industry is not as good as expected, in which risk is key to the success of the energy management contract (EMC) project. This paper summed up the risk elements of impacting EMC, based on learning the related risk research, analyzed and evaluated the risk factors using AHP, designed to provide theoretical reference for the energy management companies (EMCo) to identify risks when carrying out the EMC projects.

Keywords Energy management companies · Energy management contract · Risk · AHP

102.1 Introduction

During the Eleventh Five-Year Plan the number of China's professional energy management companies (EMCo) has grown to more than 800 while it was only 80 in 2005. The scale of the whole energy conservation service industry has also increased from 4.7 to 84 billion. However, there are risk factors restricting the rapid development of the implementation of the energy management contract (EMC). The LEPRO SEVA, a pioneer of China's energy conservation services, had faced the experience of receiving no penny and pulling back the equipment [1]. The company believes that the success of the EMC project lies in risk control.

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In view of the existing situation that risk analysis studies are quite a few, this paper would draw on the current well-considered risk analysis models, classify the risk factors in the EMCo during the implementation of EMC projects, analyze and evaluate the risk factors by using the fuzzy comprehensive evaluation method, designed to provide theoretical reference for the energy conservation companies, helping them to avoid risks as far as possible.

102.2 Energy Management Contract Model

EMCo are specialized companies based on EMC mechanism and aimed at profit. By signing a contract with units willing to engage in energy-saving, the EMCo starts to finance for the project, and provides the unit a set of energy-saving services including energy audits, project design, project financing, equipment procurement, construction, equipment installation and commissioning, personnel training, energy section confirming and guaranteeing, then recovers investment and gains profits from customers' energy-saving benefit [2].

The operation mode of EMC leads to the results that in the process of implementation of the project, all upfront capital, equipment investment, and almost all of the risk related to project implementation are borne by the EMCo. The essence of EMC is to reduce energy costs to pay for all capital and operating costs of the energy-saving projects. This energy-saving mechanism allows energy-saving units to use the future benefits of energy-saving for equipment upgrading, reducing current operating costs and improving energy utilization efficiency [3].

102.3 Risk Factors of Energy Management Contract Project

EMC project risks refer to the uncertainty during the project's option, design, construction, and operational phases [4], which include the following aspects:

1. Market risks, including adjusting policies, economic circumstances changing, and customers' integrity. Laws supporting EMC, policies not perfect, and changes in the country's macroeconomic environment may affect the implementation of the energy-saving project. Some units lacking in credibility will lead to payment risk. Many industry sources believe that, energy enterprises take over single 100 EMC projects, of which there are 95 on the money withdrawn from circulation, or even 1/3 remaining unprofitable.
2. Technical risks include advanced technology [5], operation, and maintenance. The advanced nature of the energy-saving technology is a necessity of project implementation. Trial run, the EMCo is in charge of training with the relevant technical staff of the units to ensure correct operation and maintenance of

advanced energy-saving equipment and systems. During the contract period, damage caused by the equipment or system itself, the EMCo will be responsible for the maintenance and expenses.

3. Financing risks include bank loans and guarantees. Former capital and equipment of EMC project are provided by EMCos, but currently the majority of our EMCos being operated are small, the economic strength is weak, and are unable to provide guarantees for loan security guarantees or collateral. Banks doubt the companies' credibility and provide low credit limits. The existing security also restricts the loans of small and medium-sized EMCos, increasing the difficulty of their loans. EMCo are into a financing risk.
4. Operational risks include internal management and energy-savings determination. The internal management risk refers to the risk caused by human, material, and financial resources management in the energy-saving process. The determination risk means the risk based on no uniform standard to calculate the energy savings.

102.4 Risk Assessment Based on the Analytic Hierarchy Process

The Analytic Hierarchy Process method (AHP) provides an idea that integrates different subjective judgment and gives a quantitative analysis of the results of studies and simplifies the complex system into a pairwise comparison between the various factors [6]. The AHP method can be applied to the EMC project risk analysis model of the energy conservation industry which has no unified metric ruler currently.

102.4.1 Establishing a Hierarchical Model

The structure of the EMC project risk elements is a completely independent structure, with a layer element each of which has a separate, completely different lower elements. The following is shown in Fig. 102.1.

The first level of a collection of factors: $T = \{I_1, I_2, I_3, I_4\}$

The second level of a collection of factors: $I_1 = \{P_{11}, P_{12}, P_{13}\}$, $I_2 = \{P_{21}, P_{22}\}$, $I_3 = \{P_{31}, P_{32}\}$, $I_4 = \{P_{41}, P_{42}\}$

Fig. 102.1 The hierarchical model



102.4.1.1 1–9 Ratio Scale

One-class evaluation system:

$$T = \begin{bmatrix} T & I_1 & I_2 & I_3 & I_4 \\ I_1 & 1 & 1/9 & 1/5 & 1/7 \\ I_2 & 9 & 1 & 5 & 3 \\ I_3 & 5 & 1/5 & 1 & 1/3 \\ I_4 & 7 & 1/3 & 3 & 1 \end{bmatrix} \begin{pmatrix} V & \text{weight } W \\ 0.237 & 0.039 \\ 3.409 & 0.565 \\ 0.760 & 0.126 \\ 1.627 & 0.270 \end{pmatrix} \quad (102.1)$$

Two-class evaluation system:

$$I_1 = \begin{bmatrix} I_1 & P_{11} & P_{12} & P_{13} \\ P_{11} & 1 & 5 & 7 \\ P_{12} & 1/5 & 1 & 3 \\ P_{13} & 1/7 & 1/3 & 1 \end{bmatrix} \begin{pmatrix} V & \text{weight } W \\ 3.271 & 0.731 \\ 0.843 & 0.188 \\ 0.362 & 0.081 \end{pmatrix} \quad (102.2)$$

$$I_2 = \begin{bmatrix} I_2 & P_{21} & P_{22} \\ P_{21} & 1 & 3 \\ P_{22} & 1/3 & 1 \end{bmatrix} \begin{pmatrix} V & \text{weight } W \\ 1.732 & 0.750 \\ 0.577 & 0.250 \end{pmatrix} \quad (102.3)$$

$$I_3 = \begin{bmatrix} I_3 & P_{31} & P_{32} \\ P_{31} & 1 & 1/5 \\ P_{32} & 5 & 1 \end{bmatrix} \begin{pmatrix} V & \text{weight } W \\ 0.447 & 0.167 \\ 2.236 & 0.833 \end{pmatrix} \quad (102.4)$$

$$I_4 = \begin{bmatrix} I_4 & P_{41} & P_{42} \\ P_{41} & 1 & 1/5 \\ P_{42} & 5 & 1 \end{bmatrix} \begin{pmatrix} V & \text{weight } W \\ 0.447 & 0.167 \\ 2.236 & 0.833 \end{pmatrix} \quad (102.5)$$

102.4.2 Consistency Test

1. Testing the evaluation matrix T :

To Matrix T , the weight vector $W = \{0.039, 0.565, 0.126, 0.270\}$, the maximum characteristic root $\lambda_{\max} = 4.173$; consistency index $C.I = (\lambda_{\max} - n)/(n - 1) = 0.058$; looking up table known $n = 4$, the average random consistency index $R.I = 0.89$; consistency proportional $C.R = C.I/R.I = 0.065 < 0.1$, within the permissible range, reasonable.

2. Testing the evaluation matrix I_1 :

Weight vector $W = \{0.731, 0.188, 0.081\}$, $\lambda_{\max} = 3.064$; $C.I = 0.032$; $n = 3$, $R.I = 0.52$; $C.R = 0.062 < 0.1$, within the permissible range, reasonable.

3. Testing the evaluation matrix I_2 :

Weight vector $W = \{0.750, 0.250\}$, $\lambda_{\max} = 2 = n$, without testing.
The evaluation matrix I_3 and I_4 are like the solution of I_2 .

102.4.3 Evaluation of Comprehensive Risk Degree

Forming associated matrix, listing the risk weights of elements relative to the layer and calculating the comprehensive weight. The results are shown in Table 102.1:

102.4.4 Analysis of the Results

In the second layer of the influencing factors, $P_{21} > P_{42} > P_{22} > P_{32} > P_{41} > P_{11} > P_{31} > P_{12} > P_{13}$, Advanced technology risk is the highest, followed by

Table 102.1 Associated matrixes

W	I_1	I_2	I_3	I_4	Comprehensive weight
	0.039	0.565	0.126	0.270	
P_{11}	0.731	0	0	0	0.029
P_{12}	0.188	0	0	0	0.007
P_{13}	0.081	0	0	0	0.003
P_{21}	0	0.750	0	0	0.424
P_{22}	0	0.250	0	0	0.141
P_{31}	0	0	0.167	0	0.021
P_{32}	0	0	0.833	0	0.105
P_{41}	0	0	0	0.167	0.045
P_{42}	0	0	0	0.833	0.225

energy-savings determination, operation and maintenance, bank loans, internal management, policy adjusting, guarantees, economic circumstances changing, customers' integrity. In the first layer of the influencing factors, technical risk > Market risk > operational risk > financing risks.

Technical risk is the highest risk degree in the EMC projects, which is consistent with the actual situation of China's current energy conservation industry. The success of the project is related directly to the determination of transform program, the selection of equipment and energy-saving technology. Therefore, EMCos need to consider all the aspects as far as possible, which is an effective measure to reduce the technical risk, is the foundation of the EMC project success as well.

Secondly, it is not enough to depend on the advanced technology alone, the EMC itself is a new market-oriented energy-saving mechanism, using energy costs reducing to pay the cost of energy-saving projects. It is a new energy-saving investment, putting the energy saving and environmental protection to the market. Therefore, only relying on the operation of the market can we integrate the energy conservation industry truly into the cause of our energy reduction?

In the technical risk, the advanced technology is the most important. The EMCo investigates the energy-saving status of the unit prior to the implementation of the project, but as energy-saving technology in China itself is not in the lead, the life of the energy-saving technology and new product life cycle itself is reducing over time. What's more, the general project cycle is long, once newer technology turns up, the original technology is highly likely to be replaced, thus greatly increasing the risk of the implementation of the project, which has directly impact on the efficiency and effectiveness of the EMCo.

Next, determination of energy-savings is one of the inevitable risks. As our country has no unified energy savings measurement by the standard, how to select the precise energy calculation method and how to confirm the final section of the energy reach the fixed goal are all that should be considered.

102.5 Case Authentication

In 2008, the East-screen company cooperated with and the Trane Air Conditioning Company and the GEA Cooling Tower Company, taking advantage of EMC sharing optimized integration model, investing more than 700 million, 7 years' share. They born the Shanghai Wujing Chemical Co., Ltd.'s "200,000 t/a acetate circulating water system" energy-saving technological transformation projects, succeeding saving standard coal 1,858 t per year. In 2010, the company continued in the chlor-alkali chemical air separation unit, Tianyuan factory, Huasheng plant, PVC factory, copied the air compressor waste heat recovery projects. In 2011, it implemented leak plugging the water-saving project and hydrochloric acid furnace energy-saving technological transformation project in the chlor-alkali West water system, the energy savings equivalent of standard coal 3,500 t.

The success of the East-screen company due to its EMC sharing optimized integration model, at present, general EMCos can only rely on their own single energy-saving products and technology servicing their customers. When using units require multi-faceted, multi-field, multi-system energy-saving reform, EMCo alone can barely provide a variety of energy-saving products and technologies to meet the demand of energy units. According to the needs of units, the East-screen company uses sharing optimized integration model, letting different energy-saving products manufacturers and service providers participate in energy-saving process and joint operations.

102.6 Conclusion

This paper analyzed and evaluated the risk factors in the EMC using the AHP method, adopted the success stories of the East-screen company to verify the importance of technology, capital, and other risk factors in the implementation of the project. Risk issues of EMC projects have been of public concern, to identify, research, and control risk. Reducing and even avoiding risks is critical to project success. This paper aimed to provide a theoretical reference to carry out EMC projects for EMCo in practice, improve the effectiveness of companies, and ultimately promote the vigorous development of the whole energy conservation industry.

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Chapter 103

Chinese Agricultural Industry Chain Benefit Coordination

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Abstract Constructing agricultural industry chain is currently the realistic way to solve three main agricultural issues. However, the key of stable operation of agricultural industry chain is to establish a coordination mechanism of interests which properly balances the rights of every related part. The benefit coordination of Chinese agricultural industry chain should follow the four principles, which are sharing benefit, protecting farmers, collective bargaining, and overall consideration. By the implemented subjects, whose representatives are governments, organizations, and beneficial main bodies, it use operational tools such as economy, administration, law, and morality to finally realize the interest harmony of agricultural industry chain, through the process of benefit demand, benefit distribution, and benefit coordination.

Keywords Agricultural industry chain · Coordination mechanism of interests · Principle · Basic frame

103.1 The Beneficial Main Bodies in Agricultural Industry Chain

The beneficial main body is the main body that participates in creating the value of agricultural industry chain and completes the value realization of agricultural industry chain and requires sharing the value of agricultural industry chain.

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Farmers and leading enterprises are the most important beneficial main bodies in agricultural industry chain [1]. Organization of farmer collaboration economy is representative of peasants' benefits. Because the organization played a special role in agricultural industry chain, we can view it as one of the beneficial main bodies.

Farmer is the most basic unit of economy in the agricultural industry chain, and they dispersedly work to produce primary agricultural products [2]. Through their labor, crops or breeding objects grow, develop, and mature, and then become goods for sale in the terminal market or intermediate products in next segment; organization of farmer collaboration economy lies between farmer and leading enterprise, and it is the bridge between farmer and leading enterprise. It organizes dispersed farmers to produce and represents farmers to communicate, coordinate, and negotiate with leading enterprises, and it represents farmers to participate in the profit distribution of agricultural industry chain. Leading enterprise is the main group in agricultural industry chain, and it mainly engages in the processing and marketing of agricultural products. The processing is the link in which the appreciation of produce is the largest. With the development of deep processing technology, the appreciation of produce is hundreds of times in this link. And processing have become the most important and potential link in the process of value creation of produce. Only if produce be sold in the terminal market, it can realize its value. Thus, the circulation is to complete the realization of produce value. Production—processing—circulation is the forward process of creating and realizing value, but the realization of value backward distribute into every link of creating value, which requires a fair benefit distribution mechanism to make every main body that participates in creating value share the value it deserves.

103.2 The Benefit Linking of Benefit Subjects in Agricultural Industry Chain

“Leading enterprise + farmer” and “leading enterprise + organization of farmer collaboration economy + farmer” are the two most common models of agricultural industry chain [3]. The partnerships between leading enterprises and farmers or between organizations of farmer collaboration economy and farmers, for both sides, are rooted in the pursuit of maximizing their own interests. Because of the limits of leading enterprises' own conditions or the purpose of reducing input costs, leading enterprises regard farmers as the first workshop to provide stable and qualified raw material; farmers relying on leading enterprise, have stable marketing of agricultural produce and need not worry about the difficulty to sell produce and can share part of value-added benefits. From the level of beneficial linking, there are two levels: one is the beneficial linking between leading enterprise and farmer (organization of farmer collaboration economy), and the other is the beneficial linking between farmer and organization of farmer collaboration economy. This paper mostly discusses the way of the benefit linking between

leading enterprise and farmer (organization of farmer collaboration economy). Now, there are mainly four ways of beneficial linking between leading enterprise and farmer (organization of farmer collaboration economy).

103.3 The Principle of Beneficial Coordination of Chinese Agricultural Industry Chain

103.3.1 The Principle of Benefit-Sharing

Benefit-sharing is the primary principle of beneficial coordination of Chinese agricultural industry chain. Agricultural industry chain is the cooperative game system of diverse economic main bodies. The aim is to maximize interest and cooperation is the precondition to maximize interest. Every main body of agricultural industry chain pursues the maximization of self-interest; when they realize the maximization of interest of the whole chain through correlation and synergy, there is the opposition of benefit between them. If every main body of agricultural industry chain cannot fairly share the benefit of agricultural industry chain, it happens to the benefit contradiction and benefit conflict among main bodies to affect the operation of agricultural industry chain. The main bodies of the production, processing, and current of agricultural industry chain create the value of agricultural industry chain together, and the main bodies of every link should have rights to share the benefit of agricultural industry chain, which is the precondition of the healthy and stable operation of agricultural industry chain.

103.3.2 The Principle of Protecting Farmer

Protecting farmers' interests is the basic principle of the beneficial coordination of agricultural industry chain. The target of cultivating agricultural industry chain has two levels: one is to enhance the competition ability of agriculture through the joint development of the first industry and the second industry and tertiary industry; the other is, to apply industry links to link the main bodies of the production, processing, and current into an economic union and interest union to let farmers to share the value-added of processing and current to realize continuous increase in rural incomes. Because of the significant difference of strength, information asymmetry, the peasants' weak sense of organization, and the actuality of buyer's market in produce, among the main bodies of agricultural industry chain, the farmer often receives standard form contract and leading enterprise's pricing passively. Leading enterprises, driven by interests, often keep prices down to harm the peasants' benefit by the advantage of the dominance over the agricultural industry

chain and sufficient market information. In beneficial coordination of agricultural industry chain, protecting farmers' interests sufficiently and aslant is the need of own development of agricultural industry chain.

103.3.3 The Principle of Collective Bargaining

Collective bargaining is an effective way of benefit coordination of agricultural industry chain. Because farmers' organization degree is low, for a long time, farmers only receive interest assignment passively, and the ability of tilting interest assignment to them is low, and then they have few ways to make a stand facing the behavior of damaging their own benefits. One of important reasons for this is that farmers are too dispersed to make strong power of collective bargaining. Leading enterprises are strong groups in the agricultural industry chain and have strong negotiation skills, so they can achieve larger portion in profit distribution of agricultural industry chain. To change this situation, we must increase farmer's organizing degree, so that farmers negotiate with the other main bodies in the way of collective bargaining, which is the most efficient way to ensure farmers' benefits.

103.3.4 The Principle of the Integrated

The integrated is the basic way of beneficial coordination of agricultural industry chain. We must consider the benefits of the unity and the individual, the present and the long run comprehensively, and unify arrangement and take into account the interests of all parties. The target of cultivating agricultural industry chain is realizing the maximization of every main body's interests. So the requirement of every main body's interests of agricultural industry chain should be respected, but these requirements should have respective boundaries. Any individual benefits are not above the overall benefits of the agricultural industry chain. The cultivation of agricultural industry chain is a gradual process, and the efficiency and effect of benefit coordination of the chain directly affect the process and result of cultivating agricultural industry chain. We must consider the benefit of the present and the long run, when we coordinate the interests of all parties.

103.4 Construct Benefit Coordination Mechanism of Agricultural Industry Chain

The frame of the beneficial coordination mechanism of the agricultural industry chain includes implemented subject, function object, operation instrument, and reaching goal. Implemented subject includes government, organization, and every

economic subject of the agricultural industry chain; and function object is the interests of every economic subject of agricultural industry chain; operation instrument includes the coordination of government and the coordination of organization; reaching goal is that the benefit demand of every economic subject is unobstructed, profit distribution is reasonable, benefit coordination is effective, and the interests of harmony is realized finally. Implemented subject of benefit coordination mechanism of agricultural industry chain includes each economic subject of agricultural industry chain, organization, and government. Each beneficial main body is a creator of the benefit of the chain, and they should share interests fairly and reasonably. In the realistic agricultural practice, most main bodies coordinate with other main bodies themselves. But, the coordination has every high costs, low efficiency, and inequity. Because agricultural production is fragmented, and the farmer organization degree is low, and information is asymmetric, and so on. Also this kind of coordination is essentially asymmetric. Processing and marketing also can appropriate the vast majority of the value-added income of produce, and farmers' interests often are not protected. The organization of implementing subjects is by an interest coordination group which is made up by the representatives of farmers, the rural cooperative economic organizations, and leading enterprises in the chain, and it coordinates all sorts of things in agricultural industry chain. Though this kind of coordination group is a civil society, the form of its organization is accepted by each economic entity of the chain, and it is relatively independent and authoritative, and the efficiency and effect of its coordination have increased significantly, so it also ensures that all parties are fair. For the society integrates interest, government coordinates by the laws and regulations, economic policies, and administrative interferences.

The functional object of beneficial coordination mechanism of the agricultural industry chain is the interest of each economic subject of the chain, namely, farmers' interests and leading enterprises' interests. The rural cooperative economic organization does not have own interests, and it is the spokesperson of farmers' interests.

Operation instruments of beneficial coordination mechanism of agricultural industry chain are government coordination and organization coordination. The means of government coordination are law, economic, and administrative coordinations. Organization coordination is that the coordination team organizes all parts of economic entities to have consultations and negotiations to reach consensus about interests. The key is that, all parties realize that they are in a benefit allocation and the game between them have shifted from zero-sum game to positive sum game, and establishing thoughts of win-win is the foundation to realize the interests of harmony. An aspect of organization coordination is to build contract. Contract prescribes the responsibility and obligation of every member to be clear about their cooperation process and to help the members combine their individual aims with overall goals; contract is clear about the principle of the benefit distribution and allocation of risks to make distribution more transparent, which make the operation of benefit distribution mechanism of agricultural

industry chain more fluent to meet the target of standardizing the order of agricultural industry chain and to inspire the energy of agricultural industry chain.

In the frame of this benefit coordination, the purpose of benefit coordination is to ensure that the interests of all economic entities of agricultural industry chain are fair and to realize the interest of harmony. So, the construction of benefit mechanism must be suitable to the main structure and the benefit relations, and it must regulate the behavior of the realization of all subjects' interests to prevent strong groups from appropriating weak groups' interests. The basic principles are protecting farmers' interests, safeguarding the interests of leading enterprises, and establishing the pattern of fair interests. Only if the benefit demand outlet is unobstructed, the benefit distribution is just and reasonable, and the benefit coordination is effective, we can realize this final target of the interests of harmony.

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Chapter 104

Automotive Integrated Service System

Chang-e Dou, Jing Jiang, Jiexing Wang and Wei Han

Abstract In view of the current rapid development of the automobile service industry, there is an urgent need to establish communication platform between the consumer and the server. With WebGIS technology .NET, and map network publishing tools—Super Map, we designed an Automotive Integrated Service System of Lianyungang City (AISSL). According to the overall architecture and design scheme of the system, we focus on public transportation query, lane lines simulation, quick search positioning of service sites, service enquiries, and the exchange of information between customer and service point for designing. The system integrates many service projects of automobile industries, which is convenient for people to travel and acquire the information of car scene.

Keywords WebGIS · Automotive service system · Super map · NET

104.1 Introduction

With the development of the automotive industry and people's income levels rising, customers gradually put forward higher request to the car service industry. How to understand the needs of the consumers and raise the service level is a great challenge for the auto industry in the future [1]. At present, although there are many Internet service web site map, lack for proprietary function of the car service aspects, car service information needs cannot to be contented. In order to deal with

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the situation, an Automotive Integrated Service System of Lianyungang City (AISSL) with a computer network technology and GIS technology car came into being. This paper collected car service site data and many basis of information on cars extensively. Using GIS components' development thoughts and WebGIS technology, we design an AISSL, which provides a more comprehensive change, the category, intelligence, and personalized service.

104.2 System Design

AISSL design concept is to provide better auto service information query for customer, to maximum satisfy the service information needs of owner, which provides analytical function of GIS integration for owners to search at any time and place, with the contrast of service site function, effectively resolves information block problem, then improves the whole level of service [2]. The AISSL is an automobile comprehensive service platform web site with a set of mapping service, BBS and background management function. Map service module provides basic functions and the automobile service special function for the majority of internet users, and provides excellent service. BBS module provides all kinds of information of the automobile available for the user to read. User center and blog in BBS module provide a communication place for the user. Background management module provides the convenience, improves the maintainability of the website, and reduces development costs for the management of the administrator.

104.3 System Architecture

Through combination of the WebGIS and comprehensive information database, using the .net framework, based on component technology for secondary development [3], the AISSL chooses Microsoft Visual Studio as the integrated development environment, uses SQL server database for comprehensive information storage. The system server contains maps application server, Web server, database server, the client application of JavaScript script, which makes the system more convenient and quickly reactive [4], Specific system architecture is shown in Fig. 104.1.

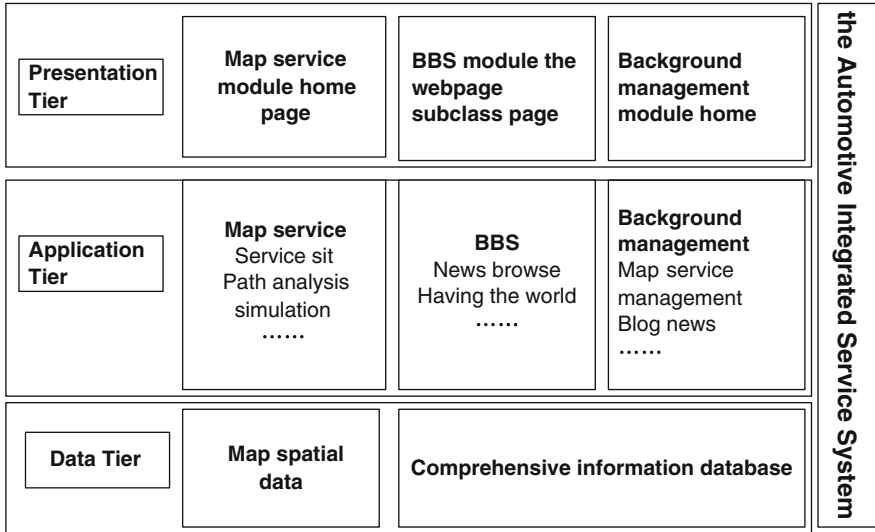


Fig. 104.1 System architecture

104.4 Function Design

104.4.1 Map Service Module Design

The Map service module mainly contains map basic functions, Lianyungang car service site search query, bus inquires the optimal path analysis, and running lines simulation, dynamic label add or remove, the weather forecast, and Google maps, the linkage of the show, and other functions.

104.4.1.1 Map Basic Functions

The basic function of the system map mainly contains: the picture show, translation, pull box amplification, pull box, click on the narrow, box choose, measuring and calculating the distance, measuring and calculating the area, and removing highlight function etc.

104.4.1.2 Map Analysis Function

Map analysis function mainly includes bus analysis, path analysis, service inquires dynamic simulation, line, Google maps, linkage map marks, etc. function.

Bus analysis:

Bus analysis function has two inquires the way: the name inquires according to coordinate and query. According to the name query, input beginning and end name, perform a search is highlighting bus lines. According to coordinate inquiry, click the map in the beginning and the end, get the beginning and the end position, click on the scheme is highlighting bus lines.

Path analysis:

Path analysis is the choice in the map in the beginning and the end, double click finish path analysis; the map highlighted the path and the results from start to finish the navigation information. If the circuit of add roadblocks, need to analyze the route to create a new optimal path.

Service inquiries:

The service inquiries mainly include: the name, according to the road and inquiries query surrounding. According to the name query, input the name of the site to inquiries, pop-up search results, and in the map highlighted the service to inquire site. According to the road inquiries, click options button, select the road on the map, pop-up inquires the results, the road on both sides of the service on the map highlighted site. Peripheral query, users search is located within the scope of certain all service site, enter a search radius, select the position of the users on the graph, pop-up search results, click search results, the system will automatically draw users and the position of the site of service between lines, to provide users with navigation; At the same time, the mouse to click the map highlighting results (4S), pop-up the service of the TAB, click on the detailed information, can view the service site home page, the user can in the evaluation for the service site, their scores to service the detailed information of the site shows and evaluation of users use similar Taobao shopping evaluation of the stars, and give the user is better experience. In addition, the process can be used in inquires generated praise figure functionality, obtain inquires the praise of the site for information chart, the system through the information shown in the chart inquires; thus, forms of data are not limited to the monotony of data, but vivid charts, and more intuitive user reactions to the site's evaluation and service information contrast for the user's choice to provide help.

Line dynamic simulation:

Lines of dynamic simulation can exist in the lines map of simulation demonstrating, intuitive dynamic for the users choose the number of lines demonstrate, demo process users can be suspended animation demo or interrupt presentation of the processing.

104.4.2 BBS Module Design

BBS module in accordance with the different function into more than one module: news module, the garage module, blog module, the user center module, web resource module, car service site information module. BBS module provides all

kinds of information from the Internet; on the major automotive BBS, the administrator can manage the renewal and the maintenance operations.

News module mainly provides the current market prices, the enterprise and the latest dynamic news information; the garage is predictable module provides transport information, buy the car with the information mainly includes: new models of the car, drive and managed, you comment on prices, the ranking, and contrast information. Transport information mainly includes: car beauty, modification, maintenance, accessories, site to recommend, insurance, traffic, policy and other information. Having provided to the blog module 1 a blog navigation and communication platform, the user center module for the already registered users to provide personal information management, head modification, password changing, published articles, receiver SMS etc. function. The network resources provide some of the network resources download. Service site module provides automotive service industry of Lianyungang all sites of detailed information, including: service site name, location, the user appraisal, and other information. In addition, the system in the BBS module design a message board function, and allow all users of the system, the content of the BUG, error messages, all attention put forward valuable opinion, convenient administrator to update maintenance.

104.4.3 Background Management Module Design

Background management module is the whole system management center, system management maintenance personnel of the administrator account login by proprietary background management system, the system module and BBS modules map data the renewal and the maintenance and operation. Background management module provides the main management function, as shown in Table 104.1.

104.5 Database Design

Standardized database must have good logic design. Standardization is a process to delete data redundancy by avoiding the same data updated in multiple locations, to improve efficiency and reduce the possibility of making mistakes. The system uses to design the standardization as a starting point, sets up much information form. According to the function of the design, the system needs the data object mainly includes regular members table, administrators data sheets, news data sheets, knowledge base data sheets, network resources data sheets, blog data sheets, books data table, service site data table, and web site information sheet parameters. Among them, the system user information mainly includes two kinds big: registered user information system and the system administrator information. Because these user information contains password information, so in the user register, system USES MD5 algorithm for the user password encryption, enhancing the

Table 104.1 Background management module mainly function

Classification management	The main management content
Web site routine management	Increase and management BBS's home page of other web site links
Column classification management	News classification management, BBS auto world class and the father module subclass management
News management module	Add, delete the news, the editor for news
The garage management module	The garage is the addition, content management
Network resource management	Add resources, resource management, series of management
Service site management	Add site, site management
Map management	The map layer display and control, the geometry object additions, mobile, updated
User management	Administrator management, member management, message management, and report to the management, comments management
Other management	Statistical information (registered users of blogs, service site, number), management log

user data security. News of the main including news data types and the main content of the news, including news type table and news content table. Knowledge is the BBS module information can say the biggest information, including the auto world module columns of information and information content classification. Do the entire module mainly includes the data table also classification of column (including column and column father classification son classification) and information table two parts. The system provides the more popular network resources (mainly for the vehicles related video) download service, and the data table mainly includes network resources type table and network resources information table, including blog information data sheets, and books recommend information form. Car service site information table can be said to be the most important system used. Mostly data table, the information is not only with the service module system. BBS site is closely related to the module, and the information value of map module is also very important. City car service system of data quantity in general or larger, in addition to the above data table outside, and some other tables, such as user message information table, user center inbox and out boxes data sheets, BBS homepage link data table, etc.

104.6 Conclusion

The system map module applied GIS function to the car service industry, and realized the interactive operation of the map data and other data. At the same time, based on component technology in the second development, the client running HTML/JavaScript packaged, the system achieves a truly WebGIS thin client idea. The client needs not to download any plug-ins, and reduces the search waiting

time, and speeds up the running speed of the system. The system also left plenty of interfaces for future optimization and expansion system function to improve the system conveniently.

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Chapter 105

Influence Factors and Countermeasures for Organization Knowledge Sharing

Baowei Zhang

Abstract Knowledge has become one of the key factors for organizations to gain competitive advantage in the era of knowledge-based economy, and knowledge sharing (KS) has turned out to be the main research points of knowledge management (KM) and knowledge innovation. Culture, organizational structure, management, and information technology are the main influencing factors affecting enterprise knowledge sharing, and proposed a range of solutions for organization knowledge sharing, knowledge innovation.

Keywords Knowledge management (KM) · Knowledge sharing (KS) · Influence factors · Business culture

105.1 Introduction

Knowledge management (KM) was taken in theory and practice seriously early, and embodied in positioning for management strategy, while there are still research limitations in making use of knowledge effectively [1]. In the period of Monopolistic Advantage Theory, Theory of Product Life Cycle, the Eclectic Theory of International Production, KM displayed one-way knowledge output, multinational companies with its abroad markets by technical know-how, management skills, and products and services. In 1996, the OECD first put forward the concept of knowledge economy and widely acknowledged. Knowledge becomes the most valuable assets of organizations. In the knowledge economy era,

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the competitive advantage of enterprises is knowledge and information, and realization of the development of enterprise lies on the knowledge accumulation, innovation, and management.

105.2 The Connotation of Knowledge Sharing

Strengthening KM is the key of achieving competitive advantage, and the core of KM is Knowledge Sharing (KS). Relevant research on KS gradually becomes the focus of KM, and gets more and more attention from scholars domestic and abroad. The model shows that the process of knowledge transformation mainly showed recycle conversion between explicit knowledge and tacit knowledge, while the process of conversion mainly includes Socialization, Externalization, Combination, and Internalization. Among these processes, Externalization, main point of KS, is important and different in KM [2]. KS refers the process that the knowledge exchange and communication within or between the organization through various channels; thus to realize the exploitation of knowledge. KS essential elements include the subjects, means, and the objects. The process of KS is the process of constant development in spiral form. KS is one of the most effective ways of realization of knowledge value [3]. Essentially, KS is the process of tacit knowledge structuralized and explicit knowledge universalized. From the perspective of content, KS is a process of tacit knowledge shifting for explicit one, while from the perspective of informatics, KS is a transforming process from data into information and then into knowledge that supports human behaviors.

Knowledge, as the product of information, intension, and value, exists in the mind, but not the collection of independent information. KS may occur in the staff as well as in the team and groups [4]. Therefore, the main body of KS lies in individuals, teams, and organizations. On the other hand, with the change of market environment and development of information and cooperative technology, in order to provide satisfactory products or services, the core department especially needs the KS with the virtual ones [5]. As the uncertainty of market environment, whether organizers choose internalization or not, they have to undertake the high transaction.

105.3 Influence Factors of KS

KS is a process that subject and object of organization communicate and exchange in software and hardware environment to promote the level of KS. And research the KS influences factors of systematically is basically useful in improving the performances of organization.

105.3.1 Organizational Culture

KS is mainly the sharing of tacit knowledge. Researches show that the tacit knowledge accounts for 90 % of individual knowledge, and explicit knowledge is accounted for little. The features of tacit knowledge make it difficult to share. The level of KS is influenced by the capability to express and acceptance of the subjects, the sharing means and so on, which are much related to organizational culture. The researches show that the organizational culture list the top among the KS influence factors. When organizational culture is in favor of KS activities, it will play the role of incentive and strengthening, promoting the KS activities.

105.3.2 Organizational Structure and Incentive Mechanism

Obliviously, the quantity of organizational structure hierarchy, feature of departments, and spreading pattern will have an effect on organization's communication, resource consumption, degree of communication convenience, and ultimately affect the KS effect and sharing level. On the other aspect, contradiction between long-term knowledge innovation and short-term knowledge service life makes it necessary to weigh the rewards against the loss because of sharing. Just as scientific incentive mechanism could promote KS, unreasonable incentive mechanism produces obstacles on KS. When participants share knowledge and get reward lower than expected, they will reduce the engagements in KS.

105.3.3 Technology Platform

Successful KS has to be completed by the aid of certain media and tools. The past decade, which also was called network economy, computer plays a more and more important role in the production and operation management. With the rapid development of computer technology and the wide used of Internet, the communication of knowledge get convenient and the advanced information technology is the important means for smooth KS. To acquire the advantages in fierce competition, the establishment of infrastructure platform for knowledge acquisition, processing, and sharing is necessary. Therefore, the soft environment such as culture and management has to be realized through the hardware tool.

105.4 Measures of Improving the Level of KS

105.4.1 Building the Culture of KS

The essence of competition under knowledge economy is talent competition, and also is the capability of learning. To gain a sound KS effect, the shared style culture is necessary. The organization culture is formed to solve the problem of survival and development, which is considered useful in following the basic faith and cognition. Terrence E. Deal and Allan A. Kennedy systematically divided the organization culture theory into five components, environment, values, hero, cultural ceremony, and cultural network. The construction of KS culture mainly lies in the management system and team atmosphere.

105.4.1.1 Perfecting the Management System

The research of New Institutional Economics shows that the lack or lag of institutions will restrict the development of the organization, as shortage of other factors of production. Therefore, the building of KS management should institutionalize every link of the system, including knowledge integration, transmission, exchange, application, and evaluation. In order to promote KS management system construction, the establishment of KM professional institutions, KS system management departmentalization, and formal knowledge communication channels turned necessary. Anyhow, the level of KS institutionalized is the symbol of KM maturity. Promotion of KS institutionalized management construction has an important significance on the development of organizations.

105.4.1.2 Building the Team Work Atmosphere

The more knowledge is shared by the people, the bigger benefit it can provide. There is a positive correlativity between sound team atmosphere and KS result. According to Sveiby and Simons [6], the establishment of KS team atmosphere, in which the members have a positive attitude toward KS is very important [6]. Team atmosphere provides employees' environment, including behavioral standards, rules, and mutual trust, which are all important factors that influence KS, plays an important role of promoting KS. Encouraging the construction of KS, free and mutual trust atmosphere can help eliminate personnel barriers in KS, actively participate in KS, and realize the effective use of knowledge.

105.4.2 Establishing Sound Organizational Structure and Incentive Mechanism

The essence of competition of knowledge economy era is a competition on management system and operation mechanism. Only by establishment of suitable incentive mechanism according with organizational structure, can it effectively condense internal members of intelligence, motivate members of the potential, and achieve the collective benefit much greater than the sum of individual. In the organization that emphasizes sharing, cooperating, and exchange, the arrangement of organization structure and construction of encouragement system is particularly important.

105.4.2.1 Constructing Sound Organizational Structure

The condition of organization structure plays a vital role in KS results, and decides the possibility of KS success in some degree. Therefore, in order to guarantee the smooth KS activities, construction of knowledge sharing organization is helpful. At present, the flattening organizations, such as matrix system, team organization, network organization and so on; type-N organization (Hedlund), type-J organization (Nonaka), cycling organization (Romme), and The Learning Organization are all set up to ensure a sound KS. These organizations structure forms are trying to find a way that offset the defects of the traditional one so as to get the flexible organizational structure of KS [7]. Of course, it is not to say, the more advanced the organizational structure the better, and only the organizational structure that suitable for operational mechanism is the best.

105.4.2.2 Establishing and Perfecting the Incentive Mechanism

The incentive mechanism based on the KS is a system about organizations and individuals achieving their goals. Emphasizing the incentive mechanism in the management system is based on the social man hypothesis. Individuals not only draw on the advantages, but also have the social tendencies, including obtaining self-understanding, getting recognized by the society and so on. The building of incentive mechanism should exploit a set of rational system to reflect the interaction mode between the object and subject, realize the optimized disposition of human resources, and the combination of personal and organizational goals. The incentive system should follow the principle of the incentive target related with KS performance, employee performances associated with team ones, and physical form matched spirit one. In pursuing personal goals, individuals realized the social identity and organizational goals.

105.4.3 Applying Appropriate Technologies for KS

KS management ultimately relies on technology to achieve the aim in addition to cultural and economic system. The information technology provide two basic capabilities for KM, knowledge coding and knowledge network. Scholars of different research fields put forward many kinds of technical solutions to help and support KS. Organizations should pay more attention to the use of information technology and construction of the cooperation and information platform, including external relation network, internal communication network, and build up the internal knowledge base and knowledge map. Through the information technology, organizations combine software environmental and hardware facilities, creating a favorable environment for sharing knowledge and promoting the knowledge inside extensive exchanges.

105.5 Conclusion

Dividing the means of KS into culture, management system, and information techniques does not mean it is not involving technology and management methods and vice versa. Among these means, an information technique is the basis for KS, providing hardware environment, while management system and organizational culture provide the soft environment. KS level is a function of each element, including organization structure, management system, organizational culture, and information technology. Although some scholars have proposed measure of the influence factors in study KS means, what relationship do these means have, and how to measure the contribution of means are still to be settled.

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Chapter 106

Dual Commitments and Knowledge Sharing in Supply Chain Collaborative Innovation

Xu-Mei Zhang, Xiao-Ping Mao and Xiang-Yu Liu

Abstract As an important part in supply chain collaborative innovation, knowledge sharing is strongly influenced by the dual commitments of employees. To achieve effective knowledge sharing in the project, the reason for employee's dual commitments is analyzed, and the employee's characteristics and knowledge sharing behavior are dissected from the perspective of project commitment and company commitment. As a result, different management strategies for self-committed employees, company committed employees, project committed employees, and dual-high committed employees are presented. It shows that the employees could be encouraged to be loyal to the project and company, and take the right knowledge sharing behavior. Finally, some insights are given to managers on project management to help them in promoting knowledge sharing.

Keywords Supply chain · Collaborative innovation · Dual commitments · Knowledge sharing

106.1 Introduction

As the knowledge economy plays an increasingly important role in the twenty-first century, in order to remain competitive in the marketplace, companies must conduct continual knowledge innovation which depends on the companies' own scarcity knowledge and the external critical knowledge obtained through knowledge sharing with outside organizations. As the supply chain turns out to be an

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important external knowledge source, more and more companies begin to carry out collaborative innovation in the supply chain in order to continuously improve their knowledge innovation capability.

Due to the fact that knowledge exists in the employee's brains, the knowledge sharing behavior of the individuals who participate in supply chain collaborative innovation projects exerts enormous influence on collaborative innovation. Employees who serve two masters that have inconsistent goals will show the characteristics of dual commitments. For example, the union members show commitment to both the union and the company, and contingent employees show commitment to their agencies and client companies [1, 2]. Meanwhile, the employees participating in supply chain collaborative innovation project display commitment to both the company and the project. Considering that the commitment of the employees have a strong influence on their knowledge sharing behavior, it is significant to conduct knowledge sharing research based on the dual commitments of the employees involved in supply chain collaborative innovation projects [3, 4].

The issue of supply chain collaborative innovation has been widely raised by researchers. Petersen et al. argued that managerial practice is critical in collaborative innovation, and they proved that the responsibility level and the opportunity that the supplier takes will affect the effectiveness of collaborative innovation heavily. They classified supplier integration into "black box" and "gray box", and proved that the impact of embeddedness with suppliers, supply base rationalization, and supplier selection on collaborative innovation (financial returns and/or product design performance) is related to the supplier integration type through using a sample of 157 firms investigating the revenue that a supplier can obtain from joining in collaborative new product developments from a dynamic, long-term perspective [5]. They found that the supplier paid more attention to the long-term proceeds, and were inclined to obtain knowledge and reputation and not the direct financial returns. The knowledge transferring (sharing) efficiency between manufacturer and supplier had a very important impact on the performance of new product development, and they came up with measures to promote knowledge sharing based on relevant factors [6, 7].

Since the innovation is implemented by the innovation team consisting of employees from different companies, and employee's knowledge sharing behavior determines the knowledge sharing efficiency in collaborative innovation project which is largely influenced by the dual commitments type of employees, it is essential to discuss the dual commitment characteristics of employees. At present, few studies except Husted's have combined dual commitments with knowledge sharing. In his study (2010), he and his partners have probed into the employees' knowledge sharing behavior of different dual allegiance types by means of analyzing the complexity of collaborative innovation management, and point out that different projects require different types of employees, suggesting choosing the suitable type of employees according to the requirements of the project [8].

While previous studies have indicated the important influence of dual commitments on knowledge sharing, little is known about the reasons for the dual

commitments or how to promote knowledge sharing [9]. The purpose of this study is to encourage employees to be loyal to both the project and their own company, and take the right knowledge sharing behavior, thus enhancing the performance of collaborative innovation projects. The analysis could help managers to understand the importance of employee's dual commitments in supply chain collaborative innovation, and could provide them with guides to promote knowledge sharing.

The remainder of this paper is organized as follows: [Sect. 106.2](#) analyzes the motivation of dual commitments. In [Sect. 106.3](#), employees are sorted into four types, and the knowledge sharing behaviors of each type are dissected. [Section 106.4](#) proposes suggestions for promoting knowledge sharing in supply chain collaborative innovation. Finally, [Sect. 106.5](#) draws the conclusions.

106.2 Analysis of the Reasons for Employee's Dual Commitments

106.2.1 The Reason to Motivate Employees' Commitment to Company

In addition to the goal of promoting project success and obtaining direct economic benefits, the company has many other goals, such as keeping internal knowledge intact and preventing knowledge leaking, gaining external knowledge to enhance the knowledge storage and to improve the company's innovation capability, and displaying the company's expertise to enhance company's reputation, and as a result, obtaining more opportunities for cooperation. Perhaps due to the responsibilities and obligations, emotional touch with the company, or keeping from losing the welfare accumulated over all these work years, employees will first show loyalty to the company in the collaborative innovation process. They are likely to focus on accessing to external knowledge rather than sharing knowledge with partners. As knowledge is important to a company, in order to protect the company's significant knowledge, the employees may ignore the project success, and refused to share knowledge which is significant to the project.

106.2.2 The Reason to Motivate Employees Being Committed to Project

By sending employees to participate in collaborative innovation projects, the company expects employees to make contributions to the project, so that they can obtain the expected benefits through the project success. Therefore, completing the project tasks becomes an urgent affair, with which the employees can realize their self-worth and be approved by the company. Thus, employees may only focus on

promoting the success of the project without paying any attention to the company's important knowledge protection or even neglecting acquiring of knowledge from the external environment. The more knowledge employees share, the more benefit the project can get, which comes because the employees will share knowledge with their partners as much as possible. What is worse, they may even ignore the company's interest by disclosing the knowledge which is vital to their company. In the long-term cooperation, employees from different companies have enough time to know each other and establish personal relationships. The factors above are likely to make employees show more commitment to the project rather than to their company.

106.2.3 The Difficulty to Balance Dual Commitments

There is the possibility that the goal of a project is inconsistent with that of the company, especially when the company wants to prevent knowledge leaking and the project needs the knowledge. It is hard for R&D employees to meet both goals when balancing between their own company and the project. Consequently, they will show asymmetry loyalty to both sides, which turns out to be either a higher project commitment, or a higher company commitment. If knowledge sharing will cause knowledge disclosure, it is not easy for the staff to choose which commitment to stick with. Lots of expertise is tacit knowledge, so precise valuation for this knowledge is almost impossible. If the employee's knowledge judgment deviates from the real value, their knowledge sharing behavior may actually be disloyal to the company even if they choose to be loyal to their own company. Hence, it is very difficult to maintain balance between the dual commitments. Therefore, high personal qualities, strong judgment ability, coordinating ability, and executive ability are all needed for employees to keep the balance well.

106.3 Characteristics of Different Types of Employees and Their Knowledge Sharing Behavior Analysis

Employees serving two masters with inconsistent goals in the supply chain collaborative innovation are likely to show imbalanced dual loyalty consciously or unconsciously, which causes negative impacts on the company and the cooperation relationship. The employee's knowledge sharing behaviors may differ with different loyal subjects as well as loyalty extent. Therefore, for better analysis of employee's knowledge sharing behavior, employees involved in the collaborative innovation are divided into four categories according to the two dimensions of company commitment and project commitment: self-committed (low company loyalty, low project loyalty), company committed (high company loyalty, low

project loyalty), project committed (low company loyalty, high project loyalty), dual-high committed (high company loyalty, high project loyalty). We will carry out a detailed analysis of the characteristics and knowledge sharing behavior of each type of employees as follows.

106.3.1 Self-Committed Employee

Self-committed employee's loyalty to the company and collaborative innovation project are both relatively low, and they put personal goals above the company and the project. They only concern their own interests and reputation in the professional field, and only regard the company's employment and participation in the project as a way to develop their personal career. Compared with the other three types, self-committed employees consider more the benefit they can get when conducting knowledge sharing, and their goal is to optimize their own interests. If the returns are not enough, they probably will refuse to share the knowledge. These employees are in the majority of those in the knowledge intensified industry. Self-committed employees may hinder knowledge sharing in collaborative innovation projects because of their self-supreme goals. However, these types of employees always possess professional skills and tacit knowledge which is vital for the project and their company. So if the project objectives are closely related to their personal goals, they will focus on innovation and share valuable knowledge with partners.

106.3.2 Company Committed Employee

Company committed employees possess high company loyalty but low project loyalty. They are highly consistent with their company and treat company goals as their own. Each project requires such employees who show a strong company loyalty, strictly implement the company's strategy, and help their own company to obtain incomes on investments. Although their starting point is fighting for company's interests, the strong sense of company loyalty often makes them confused in the process of knowledge sharing. They tend to be more cautious than other types of employees while sharing knowledge with external partners. To avoid sharing too much knowledge so as to minimize the damage to the interests of the company, they are always trying to assess the gains and losses caused by knowledge sharing more accurately, which will prevent them from effectively sharing knowledge with other companies. They may choose not to share knowledge when they cannot determine whether they should or not. If all the partners involved in the project do not share knowledge, this may lead to the failure of the innovation project, which will eventually cause loss in the company's investment and damage to the company's reputation as well. However, it is undeniable that

they are loyal to the aspects of the prevention of knowledge leaking. These employees feel very relaxed when communicating with the team members within the company, which benefits the knowledge sharing in the company's own project team, however, they cannot effectively access external knowledge that will help the company to gain external knowledge.

106.3.3 Project Committed Employee

Project committed employees possess high project loyalty and low company loyalty. They are good at socializing with partners, and play an important role in connecting the company and its partner company in the supply chain collaborative innovation. These employees are very enthusiastic about their job and devote themselves to the innovation. They give higher priority to the project goal than to the company goal. As supply chain partners may distribute throughout the country or over the world, when employees leave the company's location to participate in a collaborative innovation, the geographical distance will aggravate the difficulty of their interaction with the company, which finally leads to ignore the interests of the company. In order to promote the innovation, they may share more knowledge than they planned to, causing the company to bear a high risk of knowledge leakage. Because of their close contact with cooperation partners, it is easier to acquire knowledge from the partner than others, but they do not have the initiative to transfer the obtained knowledge back to their company. When the partner company needs their knowledge, they may even leave the original company if they think they had a better chance there. Besides, the inherent difficulties of tacit knowledge sharing raise the risk of the employee's resignation greatly. As a result, the company may lose their excellent human resource and their tacit knowledge at the same time.

106.3.4 Dual-High Committed Employee

Dual-high committed employees have both high company loyalty and project loyalty, and keep their balance well, which is the ideal employee type in collaborative innovation projects. They are concerned about the interests of their company so as to the interests of the partners, and always do their best to find a win-win solution for all parties involved. These employees own technical knowledge and economic minds, usually in a leadership position in complex collaborative innovation projects. They are skilled at deciding who and when to share knowledge and to what extent, and sharing the knowledge fully without leaking. In accordance with the business environment and the dynamic commercial value of knowledge, dual-high committed employees constantly adjust their knowledge sharing behavior. If they feel that the knowledge has important

strategic value, they tend to protect knowledge. On the contrary, they generously share knowledge with partners when the knowledge is not that important. Beyond that, dual-high committed employees have high learning skills, and are able to explore important knowledge in the project, then obtain, and transfer it back to the company.

106.4 Classified Management Strategies for Each Type of Employee

The collaborative innovation project has a complex cooperation environment where employees with different backgrounds from different companies work together, which let the management of knowledge sharing face a lot of challenges. Due to the significant impact of dual commitments on the knowledge sharing behavior, companies should identify the types of employees and organize the optimal group before sending them to participate in collaborative innovation. Staff management during the collaborative innovation process is also very important. Taking into account all these facts, it shows that companies should formulate proper management strategies for each type of employee in order to promote knowledge sharing, obtain knowledge from partner companies, and prevent knowledge leaking effectively simultaneously. With such measures, companies can achieve the successful practice of collaborative innovation project.

106.4.1 Management Strategies for Self-Committed Employees

For self-committed employees, companies always prefer to choose to guide them rather than use other methods. Companies should change those employees' cognition of knowledge sharing, let them be aware of the importance of knowledge sharing for their career, and make them initiatively conduct knowledge sharing. On the one hand, it is important to point out that knowledge sharing is not only good for the company and the project but also beneficial to themselves. For example, by contributing knowledge, the employee can obtain expert status when professional skills recognized by colleagues and experts, and can establish a good relationship that is helpful for career development, and may even get financial compensation. On the other hand, the company should help employees to be aware that continuously acquiring knowledge from outside is needed for their own development in order to fit into the rapidly changing society, and collaborative innovation projects provide an important opportunity for employees to acquire knowledge. Only by sharing knowledge with partners, can the employees gain the desired knowledge for personal professional development in the process of cooperation, and enhance their competitiveness.

106.4.2 Management Strategies for Company Committed Employees

Company committed employees are not subjectively reluctant to carry out the knowledge sharing, but result from the lack of the ability to evaluate knowledge value, and lack of self-confidence, or being excessively cautious. Therefore, the most important thing is to wipe out these obstacles to promote knowledge sharing. First of all, the company should develop a knowledge sharing guidance book that clearly defines the scope of knowledge sharing to reduce the confusion of company committed employees. Second, training should be provided to help them master the basic methods and skills of knowledge sharing, enhance the knowledge assessment ability, increase their confidence for knowledge sharing decision-making, and make them not feel anxious about sharing knowledge. Third, the company should arrange dual-high committed employees who have plentiful practical knowledge sharing experience as a mentor. If any confusion exists, company committed employees can turn to those dual-high committed employees. They can provide advice to quickly carry out knowledge sharing decision-making, and ultimately speed up the knowledge sharing efficiency. Finally, company should encourage employees to communicate with partners, in order to access external knowledge.

106.4.3 Management Strategies for Project Committed Employees

Project committed employees have the lowest loyalty to the company, and are the most likely to be inconsistent with the company's requirements. In order to promote project committed employees to share knowledge in accordance with firms' goals, measures should be taken from the following aspects. First of all, in order to prevent the disclosure of critical knowledge, before employees participate in the project, the company should furnish them with training and education including confidentiality level of knowledge, specific conduct of leakage, and punishment for disclosure. The company should ask them to maintain the critical confidential knowledge, or corresponding punishments that could be put into effect when knowledge leak occurs, which will prevent them from divulging knowledge. Second, companies should strengthen the communication channels, keeping close contact with the project committed employees, and discover the clues of knowledge leakage timely. For example, through regular communication with the Project Manager, the company could know the latest developments of employees. Third, gaining access to external knowledge is an important aspect for companies to participate in knowledge sharing in collaborative innovation projects. Project committed employees can access external knowledge more easily, so the company can use explicit incentives, such as direct money compensation and the offer of

promotion opportunities, to motivate them to transfer the obtained knowledge from the project back to the company.

106.4.4 Management Strategies for Dual-High Committed Employees

Obviously, compared with the other three employee types, dual-high committed employees perform the knowledge sharing behavior expected by the company, so that the company does not need to develop special measures to promote knowledge sharing; the company's task is to maintain the high company loyalty and high project loyalty. First of all, the company should promptly give positive feedbacks to employees who display loyalty behavior, such as verbal praises in the project meeting, making dual-high committed employees realize the company's appreciation and awareness that sharing right knowledge can bring them money, honor, status, promotion opportunities, and so on. Thus they will maintain the right knowledge sharing behavior initiatives. Second, the dual committed employees' knowledge sharing behavior can meet the company's needs best, so they are a positive model for other employees to learn. Therefore, the company should build the positive role of dual-high committed employees to drive other types of employees to share knowledge actively. The company should invite dual-committed employees to deliver a speech, and pick the typical cases to promote other employees to learn from. In this way, not only is the dual-high committed employee motivated, but also the other types of employees are encouraged to share knowledge.

106.5 Conclusion

Dual commitments of employees have an important influence on the knowledge sharing behavior, and employee's knowledge sharing behavior differs from employee's different commitment types. Therefore, companies should adopt different management strategies for self-committed employees, company committed employees, project committed employees and dual-high committed employees, guide employees to be loyal to their company and to the project simultaneously, and encourage them to effectively share knowledge without disclosure of the company's core knowledge. Thereby, companies can enhance the innovation performance and achieve a win-win situation in supply chain collaborative innovation.

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Chapter 107

Study on Management of College Automation Laboratory

Chaoran Kong, Wenbiao Huang and Wanjun Chen

Abstract With the preliminary discussion on problems of construction and management of independent college's automation laboratory, taking Zhi Jiang College for example, this article proceeds from the reality to expound measures in construction and management of the automation laboratory in order to improve students' ability and cultivate innovative talents.

Keywords Independent college · Construction of college's automation laboratory · Management of college's automation laboratory

107.1 Introduction

The independent college is one part of colleges and universities, with the goal to cultivate applied talents. Zhijiang College has built the Information engineering experimental center when it was newly established in 2002. In order to be more professional, the center has been organized into five laboratories in 2006, and they are electronic electrician practice center, computer and software specialist laboratory, electronic information engineering laboratories, communication engineering laboratories, and automation specialty laboratory.

The automation laboratory is oriented on industry demand, relies on the opening practice teaching platform, and the core is the whole four-year new system of practice teaching for automation. In the teaching process, the automation laboratory insists on the "Three Combinations" principle which means combining laboratory with subject construction, the reform of experimental teaching with the

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student's comprehensive quality and innovative ability, and the student's technology innovation with scientific research so as to promote construction and management of the demonstration center.

107.2 Problems in the Construction and Management of Independent College's Automation Laboratory

107.2.1 Created in a Short Time, Lack of Experience

The independent college in China is still new, with a history of only 10 years. Hence, the running mode, training mode, and management mechanism are still in the exploring stage. As the running time is short and its mechanism is new, the independent college is different from the traditional public schools, thus there is no existing experience to follow, which leaves the independent college with a weak foundation, though the task is urgent [1].

107.2.2 Training for the Teaching Staff of the Automatic Experiment Needs to Be Strengthened

Automation is based of automatic control theory, with the main toys of electronic technology, electronic power technology, sensor technology, computer technology, network and communication technology, and it turn in the direction of the automatic control of industrial production processes and automation in all industry and departments. Automation has distinct characteristics like combining control with management, strong electronic technology with weak electronic technology, and software with hardware, which requires that the laboratory teaching staff have good professional attainments. However, some teaching staff do not graduate from automation, and some high-level teaching staff do not pay enough attention to experiments, at the same time, they do not work carefully and confidently. The teaching staff contacts students directly, and their professional technology, ability, and quality have a great effect on cultivating student's professional skills and creative consciousness.

107.2.3 Fast Development of the College Compared to Lag in the Construction and Management of Automation Laboratory

At the beginning of constructing the independent college, most colleges first pursued the scale for its survival and did not pay enough attention to the construction and management of the automation laboratory, resulting in a small

amount of laboratories. With the fast development in the recent years, the college expanding rapidly, and the increased number of students, the original automation experiment resources already undertaken have not been able to satisfy the teaching requirements. More and more people have attached importance to the quality of higher education, and the construction and management of the automation laboratory must be raised to the height of development strategy.

107.2.4 Timeworn Contents for the Automation Experiment Teaching

At present, the contents cannot change with the reform in the curriculum system, teaching contents, and educational objectives. The experiment teaching contents are timeworn, and the new theories, new technology, and new method are not timely applied to it. The college offers less comprehensive experiments and innovative experiments than the verification experiments, and the number of experiments that has a multi-disciplinary knowledge, with the purpose of training student's innovative consciousness, ability and practice ability, aim at the frontier, and are closely related to the national economy, social development and people's livelihood is small, which interferes with the effect of experiment teaching and cultivating innovative talents [2].

107.3 The Construction of Automation Laboratory in Zhijiang College

107.3.1 Strengthen the Construction of Automation Experiment Teaching Materials

Teachers of automation should tidy up knowledge according to the information provided by manufacturers, considering the college's actual requirements and existing test equipments, and absorb other discipline's new technologies and methods actively to revise the automation experiment teaching syllabus and materials while reducing verifiable contents and increase innovative contents. In addition, teachers need to make reasonable selection and norms for the automatic control principle, electronic power technology, process control, and some other experiment projects so that they can write the experimental instruction that is suitable for students. Finally, we should also pay attention to strengthening the basic contents, adding comprehensive experiment contents, with particular emphasis on the training of student's experiment preview and design link, which means not only should we master the basic principles, measuring and experiment methods, and master and gather experience, but also highlight the training of skills and abilities in order to adapt to the needs of society.

107.3.2 Innovative Automation Experiment Teaching Content, Strengthen the Practice Links

According to the development of professional disciplines and automation and on the basis of the professional platform, automation experiment projects should try to have repetitive contents arising from settings for the curriculum and continuity of experiments. As a result, each experiment is separate and forms various function blocks, which finally forms large comprehensive experiments. It is helpful to cultivate a students' system concept and integrated innovation ability. We can also open comprehensive experiments to cultivate students' innovative thinking ability and the ability to use comprehensive knowledge to solve problems. We can open some comprehensive experiments in summer and winter vacations to cultivate students' creative thinking and ability of comprehensive experiments, and emphasize students' ability to analyze and solve problems using comprehensive knowledge.

On the basis of experiment teaching, the college should extend the teaching contents beyond the classroom and develop extracurricular academic science and technology activities and innovative activities. We also encourage students to take part in the competition related to automation major, such as the Challenge Cup Competition for national university student extracurricular academic science and technology work, electronic design contest, and so on.

107.3.3 Pay Attention to Automation Experiment Teaching Staff

The college offers automation experiment teaching staff the opportunity to learn and engage in advanced studies and organize more than 6 times training every year aiming at the characteristics of people at different levels, which fully arouses the activity of the teaching staff so that they can assume work in several related courses and serve students better. As for introduction of talent, continuative education, promotion, and performance evaluation, the college must issue a series of policies to promote the position of experiment teaching staff, perfect and establish the assessment system based on system of post responsibility, and give certain incentives to the experiment teaching staff who work well.

107.3.4 Realize Network of Automation Experiment Project

The teaching staff must use existing network resources to introduce, develop, and design several emulational experiments, such as the process control of large experiments, and so on [3]. With computer networks we can combine the experiment equipment, teaching content, teacher's instruction, and student's operation as a whole to form a workable experiment textbook. Whether teachers are present or not, students can finish all the experimental procedures, which expands space of

current experimental teaching, breaks the limits between the class teaching and extracurricular, theory, and practice and fully mobilize student's positivity to learn professional knowledge actively. Through the simulation test, students get an effect on understanding automation ideas, ways, and instrument structure and design principle that even actual experiments cannot achieve [4].

107.4 Management of Automation Laboratory in Zhijiang College

107.4.1 Establish Scientific Examination System and Standardize the Management System for Automation Experiment

Experiment examination system is an important segment to guarantee the quality of the experiment. According to the characteristics at every level in the experiment system, the automation laboratory has established a corresponding experiment examination system taking the pattern of combining the ordinary experiment and the final exam to ensure that the exam is fair. In the final exam, students extract exercises from the previous experiments and operate on the spot according to requirements. The content of the experiment test is fit to the scope of the syllabus and covers the main points in textbooks, so it is an objective examination for students' practical operation and basic knowledge. If the student flunks in the test, they cannot make up in the examination but have to learn the subject again.

Of course, a good laboratory management system is also an important part of the experiment management and teaching. For that, the college formulates comparative, complete, and scientific laboratory rules, such as the rating form for the experiment management quality in Zhijiang College of Zhejiang University of Technology, The statistical table for conditions of the laboratory in Zhijiang College of Zhejiang University of Technology, The log sheet for the running of experiments in Zhijiang College of Zhejiang University of Technology and so on. The purpose is to ensure that the automation experiment teaching is carried out on feet; all students can carry through each experiment smoothly when the laboratory is in a high load operation condition and make the systems standard and the management scientific.

107.4.2 Establish Good Opening Operation Mechanism for the Automation Laboratory

In the construction and management of automation laboratories, the college needs to specify the duties of the lab director, experiment teaching staff, and the laboratory technician in order get a clear division and improve work efficiency. To execute the related rules of the college strictly and combine the maintenance

system, compensation system, decommission system, and transfer system with personal responsibility. In addition to normal experiment teaching, the college also opens comprehensive experiments or design experiments which are related to automation majors using the spare time. Teachers or experimental teaching staff can decorate experiment exercises to students, and students can also consult the relevant material, design the plan, and prepare experiment instrument and equipment and materials according to their interests with the teacher's guidance. There is also another way that students provide novel design contents and innovative topics related to teacher's research projects, and students can form a scientific research team with teacher's guidance to conduct the research so as to cultivate student's ability to track frontier disciplines and innovate [5].

107.4.3 Clear Management of the Automation Laboratory Teaching and Embody Innovative Features in the Daily Management

The experiment teaching management is also an important part of laboratory management. Before the start of each semester the colleges will require teachers to hand in the experiment teaching plan, then give a reasonable arrangement of experiment time and place according to the curriculum contents, equipment types that the experiment requires, which can not only ensure to finish the experiment teaching task, but also make full use of the existing equipments. Before the experiment, the management personnel must check whether the experiment device and supporting equipments are complete and reliable. If there is something wrong with the experiment device, they should contact the manufacturer for servicing in time. As for problems about the experiment device during the experiment process, the teaching staff must register the fault and deal with it in time. Some students could destroy the experiment device out of curiosity or some unmoral psychology, and if the behavior cannot be found on the spot, there will be much trouble and great inconvenience to manage the laboratory once the student has left. So the laboratory has to set up a log for the service condition of experiments to record classes which have done experiments, contents, teachers, and the condition of machines everyday, which makes it convenient to find and solve problems and is also taken as a laboratory archive.

The laboratory is not only open for students whose subject is automation but for all students. As long as the experiment is related to automation, students can carry through the practical teaching link in the laboratory. Other than management methods for general laboratories, the automation lab is managed by students themselves. The student who enters the automation laboratory management team of automation laboratory has pass a comprehensive assessment and be recommended by teachers. Students who are capable and interested in automation knowledge are selected to enter the lab directly and maintain a stable number of

people in the lab. Once the staffs are determined, they will be divided into several groups; every two people and the laboratory teaching staff will connect them directly and tell them the management responsibility connection and specify the laboratory management responsibility clearly. The students are responsible for the daily management of the laboratory automation as well as fire security and safety management. As a result, students will have full autonomy to do experiments and research in the laboratory without limitations in site, time, and personnel in their spare time [6].

107.5 Conclusions

The construction of independent college's automation laboratory is a new topic, which has met with various problems on the future road. We must have a conscience and refer to brother colleges' successful experience to enhance the construction and management level of laboratories, which will help us find a characteristic way to develop the construction and management of laboratories.

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Chapter 108

Study on the Impact of Pharmaceutical Enterprises Relationship Marketing on Customer Loyalty

Huancheng Gao

Abstract The objective of this paper is to study the impact of pharmaceutical companies' relationship marketing on customer loyalty, providing references for them to select marketing strategies. The studying methods are to investigate 549 customers of pharmaceutical enterprises by self-made questionnaires and conduct statistic analysis on the collected data. The results indicate that (1) the questionnaire has both good reliability and structure validity; (2) relationship commitment has significant positive correlation with both attitudinal loyalty and behavioral loyalty, playing a significantly positive effect on their formations; (3) trust has significantly positive correlation with both attitudinal loyalty and behavioral loyalty, playing a significantly positive effect on their formations. Finally, it is concluded that the relationship marketing of pharmaceutical enterprises can improve the customer loyalty and should be paid attention to.

Keywords Pharmaceutical enterprises · Relationship marketing · Customer loyalty · Impact

108.1 Introduction

Relationship marketing derives from the mega marketing concept. Both its emergence and development benefit from the introduction of other scientific theories, mainly sourcing from the principles of Systems Theory and Cooperation Science as well as the exchange theories of Communication. Morgan and Hunt proposed the

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broadest definition on marketing, “it is all marketing activities directed towards establishing, developing, and maintaining successful relationship exchange”. Besides, they put forward the “Commitment-Trust theory” that has been recognized by a wide range of academia. They believed that the success of relationship marketing was based on intangible things such as commitment and trust, reflecting a sustainable process. This paper constructs the evaluation scale for enterprise relationship marketing using the “Commitment-Trust theory” as the theoretical foundation, studies the impact of pharmaceutical enterprises’ relationship marketing on customer loyalty through empirical methods, and expects to provide references for pharmaceutical enterprises to improve marketing strategies.

108.2 Definitions on Relationship Marketing, Customer Loyalty, and Other Related Concepts

108.2.1 Relationship Marketing

Relationship marketing derives from the mega marketing concept. In 1993, American scholar Berry first introduced relationship marketing into documents, and defined it to attract, maintain, and improve customer relationship in various service organizations from the context of service industry. Also, Some research work proposed this concept in the field of industrial marketing, and introduced relationship marketing to acquire, establish, and maintain close long-term relationships with industrial customers. From the broadest sense, Christopher and Payne defined relationship marketing as the integration of marketing, customer service, and quality management. However, Morgan and Hunt put forward the broadest definition that relationship marketing referred to all the marketing activities directed towards establishing, developing, and keeping successful relationship exchanges. Gummesson thought relationship marketing was a process of identifying, establishing, keeping, and promoting relationships with customers, as well as terminating the relationship if necessary, which could only be realized through exchanges and commitments. Additionally, the theoretical community holds the “Commitment-Trust theory” of Morgan and Hunt in great esteem. They divided the relationship impacting the success of enterprises into relationship commitment and trust, thinking relationship exchange was based on intangible things such as commitment and trust and were the key factors to explain relationship marketing connotation and impact the success of relationship marketing. The “commitment” in marketing meant that customers agreed to accept all conditions of enterprise products, demonstrated the attitude of signing psychological contracts, while trust was that customers believed that the product quality or services of the marketing enterprises always met their interests. Commitment and trust are the cornerstones of relationship marketing, and also the objectives that marketing always pursues.

108.2.2 Customer Loyalty

Loyalty refers to the undivided attention only paid to one person, thing, and material with the same single purpose. Currently, loyalty has been wildly studied in various fields [1]. The customer loyalty concept was first raised by Dick and Basu, and was preliminarily summarized as the intensity of the relationship between the attitude towards a brand and shopping behaviors. Later, there were a great number of marketing experts who supplemented to the customer loyalty definition. Griffin [1] thought loyal customers owned features such as frequently and regularly buying or being willing to buy various products or services offered by enterprises and to build the “word of mouth” reputation for enterprises, and showing indifference to the promotion activities of the same type of products or services from other brands. Neal held that customer loyalty was the proportion of how many times consumers selected the same brand of products or services in a specific product category of their total purchase amount in such a specific category. Bolton and Chen thought that loyalty has different definitions, including the aspects of behaviors, attitudes and comprehensive factors, etc. [2] defined the customer loyalty that customers still showed strong desires to continuously buying and visiting a certain enterprise or brand despite the impacts of substitutes and competitive markets, and were a high-level relationship commitment [3].

By systematically sorting out the related 300 documents, [4] found that the understandings of customer loyalty were as many as 50 different viewpoints, but actually only belonged to two kinds of methods without any speciality after summing up all of them, which were behavioral method and attitudinal method. Behavioral loyalty refers to a kind of behavior to make commitments to frequently buy products or services. Such a loyalty can be measured through indexes such as the buying amount, frequency, etc. However, attitudinal loyalty is a kind of preference and dependence on products or services. This point of view thinks that it is necessary to analyze customers’ potential attitudes and preferences besides the consideration on customers’ actual buying behaviors. The measurement indexes of the two methods include buying intention and preference degree.

108.3 Studying Methods

108.3.1 Studying Tools

In this study, questionnaire was utilized as the studying tool; the “Commitment-Trust theory” model of Morgan and Hunt was introduced into pharmaceutical enterprises relationship marketing evaluation scale. The questionnaire was parted into two dimensions of relationship commitment and trust, along with eight test questions in total. The definition of Oliver on customer loyalty was applied to customer loyalty scale, dividing customer loyalty into attitudinal loyalty and

behavioral loyalty. Attitudinal loyalty belongs to the level of consumer psychology while behavioral loyalty is their actual and repeat buying behaviors.

108.3.2 Selecting Samples and Collecting Data

700 copies of the questionnaire were distributed to their customers by combining the methods of E-mail, post office, and on-site investigation. 549 copies were actually returned, in which 542 copies were valid. The returning rate was 78.5 % and the valid rate 77.4 %.

108.3.3 Analyzing Methods

In the application of the measurement analysis model, this paper establishes the structure Eqs. (108.1) and (108.2) for the questionnaire structure:

$$\eta_1 = B\eta_1 + \Gamma\zeta_1 + \zeta_1 \quad (108.1)$$

$$\eta_2 = B\eta_2 + \Gamma\zeta_2 + \zeta_2 \quad (108.2)$$

Respectively establish the multivariate regression (108.3) and (108.4) for the impact of relationship marketing on customer loyalty and the specifics are shown as follows:

$$Y_1 = \alpha + \lambda_1 X_1 + \lambda_2 X_2 + \varphi \quad (108.3)$$

(φ is a stochastic variable)

$$\eta_2 = B\eta_2 + \Gamma\zeta_2 + \zeta_2 \quad (108.4)$$

(ε is a stochastic variable)

Then, apply Lisrel8 and SPSS16.0 to statistical analysis.

108.4 Analyses on Results

108.4.1 Inspection on the Metrology Indexes of Scale

108.4.1.1 Analyses on the Exploratory Factors of Relationship Marketing Evaluation and Customer Loyalty Scale

In the two scales, the KMO were 0.704 and the sig. were less than 0.01, indicating the two scales appropriate to carry out exploratory factor analysis, taking up 49.89 and 62.59 %, respectively, of the total variables. Two dimensions explored out in the relationship marketing scale were named as relationship commitment and trust,

Table 108.1 Analyses on the exploratory factors of relationship marketing evaluation and customer loyalty scale

Relationship marketing		Customer loyalty					
N	Relationship commitment	N	Trust	N	Attitudinal loyalty	N	Behavioral loyalty
T2	0.839	T7	0.695	X1	0.813	X6	0.809
T3	0.735	T8	0.638	X2	0.733	X5	0.772
T4	0.708	T5	0.623	X3	0.728	X4	0.727
T1	0.661	T6	0.604				

Table 108.2 Analyses on the verification factors of relationship marketing evaluation and customer loyalty scale

	χ^2/df	RMSEA	NFI	CFI
Relationship marketing	2.34	0.074	0.90	0.92
Customer loyalty	1.42	0.029	0.99	1.0

including four test questions; while the two dimensions discovered in customer loyalty scale were attitudinal loyalty and behavioral loyalty, respectively, including three test questions (Table 108.1).

108.4.1.2 Analyses on the Verification Factors of Relationship Marketing Evaluation and Customer Loyalty Scale

The verification factors in relationship marketing evaluation and customer loyalty scale were analyzed as well, to examine the structural validity of the two scales. The χ^2/df of relationship marketing was 2.34, close to 2; RMSEA was 0.074, less than 0.08; NFI was 0.90 and CFI was 0.92, both less than or equal to 0.9, indicating good fitting degree of models. However, the χ^2/df of customer loyalty was 1.42, less than 2; RMSEA was 0.029, less than 0.08; NFI was 0.99 and CFI was 1, all of which indicated a good fitting degree of models (Table 108.2).

108.4.1.3 Analyses on the Trust Degree of Relationship Marketing Evaluation and Customer Loyalty Scale

Through the analysis on relationship marketing evaluation and customer loyalty scale, it was found that the internal consistent coefficient and half-split reliability of relationship marketing were 0.762 and 0.739, respectively, and those of customer loyalty were 0.758 and 0.709, indicating good reliability of the scale (Table 108.3).

Table 108.3 Analyses on the trust degree of relationship marketing evaluation and customer loyalty scale

	Karen Bach coefficient	Half-split reliability
Relationship marketing	0.762	0.736
Customer loyalty	0.758	0.709

Table 108.4 Correlation coefficient matrixes of relationship marketing and customer loyalty

	Relationship commitment	Trust	Attitude loyalty	Behavior loyalty
Relationship Commitment	1			
Trust	0.156	1		
Attitude loyalty	0.296	0.192	1	
Behavior loyalty	0.524	0.181	0.457	1

Correlation is significant at the 0.01 level 2-tailed

108.4.2 Correlation and Regression Analyses

108.4.2.1 Correlation Analysis

After conducting correlation analysis (see Table 108.4) on relationship marketing and customer loyalty, it was found that the attitudinal loyalty and behavioral loyalty of pharmaceutical enterprises customers have significantly positive correlation ($p < 0.01$) with relationship and trust.

108.4.2.2 Multivariate Regression Analysis

In the regression Model 3, it can be seen that the standardized regression coefficient of relationship commitment to attitudinal loyalty was 0.272, sig. <0.001 , and the regression effect was significant, which indicated that relationship commitment played significantly positive effect on the formation of attitudinal loyalty; the standardized regression coefficient of trust to attitudinal loyalty was 0.150, sig. <0.001 , and the regression effect was significant as well, which indicated that trust played significantly positive effect on the formation of attitudinal loyalty.

In the regression Model 4, it can be seen that the standardized regression coefficient of relationship commitment to behavioral loyalty was 0.508, sig. <0.001 , and the regression effect was significant, which indicated that relationship commitment played significantly positive effect on the formation of behavioral loyalty; the standardized regression coefficient of trust to behavioral loyalty was 0.102, sig. <0.001 , and the regression effect was significant as well, which indicated that trust played significantly positive effect on the formation of behavioral loyalty (Table 108.5).

Table 108.5 Regression analyses on relationship marketing to customer loyalty

Model	Dependent variable	Independent variable	Unstandardized coefficients		Standardized coefficients Beta	<i>t</i>	Sig.
			B	Standard error			
Model 3	Attitudinal loyalty	(Constant)	2.254	0.157		14.321	0.000
		Relationship commitment	0.233	0.035	0.272	6.613	0.000
		Trust	0.151	0.042	0.150	3.631	0.000
Model 4	Behavioral loyalty	(Constant)	1.561	0.153		10.233	0.000
		Relationship commitment	0.470	0.034	0.508	13.774	0.000
		Trust	0.111	0.040	0.102	2.766	0.006

108.5 Discussions

108.5.1 Relationship Commitment has Positive Correlation with Attitudinal Loyalty and Behavioral Loyalty, and Plays Significantly Positive Effects on Their Formations

Loyalty means commitment, both of which are the core problems in the field of theoretical researches of relationship marketing. Relationship commitment means that there is a kind of psychological link formed between consumers and customers. Such a psychological link is just like [2] thought customers still showed strong desires to continuously buying and visiting a certain enterprise or brand despite the impacts from substitutes and competitive markets, and was a high-level relationship commitment. Also, such a commitment makes customers recognize enterprise cultures, concept values as well as the product practical values from the very bottom of their hearts, and demonstrate the high satisfaction degree. Therefore, such a demonstration will form permanent buying tendency, and subsequently making them put the buying intentions into practices from the term of behavior.

108.5.2 Relationship Commitment has Positive Correlation with Attitudinal Loyalty and Behavioral Loyalty, and Plays Significantly Positive Effects on Their Formations

Trust is another key concept in relationship marketing and also one of the important dependent variables of relationship. Additionally, many scholars put forward different points of view on the factors of the trust formation. MacNeli deemed that trust was the predictability of behavior, or the reducing of behavior uncertainty.

108.6 Conclusions

- (1) Relationship commitment has a significantly positive correlation with attitudinal loyalty, and exerts significantly positive effect on the formation of attitudinal loyalty.
- (2) Trust has a significantly positive correlation with attitudinal loyalty, and exerts significantly positive effect on the formation of attitudinal loyalty.
- (3) Relationship commitment has a significantly positive correlation with behavioral loyalty, and exerts significantly positive effect on the formation of behavioral loyalty.
- (4) Trust has a significantly positive correlation with behavioral loyalty, and exerts significantly positive effect on the formation of behavioral loyalty.

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