

Wenjiang Du
Editor

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Wenjiang Du
Editor

Informatics and Management Science III

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Preface

Welcome to the proceedings of the International Conference on Informatics and Management Science (IMS) 2012, which will be held in December 21–23, 2012, in Kunming, China.

IMS 2012 will be a venue for leading academic and industrial researchers to exchange their views, ideas and research results on innovative technologies, and sustainable solutions leading to Informatics and Management Science. The conference will feature keynote speakers, a panel discussion, and paper presentations.

The objective of IMS 2012 is to facilitate an exchange of information on best practices for the latest research advances in the area of Informatics and Management Science. IMS 2012 will provide a forum for engineers and scientists in academia, industry, and government to address the most innovative research and development including technical challenges, social and economic issues, and to present and discuss their ideas, results, work in progress, and experience on all aspects of Informatics and Management Science.

There was a very large number of paper submissions (2351). 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 614 papers for presentations, reflecting a 26.1 % 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 Informatics and Management Science.

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 enjoy the conference program, and the beautiful attractions of Kunming, China.

With our warmest regards.

December 2012

Wenjiang Du
Guomeng Dong
General and Program Chairs
IMS 2012

Organization

IMS 2012 was organized by Electric Power Research Institute, YNPG, Yunnan Normal University, Wuhan Institute of Technology, Guizhou University, Chongqing Normal University, Chongqing University, Yanshan University, Xiangtan University, Hunan Institute of Engineering, Shanghai Jiao Tong University, Nanyang Technological University, and sponsored by National Natural Science Foundation of China (NSFC). It was held in cooperation with *Lecture Notes in Electrical Engineering* (LNEE) of Springer.

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Part I
Electrical Engineering and Applications

Chapter 1

Circuit Design of Panel Points Based on Zigbee

JianMing Shen and HongLi Wei

Abstract This paper shows wireless circuit design of low-power consumption based on zigbee. SCM MSP430 which is low-power consumption serves as master control in this design. MSP430 receives humidity data transferred by SHT11 sensor. And the processed data will be transferred to wireless radio frequency SCM CC2530 through Serial Peripheral Interface (SPI). CC2530 transfers the data to coordinator through the router and finishes the transmission. This design is featured by simple structure, high stability and strong reliability. Meanwhile, the data transmission is stable, easy to be expanded and can be broadly applied.

Keywords Zigbee · Msp430 SCM · Cc2530 SCM · Humiture inspection · SHT11 sensor

1.1 Introduction

As the emergence of greenhouse, effective and accurate inspection of humidity of the greenhouse is of great significance. The original wired inspection method is both completed and expensive. The development of new wireless zigbee technology has solved the problem effectively. Zigbee is a kind of wireless communication technology which is of short distance, low consumption and low cost

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based on 802.15.4 consultative. As working environment of the circuit on panel points is relatively hard, the choice of chips is of great importance. We have adopted hardware of high stability, strong reliability and low cost as hardware of the circuit on panel points so that the circuit can work normally while transmitting data stably and accurately. What's more, they should be equipped with huge capacity of processing and available to different complex environment. Therefore, the circuit design on panel points is combination of msp430 and cc2530.

1.2 General Plan

This part contains circuit on panel points in this greenhouse inspection system. Its main task is to collect humiture data and transfer them to the sensor.

The general plan of inspection system is:

First, inspect the humiture of the greenhouse with SHT11 sensor and then transfer the data to low-consumption msp430 SCM for processing. The processed data will be transferred to wireless radio frequency SCM cc2530 through SPI interface. Finally, cc2530 will transmit the data to the coordinator through the router and the coordinator will pass the data to the upper computer to display after conducting comprehensive analysis.

The general diagram of this system is shown as Fig. 1.1.

In order to further expand the transmission sphere and reduce interference to information transmission from the surroundings, a power amplification chip CC2591 is added in. The general diagram of panel points is shown as the Fig. 1.2.

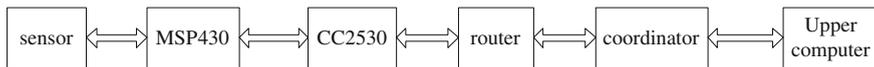


Fig. 1.1 General diagram

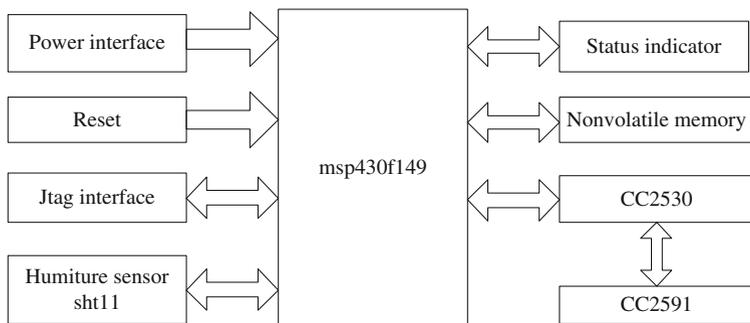


Fig. 1.2 Diagram of panel points

1.3 Hardware Circuit Design

The msp430 SCM is chosen as the main control chip in that it is a combined type of 16 bit with accurate and simple order set as well as low consumption. It came to birth in 1996 and stood out from numerous SCM because of its low consumption, rich internal and external design as well as simple and flexible developing methods. What's more, it has strong processing capability [1].

CC2530 is chosen as the wireless transmission chip in that its high selective and sensitive index can guarantee the efficiency and reliability of the transmission progress. The wireless communication equipment based on this chip can support a transfer rate of 250 kbps. Therefore, rapid automatic organization between multiple panel points can be realized.

Digital humidity sensor SHT11 is chosen for this design. It has adopted unique industrial CMOS technology, which guarantees the strong reliability and stability of the components. The features of this panel point circuit are as follows:

The inspection sphere of temperature is -40 – $+123.8$ °C, accuracy of ± 0.5 °C. The inspection sphere of humidity is 0–100 %RH, accuracy of ± 3 %RH.

The effective working time of the panel points with two dry cells is up to over 6 months.

The hardware circuit of this design is mainly consisted of power supply control module, storage module, interface circuit between main control chip msp430 and cc2530, interface circuit between msp430 and sensor SHT11 as well as relative external circuit and driving circuit.

1.3.1 Power Supply Control Module

Several module of this design calls for power supply and low-consumption is demanded. Considering this design is to be applied in outdoors, 5 V power is supplied. However, the normal working pressure of the circuit is 3.3 V, a pressure transformation is needed. TPS79533 can be adopted in the power supply circuit as shown in Fig. 1.3.

1.3.2 JTAG Interface Module

The main function of JTAG interface is to download programs and emulation debug, consisted of five pins:

TCK: inspection clock pin of JTAG; TMS: selector of TAP control module; TDI: serial data input terminal for the JTAG instruct and data register; TDO: serial data output terminal for the JTAG instruct and data register; TRST (RESET): input signal of test reset, effective in low level. Interface circuit is shown as Fig. 1.4.

Fig. 1.3 Power supply module

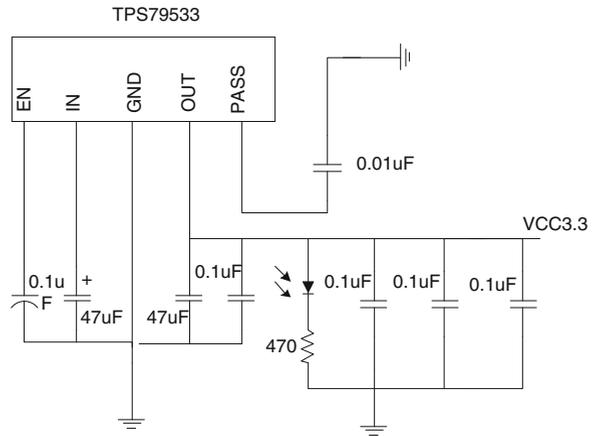
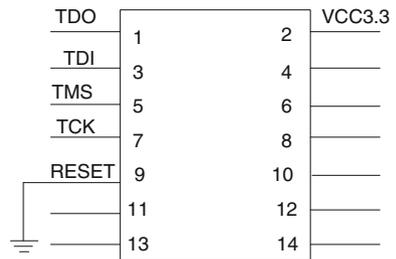


Fig. 1.4 JTAG interface circuit



1.3.3 Design of Storage Module

A piece of AT45DB041B serial FLASH is expanded as external storage in case that the internal flash of MSP430F149 is not enough. Msp430 sets the first SPI bus to connect with FLASH; therefore msp430 stays as the main module while the AT45DB041B as the lower module. The circuit of AT45DB041B module is shown as Fig. 1.5.

1.3.4 Connection of MSP430 and CC2530

MSP430F149 is quite suitable for cc2530 and the connection between the two is mainly completed by SPI interface [2]. The four signals of SPI namely, CS_n, SCLK, SI and SO connect with the micro-controller, of which three are input signals (CS_n, SCLK, SI) and the other output signal (SO). RESET_n signal is also used for power supply reset. The VREG_EN is connected to MSP430 micro-processor to control the chip at low consumption status. And the connection of GPIO interface is conducted according to specific application.

Fig. 1.5 Storage module

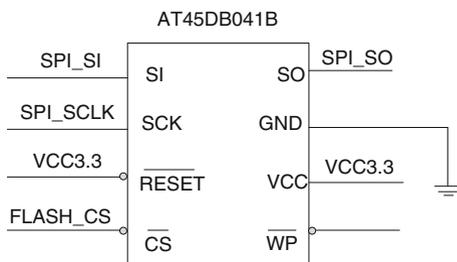
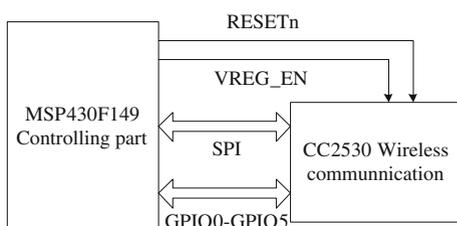


Fig. 1.6 Connecting diagram of CC2530 and MSP430



Simplified connecting diagram of CC2530 and MSP430 is shown as Fig. 1.6.

1.3.5 Connection of MSP430 and SHT11

Humiture inspection is based on the main control chip msp430 and sensor SHT11. This sensor can directly pass I2C bus and any type of micro-processor, micro-controller system thereby reducing the hardware cost in interface circuit and simplifying interface methods. The msp430 in this design is equipped with special I2C register, making the communication convenient.

The connecting diagram of MSP430 and SHT11 is shown as Fig. 1.7.

1.4 Design of Software

The general design of software works on the IAR Embedded Workbench, which is a professional embedded application developing tool equipped with C/C++ intersect compiler and debugger. This software developing workbench supports several micro-processors as well as msp430 SCM.

The software part of this design contains humiture inspection and wireless transmission. And this software is completely compiled by C Language under IAR circumstance. The process diagram of data collecting points is shown as Fig. 1.8.

The node circuit can receive data, and it also can send data.

Receiving and transmitting process diagram of the points is shown as f Fig. 1.9.

Fig. 1.7 Connecting diagram of MSP430 and SHT11

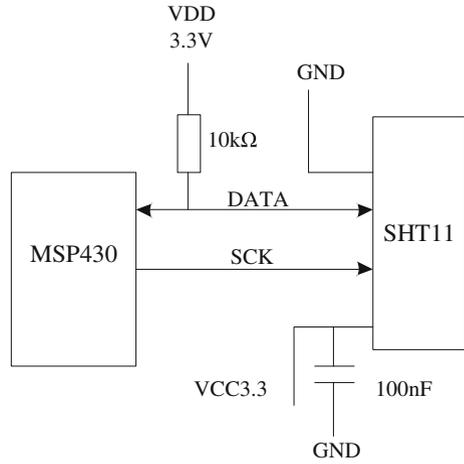
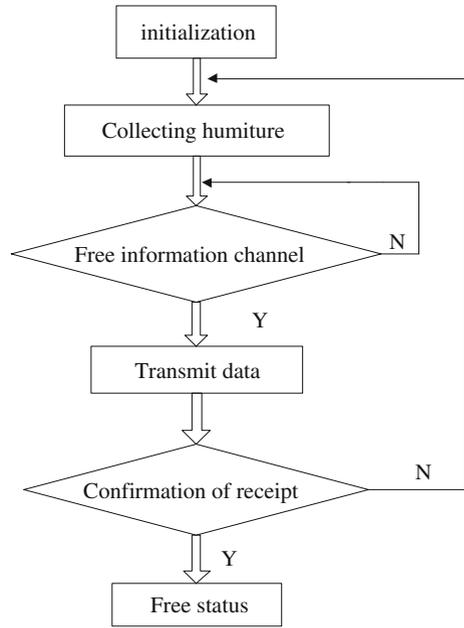


Fig. 1.8 The process diagram of data collecting points



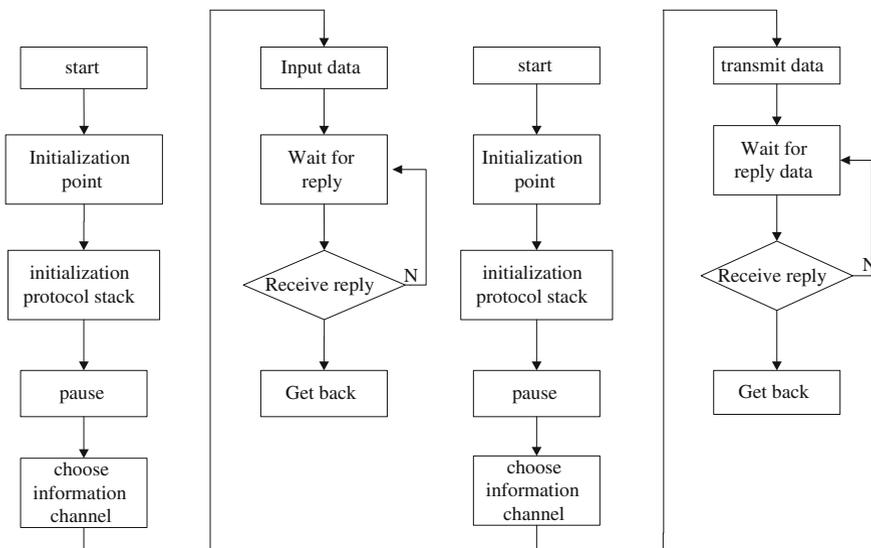


Fig. 1.9 Receiving and transmitting process diagram of the points

1.5 Conclusion

This circuit design is based on a point in zigbee humiture inspection system, whose main function is to inspect the humiture and transfer them to the coordinator and then realize transmission through sending to the upper computer [3]. With the development of zigbee technology, the wireless communication has also grown rapidly. The design of this panel point circuit is the first step of zigbee system, thereby having dramatic importance. However, this design is far from perfect, greater promotion is expected to be made in the future research so that we can achieve lower consumption, more accurate inspection and more stable communication.

References

1. Shen J, Zhai X (2005) The principles and applications of 16-bit ultra low power MCU MSP430, vol 11. Tsinghua University Publishing House, Beijing, pp 23–130
2. Simplicii TI (2009) Application programming interface. Texas Instrum 230:145–148
3. Li Y, Wang Y (2010) Digital grain temperature and humidity monitoring system. J North China Inst Aerosp Eng 5:80–89

Chapter 2

Metaphor-Based Interaction Design in Lighting Area

Xing Gao and Liangzhi Li

Abstract In this paper we present Tangible Light, a simple tangible light that use behavioral metaphor to convey meaning in its interaction design. Our purpose is to take advantage of natural physical metaphor to achieve a heightened seamlessness of interaction between people's behavior and information they want to send. At the same time we attempt to make control system invisible with embedded sensors. So here we explore a hypothesis that coupling of emotion and action in an interaction designed for metaphor and simplicity while manipulate a digital light as an instance.

Keywords Tangible interaction • Metaphor • Human senses • Intelligent lighting • Sensor technology

2.1 Introduction

In the last few decades, the trends of lighting device design are considered with more humanism and meaningful. Norman had summed up product characteristics in Emotional Design with three levels: Visceral design (Appearance), Behavioral

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design (using pleasure and effectiveness), Reflective design (Self-image, personal satisfaction, memories) [1]. Thus while thinking about interactions with objects where one communicate to use we turn to think about how to map interaction in a meaningful and comprehensive manner when manipulate objects. As machines become more and more capable, taking on many of our roles, designers face the complex task of deciding just how they shall be constructed, just how they will interact with one another and with people [1]. By the way, Bill Moggridge, the founder of IDEO, brought the conception of interaction design in the 1980s. He believes that products should have the function of interaction, which means in the using process, users can get emotionally involved through the exchange of information with products, and that designers are supposed to adopt the method of interaction design to work out a “simple, useful, and enjoyable interactive product” [2].

One prominent area where we would like to see interface expressivity thinking applied is consumer devices [1]. In this section our work is focused on exploring how to let people use their natural behaviors to communicate with the light device, instead of the traditional switch. As a prove instance, we rely on manipulate light which is an appliance that used in daily life [3]. Thus we hope to shorten the gap between a user’s goals for action and the means to execute those goals which Hutchins, Hollan, and Norman described this as the gulf of execute, which on [4].

2.1.1 Relate Work

We present several related work based on consumer device by using novel approaches to turn communication to become intuitiveness. For example, the Marble Answering Machine is a classic example which influenced many following research. The user can place the marble which hold the message onto an augmented telephone, then dialing the caller automatically [5]. Another project is focus on how to naturally control a device, for example a bottle shape is chosen, and then opening the bottle by pulling out a cork is a well-understood mechanism [6]. And That MIT Media Lab did recently is a Speak Cup, a simple tangible interface that uses shape change to convey meaning in its interaction design [7]. Other research institutes also pay attention to this promising field, such as Potsdam University of Applied Sciences explore a series of experiments in the Living Interfaces project, one part project is a door lock stalled at the inside of a domestic front door, and it remains locked until given a kiss by its owner [8]. There are various researches attend to invoke interaction metaphorically to disambiguate the users’ interpretation of how to interact with the objects.

Fig. 2.1 Natural ways to manipulate light



2.2 Tangible Light

We first imagined Tangible light during a design exercise. In the design process we challenged ourselves to create interfaces with metaphor interaction by human senses without relying on abstract buttons or blinking lights.

2.2.1 Motivation

The idea of Cornfield Light comes from our memory that when we come through the cornfield we will stroke the waves of wheat and let it follow our footsteps (Fig. 2.1).

By brainstorming alternative ways of engaging the user on a physical, physiological and mental level, we decided to use behavior like gesticulation and action like waving as a metaphor affordance for light use.

2.2.2 Interactive Design

Through this live Cornfield Light, we also try to put forward the prototype to quest for an innovative interaction design based on human behavior. In this prototype, there is a connection between human and product by making good use of the behavior. This kind of behavior comes from life experience and emotional experience of people. When people come through the cornfield they will naturally let hands on the sea of wheat and let hands waves metrically. In order to keep this kind of emotional interaction between product use and human being we explore to control a light in the same way. After doing research and talking about the aesthetics of the light, the shape of the light was designed like wheat (Fig. 2.2).

When using it, people come across to this kind of light; they will wave or touch the light naturally. At the same time, the light will turn on (Fig. 2.3).



Fig. 2.2 Cornfield Light, during experiment we design many lights in a platform to do exploration

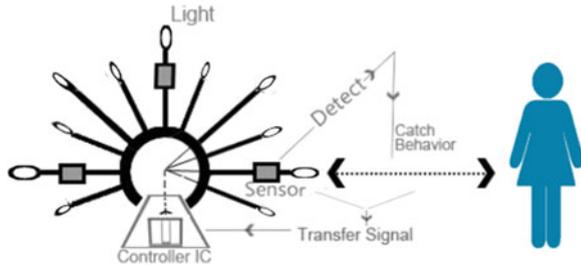


Fig. 2.3 Natural ways to manipulate light

Meanwhile in the real world, when a process that was not a focus of attention catches our interest, we are often able to seamlessly integrate it into our activity [9]. As natural behavior is a naturally element attracted by periphery sense user will subconsciously touching when use it.

Moreover during this process one thing we focus on to make the control system invisible. Mark Weiser's seminal paper on Ubiquitous mentioned: "The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it".

Fig. 2.4 System prototype



2.2.3 Implementation

The basic principle of this prototype is using the sensor to control the light's change situation. Every fluorescent light is made by a bunch of fiber which is like the plant. A color LED light is fixed at the bottom of the every fiber, and there're several sensors set both on the head and at the bottom of fibers, which are able to detect user's movement and position. Whenever people walk into it, touching the fiber, lights will be triggered, and they seem to be alive, being able to give feedback by a variety of changes according to people's location and movement, so that the interaction becomes more interesting and special (Fig. 2.4).

2.3 Tangible Light Study

We have set up the four Tangible lights beside a sofa of a drawing room for three consecutive days. Then we invited subjects for test, after that each of them did a questionnaire and all the process recorded by photos.

20 designers and 20 work staff participated in our experiment, including ten females and ten males, respectively. The 20 designers are people who work at design companies or teachers in design school. The 20 work staff is people who work in companies which have no relationship with design.

The data from the experiment is analyzed by appropriate methods then made a summary including key points from data of pictures and questionnaire (Tables 2.1 and 2.2).

Comparison the study, solutions that used metaphor tended to be more easily understood. Perhaps, this is because metaphors help the user apply analogies of structure and organization to the device, so the designer does not need to further specify the operation [1].

Table 2.1 Key summary from video data

	Designers	Work staff
Day 1	100 % subjects come across to the light and waved on the light 60 % subject interacts with the light several times Subjects felt surprise, pictures showed they all enjoyed that moment they turn on/off the light by their own natural way	
Day 2	All the subjects' wave on the light naturally. 40 % subjects interact with the light when they felt tired	
Day 3	All the subjects wave on the light naturally. 50 % subjects interact with the light when they felt tired	

Table 2.2 Key summary from questionnaire

	Designers	Work staff
	All the subjects said the device enlightened them when they did a natural gesticulation means turn on the light	
	All the subjects believed it is a natural behavior to turn on/off the light	
	All the subjects said the process they did to turn on/off the light is fitted for their emotion that their subconscious thinking	
	50 % subjects believed this relaxed use experience let them felt confident	60 % subjects believed this relaxed use experience let them felt confident
	60 % subjects were interested in this light system	50 % subjects so eager to have it that ask the price

2.4 Future Work

For further study we want to set this light in a gallery, and try to record the using experience by both artists and commercial people who have visited the gallery.

After this, a long-term study is planned. We decide to set three lights in three lights in three different places, in order to test the use experience by potential customers.

2.5 Conclusion

In this paper we add a new angle to design interaction and presented a novel interaction in which we find a natural connection between human and the device. From our testing we found that users enjoyed live natural lights. This explores guides the imagination beyond the constraints of function driven designs, and focuses on the higher level interaction design purpose and metaphors.

Acknowledgments We would like to thank our colleagues for their contributions to the prototype.

References

1. Norman DA (2005) Emotional design why we love (or hate) everyday things, vol 5(10). Basic Books, New York, pp 23–25
2. Pearce J, Rogers Y, Sharp H (2002) Interaction design beyond human-compute interaction, vol 25(11). Wiley, New York, pp 78–90
3. Ishii H (2010) Tangible bits: beyond pixels. In: TEI'08, vol 26(11), pp 98–111
4. Hutchins EL, Hollan JD, Norman DA (2008) Direct manipulation interfaces. In: Norman DA, Draper SW (eds) User centered system, Syst Control Lett, vol 15(16), pp 78–82
5. Crampton Smith G (1995) The hand that rocks the cradle. ID 23(07):60–65
6. Ishii. H, Mazalek A, Lee J (2001) Bottles as a minimal, interface to access digital information, Ext. Abstracts, CHI 2001, vol 25(12). ACM Press, Washington, pp 187–188
7. Zigelbaum J, Chang A, Gouldstone J, Monzen JJ, Ishii H (2008) SpeakCup: simplicity, BABL, and shape change. In: TEI'08, vol 14(05). ACM Press, New York, pp 145–146
8. Roy M, Hemmert F, Wettach R (2009) Living interfaces: the intimate door lock, vol 16(09). ACM, New York, pp 45–46
9. Ishii H, Ullmer B (1997) Tangible bits: towards seamless interfaces between people, bits and atoms. CHI 12(20):1–8

Chapter 3

Research on Scattering of Weekly Lossy Homogeneous Gyrotropic Elliptic Cylinder

Shi-Chun Mao, Fan Wang and Zhen-Sen Wu

Abstract A solution to the scattering properties by a weekly lossy homogeneous gyrotropic elliptic cylinder is obtained. The transmitted field of the gyrotropic elliptic cylinder under a transverse-electric illumination is presented. A first-order Taylor expansion is introduced to treat the Mathieu functions of complex arguments. The result is in agreement with that available as expected when the elliptic cylinder degenerates to a gyrotropic circular one.

Keywords Electromagnetic scattering · Lossy material · Elliptical cylinder

3.1 Introduction

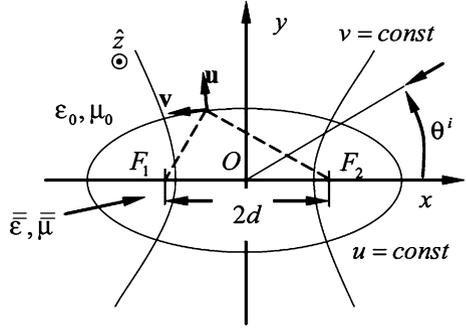
Several solutions have been reported on the two dimensional scattering by gyrotropic spheres and circular cylinders [1, 2]. The present work is to solve the scattering problem by a weekly lossy homogeneous gyrotropic elliptic cylinder. The proposed solution is based on integral equations and the classic eigenfunction expansion in elliptic coordinates in terms of Mathieu functions [3, 4]. As the subroutine for Mathieu functions of complex arguments is not available, a first order approximation

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Fig. 3.1 Geometry of the problem



of Taylor formula is introduced to treat weakly lossy materials by making use of the available subroutine (Fig. 3.1).

3.2 Formulation

Consider a homogeneous gyrotropic medium characterized by the following permittivity and permeability tensors:

$$\bar{\bar{\epsilon}} = \begin{bmatrix} \epsilon_{xx} & -j\epsilon_{xy} & 0 \\ j\epsilon_{xy} & \epsilon_{xx} & 0 \\ 0 & 0 & \epsilon_{zz} \end{bmatrix} \epsilon_r, \bar{\bar{\mu}} = \begin{bmatrix} \mu_{xx} & -j\mu_{xy} & 0 \\ j\mu_{xy} & \mu_{xx} & 0 \\ 0 & 0 & \mu_{zz} \end{bmatrix} \quad (3.1)$$

Where $\epsilon_r = \epsilon' + j\epsilon''$ ($\epsilon'' \ll \epsilon'$) is the complex relative dielectric permittivity?

Only the case of H -polarization is considered. The Magnetic field inside an elliptic cylinder in the elliptic coordinate in terms of Mathieu functions can be written as follows [5]

$$\begin{aligned} H(u, v) = & \int_{C_\theta} d\theta g(\theta) \sum_{m=0}^{\infty} j^m M c_m^{(1)}(q_1, u) c e_m(q_1, v) c e_m(q_1, \theta) \\ & + \int_{C_\theta} d\theta h(\theta) \sum_{m=1}^{\infty} j^m M s_m^{(1)}(q_1, u) s e_m(q_1, v) s e_m(q_1, \theta) \end{aligned} \quad (3.2)$$

With

$$q_2 = (kd/2)^2 = (k_1 d/2)^2 \epsilon_r \quad (3.3)$$

$$k = \left[\frac{\omega^2 \mu_{zz} (\epsilon_{xx}^2 - \epsilon_{xy}^2)}{\epsilon_{xx}} \right]^{1/2} \sqrt{\epsilon_r} = k_1 \sqrt{\epsilon_r} \quad (3.4)$$

While the coefficients $g(\theta)$ and $h(\theta)$ can be determined by the boundary condition, the range of the integral equation is periodic with period 2π , ce_m , se_m , $Mc_m^{(1)}$ and $Ms_m^{(1)}$ denote angular and radial Mathieu functions [4].

Since the subroutine for Mathieu functions of complex arguments is not available present, a first order approximation, based on their analytical properties and on the first-order Taylor formula, is adopted. That is [6]:

$$\begin{aligned} f(q, \eta) &\approx f(\operatorname{Re}(q), \eta) + \frac{\partial f}{\partial q}(\operatorname{Re}(q), \eta)(q - \operatorname{Re}(q)) \\ &\approx f(\operatorname{Re}(q), \eta) + \frac{\Delta f}{\Delta q}(q - \operatorname{Re}(q)) \end{aligned} \quad (3.5)$$

Where $\operatorname{Re}(q)$ is the real part of q , $f(q, \eta)$, $\eta = u, v$ is angular or radial Mathieu functions, $\frac{\Delta f}{\Delta q} = \frac{f(\operatorname{Re}(q) + \Delta q, \eta) - f(\operatorname{Re}(q), \eta)}{\Delta q}$. This approximation is valid only when $q - \operatorname{Re}(q)$ is small, that is for weakly lossy materials.

The tangential components of the electric and magnetic fields have to be continuous on the surface of $u = u_0$, which leads to two equations:

$$H = H^i + H^s \quad (3.6)$$

$$E_v = E_v^i + E_v^s \quad (3.7)$$

In order to solve the unknown coefficients, Galerkin's method is applied on the boundary conditions and the corresponding equations are given by

$$\int_{C_\theta} d\theta g(\theta) G_n^{(1)}(\theta) + \int_{C_\theta} d\theta h(\theta) H_n^{(1)}(\theta) = F_n^{(1)} \quad (3.8)$$

$$\int_{C_\theta} d\theta g(\theta) G_{n'}^{(2)}(\theta) + \int_{C_\theta} d\theta h(\theta) H_{n'}^{(2)}(\theta) = F_{n'}^{(2)} \quad (3.9)$$

After the unknown coefficients are solved, the electromagnetic field and the radar cross section per unit length can be calculated.

3.3 Numerical Results

The first example is provided by Fig. 3.2, when a lossless gyrotropic elliptic cylinder degenerates to a circle one. The result is in perfect agreement with that generated by circular cylinder [3].

Figure 3.3 consists of the media with \hat{x} and \hat{y} principal axes, i.e. $\varepsilon_{xy} = 0$. It shows the effects of different lossy medium parameters with the case of ε'' . Figure 3.4 shows the effects of different lossy medium parameters ε_{xy} as an imaginary number versus the scattering angle. It is observed that the loss of

Fig. 3.2 H-polarization CS, $u_0 = 6.0, d/\lambda = 1.24 \times 10^{-3}, \epsilon_{xx} = 4\epsilon_0, \epsilon_{xy} = 2j\epsilon_0, \mu_{zz} = 2\mu_0, \epsilon_r = 1.0, \theta^i = 0^\circ$

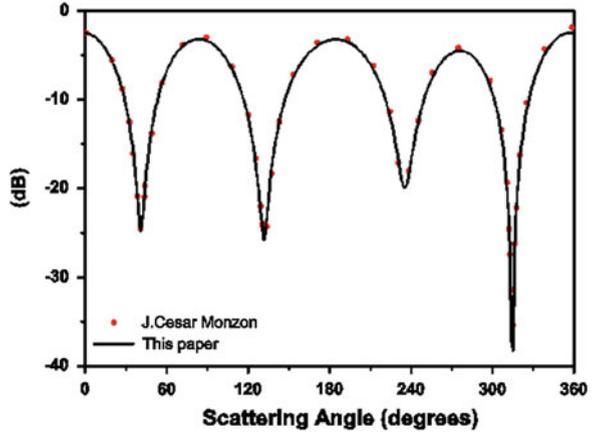


Fig. 3.3 H-polarization RCS, $u_0 = 0.2, d/\lambda = 0.4, \epsilon_{xx} = 2.0\epsilon_0, \epsilon_{xy} = 0, \mu_{zz} = 2.0\mu_0, \epsilon' = 1.0, \theta^i = 0^\circ$

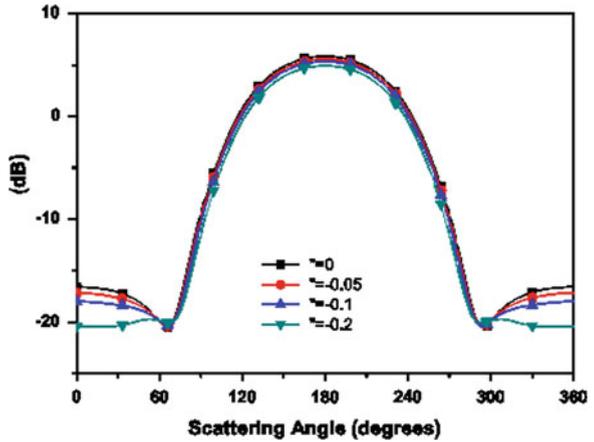
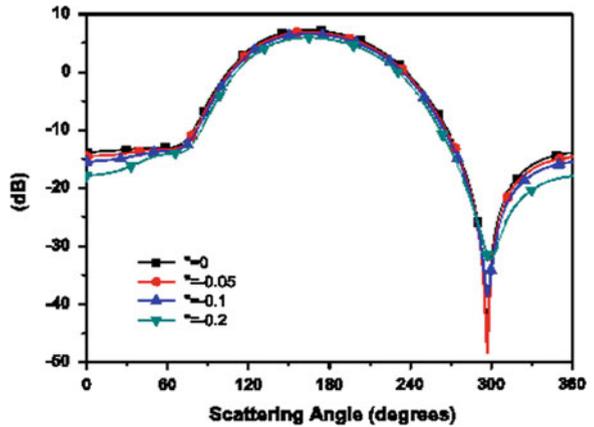


Fig. 3.4 H-polarization RCS, $d/\lambda = 0.4, u_0 = 0.2, \epsilon_{xx} = 2.0\epsilon_0, \epsilon_{xy} = j, \mu_{zz} = 2\mu_0, \theta^i = 0^\circ, \epsilon' = 1.0, \theta^i = 0^\circ$



material tend to decrease the radar cross section compared with the lossless case. It should be noted that for $\varepsilon'' \leq 0.3$ the approximation is very good agreement.

3.4 Summary

A solution to the electromagnetic scattering problem by a gyrotropic elliptic cylinder has been proposed. A first order approximation of Taylor formula is introduced to treat weekly lossy materials by making use of the available subroutine. The validity and accuracy of the numerical results are examined by making use of limiting cases such as circular cylindrical structures.

References

1. Qiu C-W, Li L-W, Yeo T-S (2005) IEEE Antennas wirel Propag Lett 4:467–468
2. Geng YL, Wu XB, Li LW, Guan BR (2005) IEEE Trans Antennas Propag 53:3982–3983
3. Monzon JC, Damaskos NJ (1986) IEEE Trans Antennas Propag 34:1243–1244
4. Blanch G (1965) In: Abramowitz M, Stegun IA (eds) Handbook of mathematical functions, vol 562. Dover Publications, New York, pp 345–346
5. Mao S-C, Wu Z-S (2008) Dark multi-soliton solutions of the nonlinear Schrodinger equation with non-vanishing boundary. J Opt Soc Am A 25:2925
6. Caorsi S, Raffetto M (1998) IEEE Trans Antennas Propag 46:1750–1751

Chapter 4

Research of Novel Circular Grating

Peng Guo, Hua Zou, Funing Chen, Chunmei Tang
and Kaixiao Zhang

Abstract Given that most of the optical systems are circularly symmetric, the Circular Dammann grating has wide application. However, its parameters' design is a hard problem which restricts its development. This paper presents a new method to optimize the design of Circular Dammann grating with introducing quantum genetic algorithm and some appropriate revises. Compared with other design methods, it has obvious advantages. At the end of this paper, the simulation results are given.

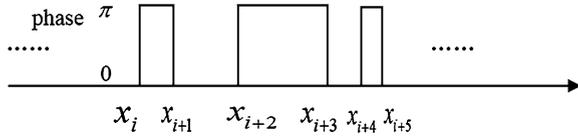
Keywords Dammann grating · Circular Dammann grating · Quantum genetic algorithm · Uniformity of thickness

4.1 Introduction

After the invention of the Dammann grating [1], it has been widely used in different field. But it produces a square diffraction field due to its structural features, while the majority of optical systems have annular symmetry structure. In this case, Zhou Changhe proposed one kind of Circular Dammann grating [2], which has broad application prospects. However, the parameters of the Circular Dammann grating are very hard to design. Simulated annealing algorithm, genetic algorithm are commonly used in many component design including the design of Dammann grating [3, 4], but the effect is not satisfied. This paper introduces quantum genetic algorithm for the design of a novel Dammann grating. During

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Fig. 4.1 The structure of the Dammann grating



operation, the algorithm can be optimized according to the actual situation, and finally, achieving satisfactory results.

4.2 The Theory of Dammann Grating

Dammann grating was first proposed by Dammann and Gortler in 1971 and used to generate the one-dimensional or two-dimensional array of equal strength beam, which can produce multiple imaging of an object. Figure 4.1 shows the structure of Dammann grating.

4.3 Circular Dammann Grating

Circular Dammann grating (CDG) evolves from Dammann grating, which can generate annular diffraction intensity distribution. CDG is usually designed to be the phase grating which has high efficiency. Usually, in order to reduce the complexity, it is binary, which means the grating phases are only 0 or π . Figure 4.2 shows the structure and some parameters of CDG.

4.4 The Grating Parameters

According to the theory of diffraction, CDG and its far-field diffraction complex amplitude satisfy the equation [5]:

$$\psi(\xi) = \sum_{j=1}^{N+1} \exp(i\phi_j) \left[r_j^2 \frac{2J_1(r_j\xi)}{r_j\xi} - r_{j-1}^2 \frac{2J_1(r_{j-1}\xi)}{r_{j-1}\xi} \right] \quad (4.1)$$

(ξ —distance from the center of the diffraction field; ϕ_j —phase of j-th ring, are 0 or π ; r_j —normalized radius of j-th ring; $J_1()$ —first order Bessel functions) $\psi(\xi)$ is the complex amplitude, so the intensity of diffraction field is?

$$I(\xi) = |\psi(\xi)|^2 \quad (4.2)$$

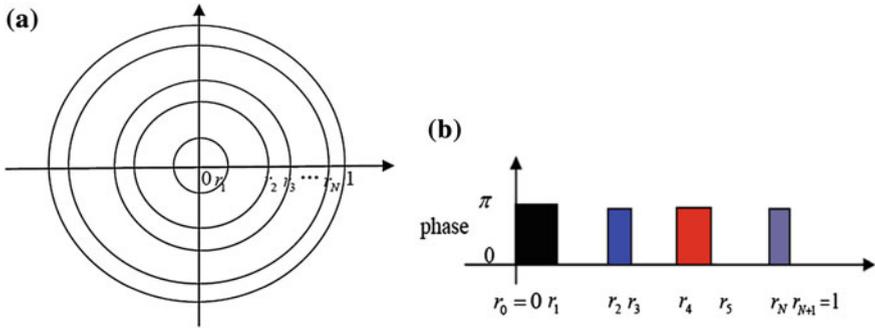


Fig. 4.2 a The structure of CDG and b phase distribution, r_i is the normalized radius

Evaluation indicators—diffraction efficiency η and uniformity g [2]. Diffraction efficiency is shown in Eq. (4.3):

$$\eta = \sum_{i=1}^M I_i / I_{total} \tag{4.3}$$

$(\sum_{i=1}^M I_i)$ —the sum of energy of the light intensity within the halo of the diffraction field, I_{total} —the total energy of the diffracted field)

Uniformity is shown as:

$$g = \sum_{i=1}^M (I_i - I_{av})^2 / \sum_{i=0}^M I_i \tag{4.4}$$

I_{av} is the average intensity, defined as

$$I_{av} = \frac{1}{M + 1} \sum_{i=0}^M I_i \tag{4.5}$$

The goal is to make the brightness of the diffraction halo as uniform as possible, in other words, making the value of uniformity g as small as possible.

From the above, the calculation of g contains first order Bessel functions and a series of logical operations (Take the judgment of I_i for example), so it is very complicated. Those traditional algorithms have their own advantages, but most of them are not very satisfied.

4.5 Quantum Genetic Algorithm

In 1994, Peter Shor proposed the quantum integer factorization algorithm, making this classic NP problem effectively solved on a quantum computer [4]. The classical algorithm can be accelerated, with introducing concepts of quantum

Table 4.1 Some parameters of optimization

Ring number	Order	Normalized radius	Uniformityg	Diffraction efficiency
2	1	0.5703, 1.0000	6.2e-004	0.70
5	4	0.1552, 0.3408, 0.4894, 0.7600, 1.0000	8.3e-004	0.88
6	5	0.1451, 0.2734, 0.4299, 0.5587, 0.7899, 1.0000	1.5e-005	0.88
14	13	0.0840, 0.1646, 0.2429, 0.2974, 0.3342, 0.3790, 0.4506, 0.5242, 0.6021, 0.6634, 0.7249, 0.7771, 0.8868, 1.0000	0.0094	0.87

computing. In 1996, Narayanan and Moore proposed quantum-inspired genetic algorithm and proved the validity in small scale TSP problems [3].

Quantum encoding can take advantage of the current optimal solution, to avoid a random direction in the process of variation in the traditional genetic algorithm, so it converges faster and better. Actual operation shows that quantum coding works well, and that it makes up for the lack of local search ability of genetic algorithm.

The crossover improves the capability of the algorithm to approach, and eventually find the optimum, and the mutation helps the algorithm quickly converge to a local optimum. When identify the current optimal solution near the global optimal solution, for example, to further optimize the already rather good result, the crossover can be reduced or eliminated. The actual operation also shows it is unnecessary for a population with too many individuals, and a population of four individuals is well.

During low-level CDG parameters' calculation, the algorithm works well. However, when the order increases to seven and more, the effect is not ideal. In

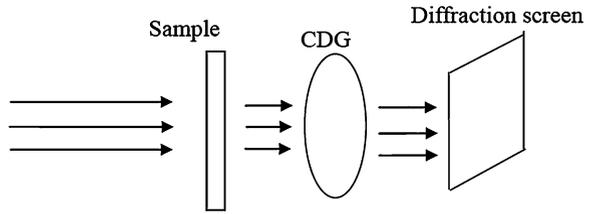
this case, $\min f(R) = \sum_{i=1}^7 (r_i - 0.4)^2$ is tested.

When other conditions remain unchanged, better results can be achieved by appropriately reducing the magnitude of the mutation.

Because the effect of this algorithm seems ideal during the operation of the program, we do not take the optimal solution in current population as the current optimal solution, but use the optimal solution has appeared since the program started as the current optimal solution instead. Due to this change, the optimal solution will not be degraded with the instability of the traditional algorithm.

When the program ends, if we are not satisfied with the result, we can regard this result as an individual of the initial population, and then re-run the program. We calculated a number of parameters, and Table 4.1 shows some of them.

Fig. 4.3 Schematic diagram of detecting the uniformity of thickness



4.6 Grating Fabrication

Binary grating is produced by etching the surface of the optical glass.

s —etching depth of the grating

n —refractive index of the grating

λ —wavelength of the incident light

In order to make the phase change π , s , n and λ meet the following relation:

$$\min f(R) = \sum_{i=1}^7 (r_i - 0.4)^2 s = \frac{\lambda}{2(n-1)} \quad (4.6)$$

If $\lambda = 632.8 \text{ nm}$ and $n = 1.61$, $s = 0.492 \text{ }\mu\text{m}$ can be calculated.

4.7 Detecting the Thickness Uniformity by Using CDG

Schematic diagram of detecting the uniformity of thickness by using CDG is shown in the Fig. 4.3. After going through the sample; incident light will produce a phase delay. In terms of the sample with same thickness, which will cause the same phase delay, regardless of any angle the sample is placed in. The final annular light field on the diffraction screen distribution looks as same as the one the sample doesn't exist. If the thickness is uneven, then the phase delay is not the same, and distribution of the annular light field will be distorted. The uniformity of sample's thickness can be testified from the degree of the distortion. Calculation with the Eq. (4.6) shows the high accuracy of the test.

4.8 Simulation Results

The simulation of intensity distribution of the light field is shown in the Fig. 4.4, which are better than others' [2].

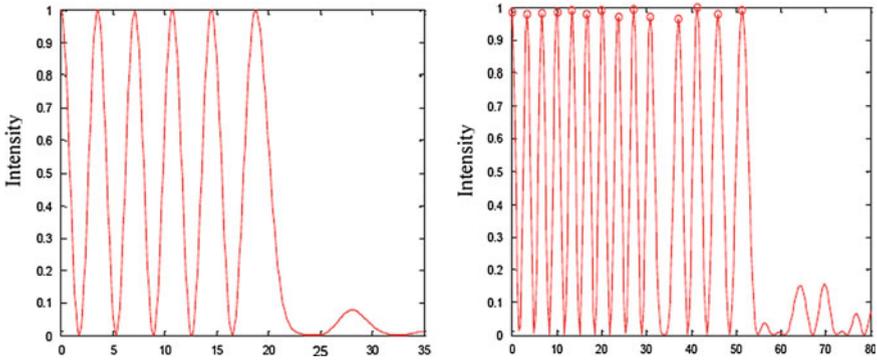


Fig. 4.4 The intensity distribution of five-order six-ring and thirteen-order fourteen-ring

4.9 Summary

The CDG can be used for long-range beam collimation, laser processing, etc. In the design of CDG, the quantum genetic algorithm shows the superiority that the traditional optimization algorithms don't have. In addition, the quantum genetic algorithm can be widely used in optimization problems.

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References

1. Dammann H, Gortler K (1971) High-efficiency in lines multiple imaging by means of multiple phase holograms. *Opt Commun* 3:312–315
2. Zhou C et al (2003) Circular Dammann grating. *Opt Lett* 28(22):2174–2176
3. Narayan A, Moore M (1996) Quantum-inspired genetic algorithms. In: *Proceedings of IEEE international conference on evolutionary computation*, Nagoya, vol 25, pp 61–66
4. Shor PW (1994) Algorithms for quantum computation//Discrete logarithms and factoring. In: *Proceedings of 35th annual symposium on foundations of computer science*. IEEE Computer Society Press, New York, vol 11, pp 124–134
5. Sales TRM, Morris G (1997) Diffractive superresolution elements. *J Opt Soc Am A* 14:1637–1646

Chapter 5

Research on Doctrine of Linear Polarized Photon Pairs

Xiaopeng Zhang and Duanyin Shi

Abstract A scholar of Peking University guessed that a single photon is left-rotating photon or right-rotating photon, and these two kinds of photon can be composed of a linear polarized photon pair. Based on this conjecture, establish respectively the wave equation of photon for the dual-slit interference and the single-slit diffraction experiments. To get respectively the light intensity distribution model with complex integration method. Finally, to get the result is to match with the result of Born through mathematical simulation in MATLAB software.

Keywords Light wave-particle duality · Photon · Light intensity distribution model · Annihilation

5.1 Introduction

The debate between the particle theory of light and the wave theory of light, started from the early seventeenth century to early twentieth century, ended with the wave-particle duality of light, going through nearly 300 years [1]. Through the efforts of some well-known physicists such as Huygens, Hooke, Newton, Thomas

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Young, Fresnel, Einstein, etc., opened the myths veil which covered ‘the nature of light’, and eventually lead to the birth of the wave-particle duality theory. Many physicists continue to be committed to explore mysteries of the wave-particle duality of light, and made some progress.

A scholar of Peking University guessed that a single photon is left-rotating photon or right-rotating photon, and these two kinds of photon can be composed of a linearly polarized photon pair. When the optical path difference of these two photons is even multiple of the unit length optical path of a single photon, they have the same phase, the photon is “apparent state”, and the light intensity is to be increased. When the optical path difference of the left-rotating photon and the right-rotating photon is odd multiple of the unit length optical path of a single photon, they have the opposite phase, the photon is “instant hidden state”, and the annihilation is to be happened.

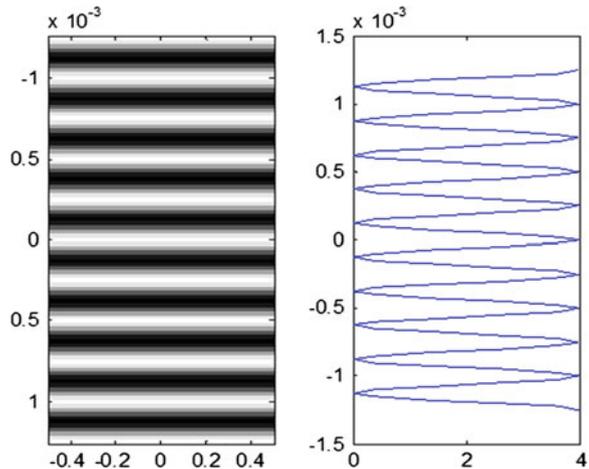
5.2 Preliminaries

5.2.1 The Classical Dual-Slit Interference Light Intensity Distribution Model

Intervention is a unique phenomenon of fluctuations, and it is a superposition result of two or limited column light waves which satisfy the coherence conditions. When these two column waves overlap, it will form a stable periodic distribution in space and appear light and dark stripes (see Fig. 5.1).

Let φ_1 and φ_2 to be respectively the initial phase of two point wave source, let P to be any point in time and space. Then, $U_1(P)$ and $U_2(P)$ are respectively the

Fig. 5.1 Double-slit interference



vibration of the point P when two waves exist independently, $A_1(P)$ and $A_2(P)$ are respectively the amplitude of point P . The conclusion is [2]:

$$\begin{cases} U_1(P) = A_1(P)\cos(\omega t + \varphi_1) \\ U_2(P) = A_2(P)\cos(\omega t + \varphi_2) \end{cases} \quad (5.1)$$

The following in a complex domain to push this conclusion,

$$\begin{cases} \tilde{U}_1(P) = A_1(P)e^{i\varphi_1(P)} \\ \tilde{U}_2(P) = A_2(P)e^{i\varphi_2(P)} \end{cases} \quad (5.2)$$

$$\tilde{U}(P) = \tilde{U}_1(P) + \tilde{U}_2(P) = A_1(P)e^{i\varphi_1(P)} + A_2(P)e^{i\varphi_2(P)} \quad (5.3)$$

By the intensity is proportional to the square of amplitude, then

$$I(P) = \tilde{U}(P)\tilde{U}^*(P) = [\tilde{U}_1(P) + \tilde{U}_2(P)][\tilde{U}_1^*(P) + \tilde{U}_2^*(P)] \quad (5.4)$$

$$= [A_1(P)]^2 + [A_2(P)]^2 + A_1(P)A_2(P)(e^{i\varphi_1 - i\varphi_2} + e^{-i\varphi_1 + i\varphi_2}) \quad (5.5)$$

$I(P)$ is the intensity of the point P after the two waves interference. Intervention must meet the same frequency and the same initial amplitude, then

$$I(P) = 4I_0 \cos^2\left(\frac{\pi dp}{\lambda}\right) \quad (5.6)$$

$$p \equiv \sin \theta - \sin \theta_0 \quad (5.7)$$

In Eqs. 5.6 and 5.7, I_0 is the intensity of the center point, d is the spacing of diffraction slit, dp is the optical path difference of two column waves, θ_0 is the angle of the incident beam and the normal of the diffraction grating surface, θ is the angle of the diffracted beam and the normal of the diffraction grating surface.

5.2.2 The Classical Single-Slit Diffraction Light Intensity Distribution Model

In addition to the interference, another important feature of the fluctuations is the diffraction phenomenon (see Fig. 5.2). The following is showed the single-slit diffraction light intensity distribution. Here, we still use the complex integration method to derive the light intensity distribution. According to the Fresnel-Kirchhoff formula [3]

$$\tilde{U}(\phi) = \frac{-i}{\lambda f} \iint \tilde{U}_0 e^{ikr} dx dy \quad (5.8)$$

Fig. 5.2 Single slit diffraction

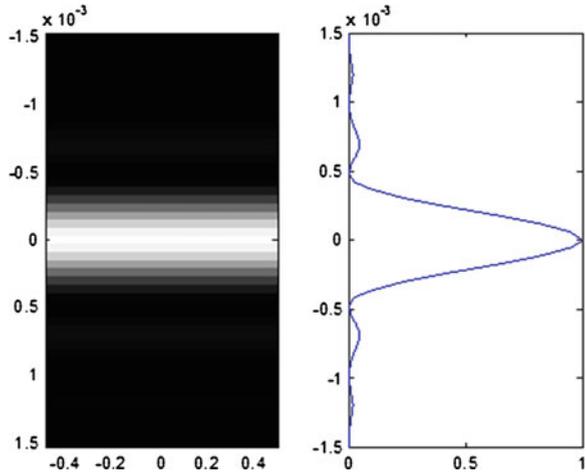
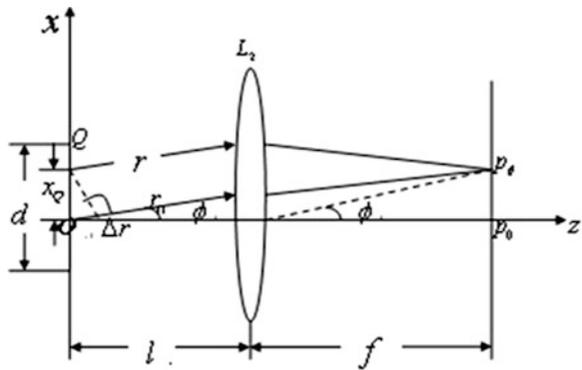


Fig. 5.3 Single slit diffraction principle



In Eq. 5.8, r is the optical path from point Q whose coordinate is x_Q to the point P_ϕ . Figure 5.3 shows:

$$\Delta r = r - r_0 = -x_Q \sin \phi \tag{5.9}$$

Integral of Eq. 5.8, C is a constant which is independent of x :

$$\begin{aligned} \tilde{U}(\phi) &= C \int_{-d/2}^{d/2} e^{ik\Delta r} dx = C \int_{-d/2}^{d/2} \exp(-ik \sin \phi) dx \\ &= 2C \frac{\sin \frac{\pi d \sin \phi}{\lambda}}{\frac{\pi d \sin \phi}{\lambda}} = 2C \frac{\sin \frac{\pi dp}{\lambda}}{\frac{\pi dp}{\lambda}} \end{aligned} \tag{5.10}$$

Due to $I(P) = \tilde{U}(P)\tilde{U}^*(P)$, so

$$I(P) = I_0 \left(\frac{\sin \frac{\pi dp}{\lambda}}{\frac{\pi dp}{\lambda}} \right)^2 \tag{5.11}$$

Equation 5.11 shows that the light intensity distribution has a relationship with the width of single slit and the wavelength. When the width of single slit is narrower, the diffraction phenomenon is more obvious.

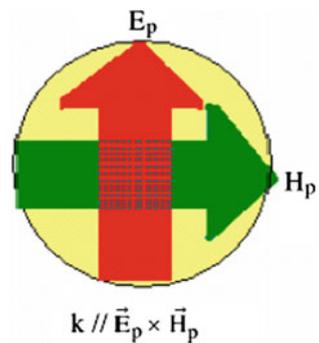
5.3 Mathematical Modeling Based on the Doctrine of Polarized Photon Pairs

A scholar of Peking University guessed that photon is the electromagnetic field which advances with a straight-line by the light speed, and all photons have the equal speed. A single photon is left-rotating photon or right-rotating photon, and these two kinds of photon can be composed of a linear polarized photon pair. When the optical path difference of these two photons is even multiple of the unit length optical path of a single photon, they have the same phase, the photon is “apparent state”, and the light intensity is to be increased. When the optical path difference of the left-hand photon and the right-hand photon is odd multiple of the unit length optical path of a single photon, they have the opposite phase, the photon is “instant hidden state”, and the annihilation is to be happened.

5.3.1 The Dual-Slit Interference Light Intensity Distribution Model of the Polarized Photon Pairs Doctrine

Since photon is the minimum unit of the classical electromagnetic field energy it is reasonable to assume that a photon consists of electric field vector matter E_p and

Fig. 5.4 Classical structure of single photon



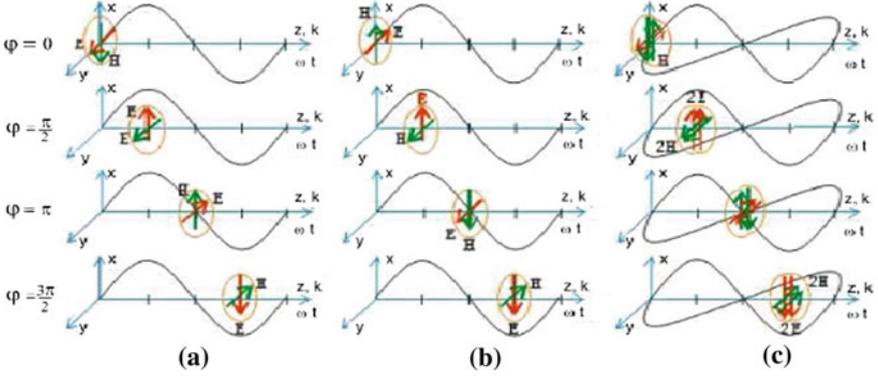


Fig. 5.5 Classical picture of wave-particle duality of a single-photon **a** Left-rotating photon **b** Right-rotating photon **c** Linear polarized photon pair

magnetic field vector matter H_p with $H_p \perp E_p$, E_p and H_p overlapping at the same spherule space. We denote the orientations of the electric and magnetic field vector matter by a red and green arrow respectively as shown in Fig. 5.4. The wave vector k can also be ascribed to individual photon, thus the energy flow of a photon $S_p = E_p \times H_p$ along the k direction [4].

Since the spin angular momentum of photon is $J = \pm\hbar$, this suggests that there is neither unpolarized photon nor linear polarized photon in our realistic world, so only exist right-hand circular polarized and left-hand circular polarized photons corresponding respectively to the helicity values $\Lambda = +1$ and -1 . The right (left)-hand circular polarized light consists of right (left)-rotating photons, while the linear polarized light is synchronously synthesized from coherent left-rotating and right-rotating photon pairs(see Fig. 5.5).

Let P to be any point in time and space, $U_1(P)$ and $U_2(P)$ are respectively the vibration of the point P when left-hand or right-hand photon move to it separately. $A_1(P)$ and $A_2(P)$ are respectively the amplitude of point P , ω is an angular velocity. In the dual-slit interference experiment, let the rotating optical path of a single photon with unit length to be 2π , so the optical paths of left-hand and right-hand photons through the two slits are $2\pi R_1$ and $2\pi R_2$. To establish the wave equation:

$$\begin{cases} U_1(P) = A_1(P)\cos(\omega t + 2\pi R_1) \\ U_2(P) = A_2(P)\cos(\omega t + 2\pi R_2) \end{cases} \quad (5.12)$$

The following in a complex domain to push the conclusion similar to Eq. 5.2:

$$\begin{aligned} I(P) &= \tilde{U}(P)\tilde{U}^*(P) = [\tilde{U}_1(P) + \tilde{U}_2(P)][\tilde{U}_1^*(P) + \tilde{U}_2^*(P)] \\ &= [A_1(P)]^2 + [A_2(P)]^2 + A_1(P)A_2(P)(e^{i2\pi(R_1-R_2)} + e^{-i2\pi(R_1-R_2)}) \end{aligned} \quad (5.13)$$

$I(P)$ is the intensity of the point P after the two waves interference. Intervention must meet the same frequency and the same initial amplitude, then

$$I(P) = 4I_0 \cos^2\left(\frac{dp}{2R}\right) \quad (5.14)$$

$$dp = 2\pi|R_1 - R_2| \quad (5.15)$$

5.3.2 *The Single-Slit Diffraction Light Intensity Distribution Model of the Polarized Photon Pairs Doctrine*

In the single-slit diffraction experiment, let the rotating optical path of rotating optical path of a single photon with unit length to be 2π , so the optical paths of left-hand and right-hand photons through the two slits are $2\pi R_1$ and $2\pi R_2$. To establish the wave equation:

$$\begin{cases} U_1(P) = A_1(P)\cos(\omega t + 2\pi R_1) \\ U_2(P) = A_2(P)\cos(\omega t + 2\pi R_2) \end{cases} \quad (5.16)$$

Similarly, using the complex integration method to derive the intensity distribution model:

$$I(P) = I_0 \left(\frac{\sin \frac{\pi dp}{\lambda}}{\frac{\pi dp}{\lambda}} \right)^2 = I_0 \left(\frac{\sin \frac{dp}{2R}}{\frac{dp}{2R}} \right)^2 \quad (5.17)$$

5.4 Mathematical Simulation

5.4.1 *Simulating the Results of Dual-Slit Interference of Light Intensity Distribution Model Based on the Polarized Photon Pairs Doctrine*

According to the light intensity distribution model, the following to do the simulation experiment in MATLAB software [5], to analyze the experimental result, and to compare with Born model. Let $d = 0.002m$ in Eqs. 5.6 and 5.14, then calculating the result of the intensity distribution function (see Fig. 5.6, the second figure is the result of Born).

Figure 5.6 shows that the result is to match with the result of Born.

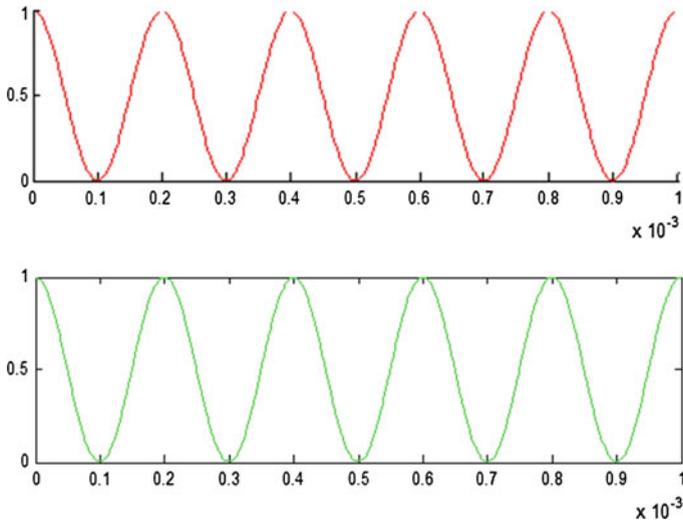


Fig. 5.6 Simulation the results of dual-slit interference

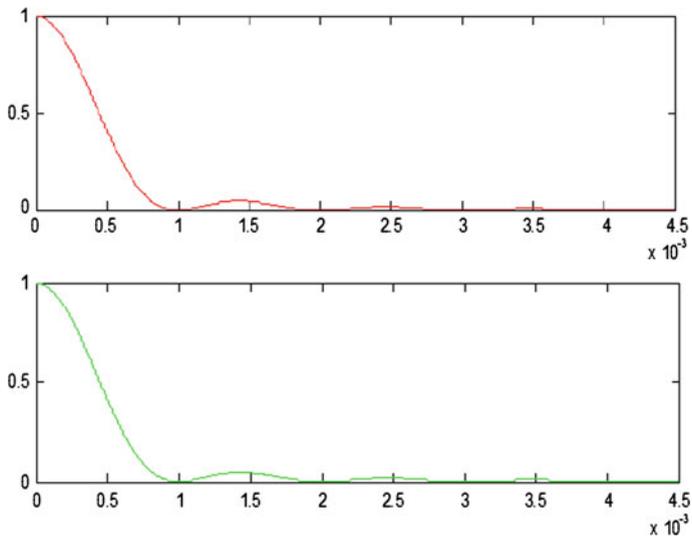


Fig. 5.7 Simulation the results of single-slit diffraction

5.4.2 Simulating the Results of Single-Slit Diffraction of Light Intensity Distribution Model Based on the Linear Polarized Photon Pairs Doctrine

According to the light intensity distribution model, the following to do the simulation experiment in MATLAB software, to analyze the experimental result, and to compare with born model. Let $d = 0.002m$ in Eqs. 5.11 and 5.17, then calculating the result of the intensity distribution function [6] (see Fig. 5.7, the second figure is the result of Born).

Figure 5.7 shows that the result is to match with the result of Born.

5.5 Summary

According to the conjecture of the scholar of Peking University, First to establish respectively the equation of photon movement for the dual-slit interference and single slit diffraction experiments. Then get respectively the light intensity distribution model using complex integration method. Finally, to get the results are to match with the results of Born through mathematical simulation in MATLAB software.

References

1. Fang W, Xiao X (2008) The debate between the particle theory of light and the wave theory of light. *Phys Eng* 18:55–58
2. Born M, Wolf E (2001) *Principles of optics*. Cambridge University Press, Cambridge
3. Abedin KM, Islam MR, Haider AFMY (2007) Computer simulation of Fresnel diffraction from rectangular apertures and obstacles using the Fresnel integrals approach. *Opt Laser Technol* 39:131–135
4. Zu D (2008) The classical structure model of single photon and classical point if view with regard to wave-particle duality of photon. *Prog Electromagn Res Lett* 1:109–118
5. Wang Z (2010) Matlab modeling and simulation applications. *Mech Ind Press* 12:29–35
6. X Sun (2009) Optical experiment and the simulation. *Beijing Inst Technol Press* 11(4): 760–766

Chapter 6

Influential Factors Analysis of Frequency Domain Inverse Q Filtering Based on Effective Quality Factor

Xueying Li, Huijian Wen and Guangjuan Fan

Abstract To overcome the difficulties of layered Q modeling for layered inverse Q filtering in actual data processing, a frequency domain inverse Q filtering method based on effective quality factor was proposed. This method can be applied to the visco-elastic medium in which the effective quality factor vary weakly in horizontal direction. A threshold constrained, high frequency maintained stabilization controlling strategy was represented to ensure the stability of arithmetic in actual data processing. Some influential factors, such as Signal-to-Noise ratio, the accuracy of effective quality factor, threshold size, tuning parameters selection, that impact compensation effect of inverse Q filtering are researched. This research can provide beneficial guidance for using inverse Q filtering correctly in actual data processing.

Keywords Frequency domain inverse Q filtering · Effective quality factor · Stabilization controlling · Viscoelastic absorption compensation · Signal-to-noise ratio

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6.1 Introduction

The earliest inverse Q filtering is represented by Hale, which is based on mathematical model proposed by Futterman [1] and approximate high frequency compensation was developed by series expansion [1, 2]. Based on wavefield extrapolation theory, Wang [3] proposes a stabilized inverse Q filtering algorithm, which can be implemented in a layered manner in the layer medium. This method can complete amplitude compensation and phase correction at the same time [3, 4]. Amplitude compensation operator is written as two 1D functions in the time and frequency domain by this algorithm. Inverse Q filtering compensation has high calculation efficiency based on wave field extrapolation theory and FFT algorithm. Wang [5] introduces it into the situation that Q value varies continuously with time and depth [5]. Although the predecessors have developed the inverse Q filtering based on layer Q value from wave field extrapolation theory, there are a lot of difficulties in layer Q modeling which is directly obtained by seismic data and the accuracy is not exactly enough. In order to overcome the difficulties of layer Q modeling and raise computational efficiency, an algorithm of frequency domain inverse Q filtering based on effective quality factor is proposed and some influential factors are analyzed.

6.2 Frequency Domain Inverse Q Filtering Based on Effective Quality Factor

6.2.1 Fundamental Principle

Based on the wavefield propagation theory, for layered viscoelastic medium, we assume z axes vertical down; the thickness of every horizontal uniform layer is Δz , we can consider the varying relationship of the plane wave $U(z, \omega)$ which extrapolation vertically as:

$$U(z + \Delta z, \omega) = U(z, \omega) \exp[-ik_z(\omega)\Delta z] \quad (6.1)$$

where ω is angular frequency, $k_z(\omega)$ is spatial angular frequency. Inverse Q filtering is inverse propagation process of wave field, via:

$$U(z + \Delta z, \omega) = U(z, \omega) \exp[ik_z(\omega)\Delta z] \quad (6.2)$$

According to modified kolsky model we know:

$$k_z(\omega) = \left(1 - \frac{i}{2Q_i}\right) \frac{\omega}{v_i} \left(\frac{\omega}{\omega_h}\right)^{-r} \quad (6.3)$$

$\gamma = \frac{1}{\pi Q_i} Q_i v_i$ is the medium quality factor and velocity of i th layer, $\tau = 0$ is the tuning parameter related to peak frequency or the highest frequency.

We can substitute Eqs. (6.3)–(6.2), and make the vertical travel time $\tau =$

$\sum_{i=1}^n z_i/v_i \mp$ and $\Delta\tau = \Delta z/v_i$, then:

$$U(\tau + \Delta\tau, \omega) = U(\tau, \omega) \exp \left[i\omega \left(\frac{\omega}{\omega_h} \right)^{-r} \Delta\tau \right] \exp \left[\frac{\omega \Delta\tau}{2Q_i} \left(\frac{\omega}{\omega_h} \right)^{-r} \right] \quad (6.4)$$

The two e exponents expression at the right of the equation are the phase compensation item and the amplitude compensation item.

We can consider earth Q model $Q(\tau)$ as a 1D function of vertical time τ . When surface wave field ($\tau = 0$) is downward continuation to time τ :

$$U(\tau, \omega) = U(0, \omega) \exp \left[i\omega \left(\frac{\omega}{\omega_h} \right)^{-r} \sum_{i=1}^n \Delta\tau \right] \exp \left[\frac{\omega}{2} \left(\frac{\omega}{\omega_h} \right)^{-r} \sum_{i=1}^n \frac{\Delta\tau}{Q_i} \right] \quad (6.5)$$

Define effective quality factor, Q_{eff} , as:

$$\frac{1}{Q_{eff}} = \frac{1}{\tau} \sum_{i=1}^n \frac{\Delta\tau}{Q_i} \quad (6.6)$$

The Q_{eff} can vary continuously with the time. Put it into Eq. (6.5), the inverse Q filtering algorithm based on effective quality factor in frequency domain can be gotten:

$$U(\tau, \omega) = U(0, \omega) \exp \left[i\omega \left(\frac{\omega}{\omega_h} \right)^{-r} \tau \right] \exp \left[\frac{\omega \tau}{2Q_{eff}} \left(\frac{\omega}{\omega_h} \right)^{-r} \right] \quad (6.7)$$

6.2.2 Stabilization Controlling

In order to avoid the high frequency noise enhance unnecessarily in the compensation processing, we design an inverse Q filtering compensation operator to suit to high frequency. Therefore a high frequency maintaining, threshold constraint stabilization controlling strategy is proposed. Its core idea is to reconstruct a compensation operator $\Gamma(\chi)$ based on the independent variable χ ($\chi = \omega \left(\frac{\omega}{\omega_h} \right)^{-\gamma} \tau$) in frequency domain. Given cut-off value χ_c (χ_c can be obtained by the amplitude controlling threshold G_{lim}), when χ is less than or equal to χ_c , the $\Gamma(\chi)$ is the accurate inverse Q compensation operator spectrum. When χ is great then χ_c , the $\Gamma(\chi)$ is suppressed by multiplying with a first-order smooth derivable e exponent

function to attenuating it to a little small constant. Assume $\omega' = \omega \left(\frac{\omega}{\omega_h} \right)^{-\gamma}$, so the stabilization controlling is:

$$\Gamma(\chi) = \begin{cases} \exp\left(\frac{\chi}{2Q_{eff}}\right) & \chi = \omega' \tau \leq \chi_c \\ \Gamma(\chi_c) \exp\left(-\ln(\alpha) \cdot \frac{(\chi - \chi_c)^2}{(\chi_{Max} - \chi_c)^2}\right) & \chi_c < \chi < \chi_{Max} \end{cases} \quad (6.8)$$

After stabilization controlling, the Eq. (6.7) is:

$$U(\tau, \omega) = U(0, \omega) \exp(i\omega' \tau) \Gamma(\chi) \quad (6.9)$$

Made inverse transformation to Eq. (6.9), the time domain seismic data after inverse Q filtering compensation can be obtained as:

$$u(t) = \frac{1}{\pi} \int_0^{\infty} U(\tau, \omega) d\omega = \frac{1}{\pi} \int_0^{\infty} U(0, \omega) \exp(i\omega' \tau) \Gamma(\chi) d\omega \quad (6.10)$$

6.3 Influential Factors Analysis

6.3.1 Signal-To-Noise Ratio

For seismic traces without noise, the seismic wave energy will attenuate to the 0 when it spread to a certain distance; for seismic traces with noise, the seismic wave energy will attenuate gradually under noise level after spreading to exceeding a certain depth. To recover effective signal can cause noise amplification excessively, in other words, this part effective signal can't be recovered in theory. Thus effective signal recovering can cause the enlargement for noise excessive. Therefore the noise levels are higher, the harder to keeping stabilization and the worse for inverse Q compensation. So the high frequency noise must be suppressed reasonably before inverse Q filtering.

6.3.2 The Accuracy of Effective Quality Factor

We select different effective quality factors to compensating the forward modeling shot gather in order to verify the influence of effective quality factor for frequency domain inverse Q filtering. The three local frequency spectrums of reflective interface gained by generalized S transform are represented in Fig. 6.1. When the effective quality factor is 40, the over-compensation occurs in the second interface. Because of the stabilization controlling, high frequency component can't be

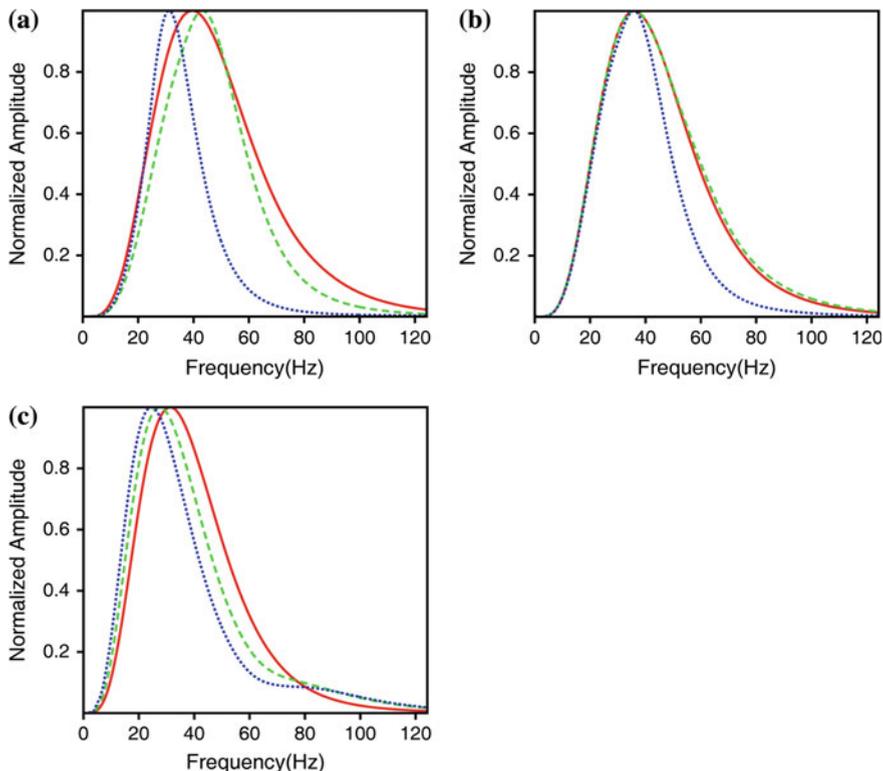


Fig. 6.1 The local frequency spectrum after viscoelastic compensation to shot gathers with different effective quality factors

recovered validly, so the peak frequency of the third interfaces decreased (Fig. 6.1a). When effective quality factor is 50, the peak frequency of the second interface and the third interface is consistent to the first interface’s peak frequency. Because of stabilization controlling, the third interface’s peak frequency is low slightly (Fig. 6.1b). When the effective quality factor is 80, the under-compensation appears (Fig. 6.1c). So only selecting the right effective quality factor, can we obtain a good compensating effect?

6.3.3 The Tuning Parameter Selecting

Observing Eq. (6.7), we can see that tuning parameter will have an influence on the phase spectrum directly. So selecting the different tuning parameters will affect the arrival time of seismic wavelet after compensation. Figure 6.2a and b are the highest and peak frequency, which are selected as tuning parameter. The

comparison of time domain local trace which is near 2 s between two viscoelastic compensation results are show as Fig. 6.2c. From Fig. 6.2c, we can see that selecting the highest frequency has better effect on phase compensation than selecting the peak frequency, and it is more close to the situation without viscoelastic compensation and the travel time is more accurate.

The solid line represents the local frequency spectrum of the first interface, the dashed line represents the local frequency spectrum of the second interface, and the dot line represents the local frequency spectrum of the third interface.

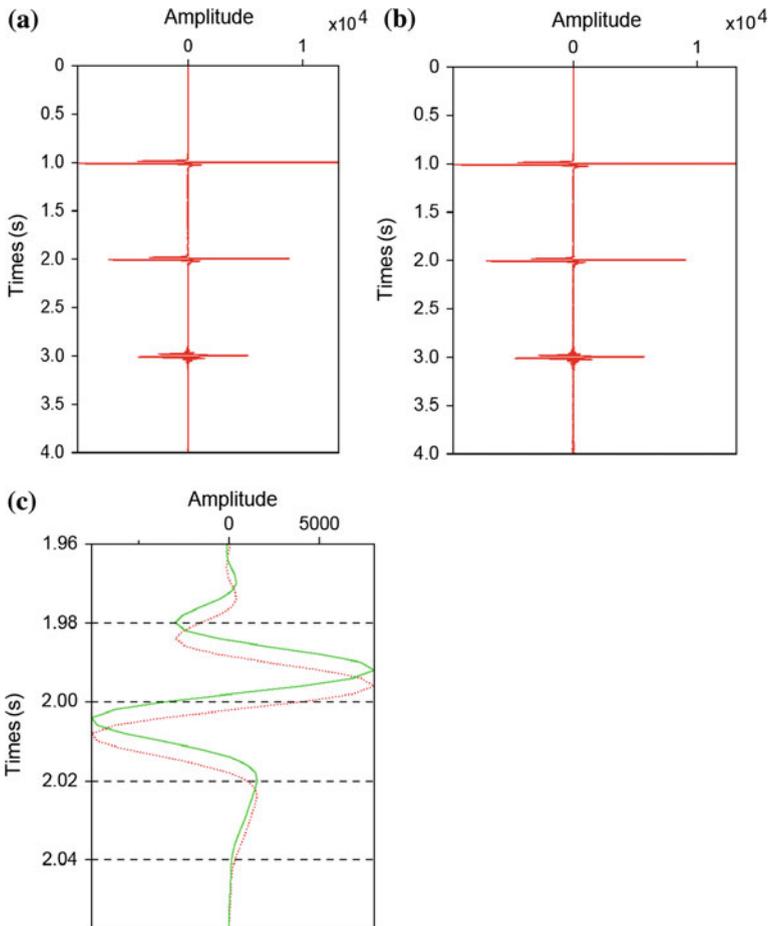


Fig. 6.2 Compensation effect of inverse Q filtering for the highest frequency and peak frequency, which are selected by tuning parameter (a: the compensation effect of peak frequency; b: the compensation effect of the highest frequency, c: the comparison near 2 s) (The solid line represents peak frequency; the dash line represents the highest frequency)

6.3.4 The Threshold Selecting

The threshold will have an impact on the effect of stabilization controlling directly. When the threshold is 200, the widen degree of frequency band is small, the improvement of resolution is not obvious and the amplitude compensation is weak. When the threshold is 20000, the amplitude is validly recovered, the improvement of resolution is more obvious, but the bottom of seismic trace has appeared an unstable phenomenon. It show that the larger the threshold, the greater the amplitude compensation, at the same time it adds the risk of algorithm unstable.

6.4 Conclusion

A frequency domain inverse Q filtering based on effective quality factor is developed in this article. Some different influential factors that impact compensating effects of inverse Q filtering, such as seismic data signal-to-noise ratio, the accuracy of effective quality factor, threshold size, tune parameters selecting, are researched. Through comparative analysis of single factor, we find that the noise levels are higher, the signal-to-noise ratio is lower, the stabilization controlling is harder, the compensation effect is worse. Therefore the noise must be suppressed reasonably before inverse Q filtering. The accuracy of effective quality factor has a strong influence on the amplitude recovery of inverse Q filtering, but it has nothing to do with phase compensation. When small effective quality factor is selected, the over-compensation occurs in the inverse Q filter; when the selecting of effective quality factor is big, the under-compensation occurs. Selecting the highest frequency has better effect on phase correction than selecting of peak frequency. Travel time is more accurate. The larger the threshold is, the greater the amplitude compensation, the closer to without viscoelastic compensation seismic trace after amplitude compensation. But it adds the risk of algorithm unstable.

References

1. Futterman WI (1962) Dispersive body waves. *J Geophys Res* 67(13):5279–5291
2. Hale D (1981) An inverse Q-filter. *Standford Explor Proj* 28:289–298
3. Wang YH (2002) A stable and efficient approach of inverse Q filtering. *Geophysics* 67(2):657–663
4. Robinson JC (1979) A technique for the continuous representation of dispersion in seismic data. *Geophysics* 44(5):1345–1351
5. Wang YH (2006) Inverse Q filter for seismic resolution enhancement. *Geophysics* 71(3):V51–V60

Chapter 7

Hilbert–Huang Transform Based Partial Discharge Signal Analysis

Hung-Cheng Chen

Abstract As a key concern in a power system, a deteriorated insulation will cause a partial discharge phenomenon and hence degrades the power supply quality. Thus, a partial discharge test has been turned into an approach of significance to protect a power system from an unexpected fault. As the first step in this work, a defect cast resin transformer is treated as a test object, and the detected partial discharge data are then transformed into a time–frequency–energy distribution through the Hilbert–Huang Transform. The distribution is capable of providing both time-domain and frequency-domain information. It is a highly promising approach to pattern identification of a partial discharge and fault diagnosis.

Keywords Partial discharge · Hilbert–Huang transform (HHT) · Empirical mode decomposition · Intrinsic mode function

7.1 Introduction

As an essential facility in all industries, a power system may demonstrate influence on economic growth or human’s daily life, from as little as a long term power outage to as serious as a sever damage to generation and distribution equipments, or even an entire power network shutdown, i.e. a tremendous thread to the power system. The economic loss attributed to an unsecured power system cannot be ignored, for the reason that it may lose clients, and requires a great deal of human

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as well as financial resources to recover malfunctioned facilities. Moreover, power providers may face lawsuit over the economic loss in such aspects as enterprise production, resident daily life, mass transit and transmission business. Hence, a study on the insulation status turns into a critical task in an attempt to take effective and protective measures in the early stage of a deteriorated insulation, i.e. to reduce the potential loss as a consequence of an abrupt power failure and hence improve the power quality [1].

There is a great amount of information embedded in a partial discharge signal, such as deteriorated insulation information. Accordingly, much more informative data are revealed by an analysis of such signal made in both the time and the frequency domains. With an artificially flawed cast resin transformer as the test object, a partial discharge signal, detected by an AE sensor [2, 3], is analyzed by Hilbert–Huang (HHT), a transform applied to a wide range of signal processing over recent years [4]. As a novel way to analyze a nonlinear as well as non-stationary signal, HHT decomposes signals into a number of intrinsic mode functions (IMF) through an empirical mode decomposition (EMD). Transient state spectra of individual IMF components are then made available by HHT to reach the goal of the aforementioned signal analyses [5, 6].

7.2 Hilbert–Huang Transform

7.2.1 Empirical Mode Decomposition

EMD is an approach in which a complicated signal can be expressed as the sum of n number of IMF. Identifying the features contained in respective IMFs in an effective manner, EMD demonstrates a high adaptability in the aspect of nonlinear as well as nonstationary signal analyses.

It is postulated in an EMD analysis that an arbitrary signal $x(t)$ can be written as the sum of a number of IMFs, each reflecting the physical meaning over respective spectral band. A typical IMF must satisfy two of the underlying conditions. The first condition is that there exists the same number of extrema as zero crossing points, or a maximum difference of unity between such two numbers, while the second is that the upper and the lower envelopes, covering all the local maximum and minimum points, respectively, exhibit a zero mean.

EMD decomposition is made through the following steps. As the first step, all the local extrema points must be located, and then concatenated via cubic splines so as to form the upper and the lower envelopes respectively. The mean m_{10} between such two envelopes is evaluated as

$$x(t) - m_{10} = h_{10}. \quad (7.1)$$

In case h_{10} does satisfy the IMF definition, h_{10} is treated as the first IMF. If not, the above step is iterated with h_{10} as the initial value until the maximum shifting number k is reached or the IMF definition is satisfied.

$$h_{1(k-1)} - m_{1k} = h_{1k} \quad (7.2)$$

It is found empirically that it is very unlikely to make h_{1k} satisfy the IMF definition in the course of decomposition, meaning that it takes the maximum number, k , of iterations to terminate the decomposition process. Consequently, a critical issue of the precise determination of the optimal shifting number in each IMF is detailed as follows.

Subsequently, letting $c_1 = h_{1k}$, c_1 is extracted out of $x(t)$, and r_1 , the updated signal, is given as

$$x(t) - c_1 = r_1. \quad (7.3)$$

Performing n times of the above iterations leads to n IMFs, presented as

$$\begin{aligned} r_1 & - c_2 = r_2 \\ & \vdots \\ r_{n-1} & - c_n = r_n. \end{aligned} \quad (7.4)$$

Such iteration terminates in the event that no more IMF can be found for a monotonic function r_n . Derived from Eqs. (7.3) and (7.4), the EMD decomposition is represented as

$$x(t) = \sum_{i=1}^n c_i + r_n \quad (7.5)$$

7.2.2 Hilbert Spectrum

Based on the local characteristic timescale of the signal, EMD decomposes a signal into n IMFs as intended, such that an instant frequency reflects certain type of physical meaning. Taking the Hilbert transform of Eq. (7.5), $c_i(t)$ is transformed into

$$\hat{c}_i(t) = \frac{1}{\pi} \int_{-\infty}^{\infty} \frac{c_i(\tau)}{t - \tau} d\tau. \quad (7.6)$$

Construct an analytical signal

$$z_i(t) = c_i(t) + j\hat{c}_i(t) = a_i(t)e^{j\varphi_i(t)} \quad (7.7)$$

and then an amplitude function is given as

$$a_i(t) = \sqrt{c_i^2(t) + \hat{c}_i^2(t)} \quad (7.8)$$

an instantaneous phase function is as

$$\varphi_i(t) = \arctan \frac{\hat{c}_i(t)}{c_i(t)} \quad (7.9)$$

The instantaneous frequency is represented as

$$f_i(t) = \frac{1}{2\pi} \omega_i(t) = \frac{1}{2\pi} \times \frac{d\varphi_i(t)}{dt} \quad (7.10)$$

and the Hilbert spectrum is denoted as

$$H(\omega, t) = \text{RP} \sum_{i=1}^n a_i(t) e^{j \int \omega_i(t) dt}. \quad (7.11)$$

Without taking the residual r_n into account and with RP standing for the real part of a complex operand.

A superior adaptability is seen for a partial discharge analysis made by HHT due to the nature of a nonlinear as well as nonstationary signal. As referred to previously, intrinsic physical meaning is revealed respectively by instant frequencies such that a deteriorated insulation can be detected in early stage [7, 8].

7.3 Partial Discharge Signal Analysis Using HHT

The entire detection and signal analysis architecture mainly consist of four parts, that is, parts of a data acquisition, a signal process, an EMD process and an HHT analysis. With an AE sensor mounted onto a defect cast resin transformer, a partial discharge signal, acquired through an A/D converter, is dispatched to a PC for subsequent analyses. The detected signal is processed through steps of EMD, the optimal shifting number determination and illusive component filtration, such that the IMFs are precisely extracted and intrinsic physical meaning is well preserved as intended over respective spectral band. Both the instant frequency out of each IMF and the discharge duration are adopted as a diagnostic tool for a wide range of system problems.

Presented in Fig. 7.1 is a typical partial discharge signal detected by an AE sensor mounted on a flawed cast resin transformer. Such detected signal is then decomposed through an EMD process into eight IMFs, as illustrated in Fig. 7.2, subsequent to which the embedded trend curve is identified and filtered out. The existence of such trend curve will inevitably bring about a lower possibility to satisfy the IMF definition, but the HHT analysis accuracy is seen subject to an

Fig. 7.1 Typical partial discharge signal detected from a defect cast resin transformer

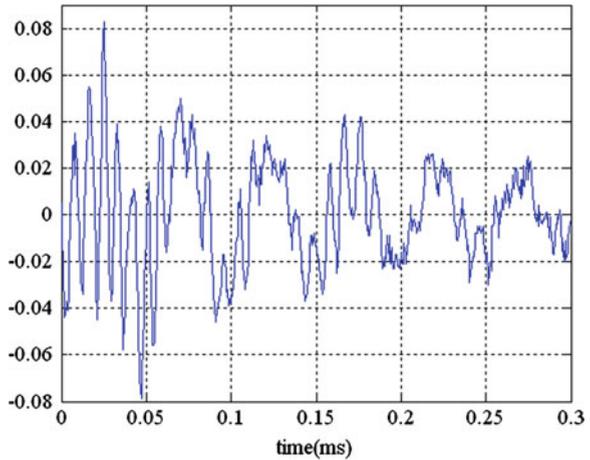
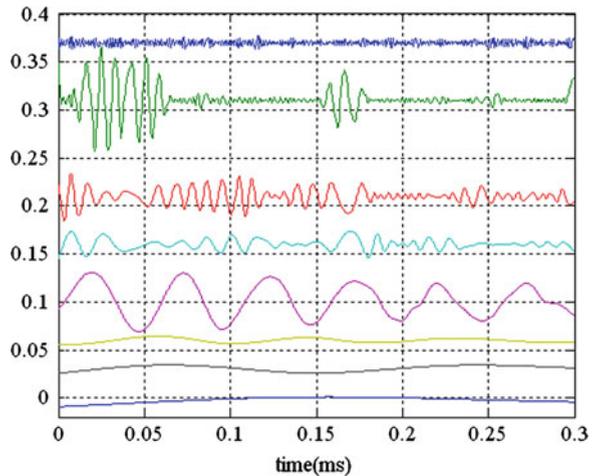


Fig. 7.2 EMD result for an original partial discharge signal



increment in the shifting number. The identification of such trend curve is conducted with an increased shifting number until the EMD result is demonstrated stable, and then all the intrinsic physical meaning carried by individual IMFs is disclosed. The fifth IMF is presumed to be the interference from the AE sensor improperly mounted. Plotted in Fig. 7.3 is the partial discharge signal with the trend curve filtered.

Plotted in Figs. 7.4 and 7.5 are the Hilbert spectrums with and without a trend curve, respectively. It is demonstrated that the trend curve plays a crucial role in the accuracy of HHT analysis, due to which high frequency noise component is reduced significantly.

Fig. 7.3 Original partial discharge signal with the *trend curve* filtered

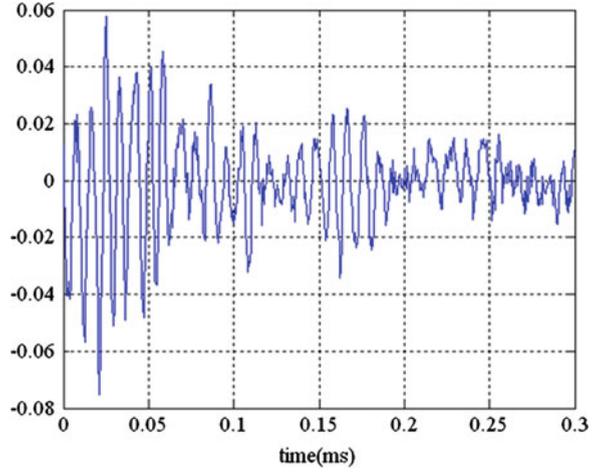


Fig. 7.4 Hilbert spectrum of an original signal

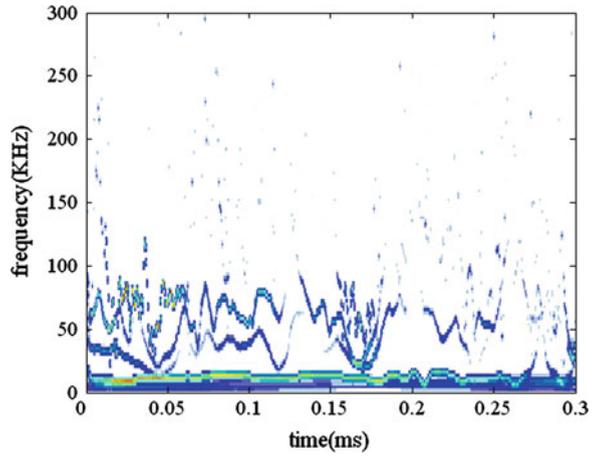
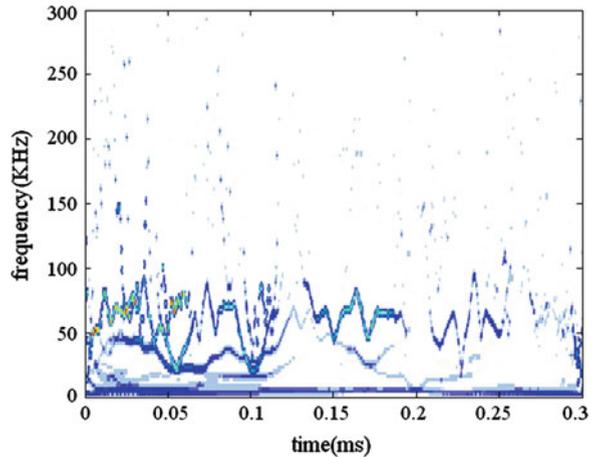


Fig. 7.5 Hilbert spectrum of a signal in the absence of a *trend curve*



7.4 Summary

In this paper, a HTT is applied to partial discharge signal analyses in such a way that all the intrinsic physical meaning as well as the corresponding time instant is preserved over the time–frequency–energy distribution. Revealing informative data both in time and frequency domains, such transform is deemed as a promising diagnostic or a mode identification tool in practical applications.

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References

1. Biswas S, Koley C, Chatterjee B, Chakravorti S (2012) A methodology for identification and localization of partial discharge sources using optical sensors. *IEEE Trns Dielectr Electr Insul* 19:18–23
2. Boczar T, Zmarzly D (2004) Acoustic emission measurements of ultrasound induced cavitation bubbles in aged insulating oils. *IEEE Trans Dielectr Electr Insul* 11:433–439
3. Boczar T, Borucki S, Cichon A, Zmarzly D (2009) Application possibilities of artificial neural networks for recognizing partial discharges measured by the acoustic emission method. *IEEE Trns Dielectr Electr Insul* 16:214–219
4. Wang XD, Li BQ, Liu ZW, Roman HT, Russo OL, Chin KK, Farmer KR (2006) Application of improved hoththeadness transform to partial discharge defect model recognition of XLPE power cable. *IEEE Trans Power Deliv* 21:1063–1069
5. Li HL, Kwong S, Yang LH, Huang DR, Xiao DP (2011) Hilbert-Huang transform for analysis of heart rate variability in cardiac health. *IEEE-ACM Trans Comput Biol Bioinform* 8:1557–1563
6. Attoh-Okine N, Adu-Gyamfi Y, Mensah S (2011) Potential application of hybrid belief functions and Hilbert-Huang transform in layered sensing. *IEEE Sens J* 11:530–539
7. Lai CP, Narayanan RM, Narayanan Q, Davydov A (2008) Through wall surveillance using ultrawideband random noise radar. *IET Radar Sonar Navig* 2:244–253
8. Tong JH, Chiu CL, Wang CY (2010) Improved synthetic aperture focusing technique by Hilbert-Huang transform for imaging defects inside a concrete structure. *IEEE Trans Ultrason Ferroelectr Freq Control* 57:2512–2519

Chapter 8

Design of Image Acquisition System Based on FPGA

Guili Han, Zhongxian Li and Xiaoyu Liu

Abstract With the rapid development of science and technology, in system monitoring, the use of image data transmission can control the operation quickly, but in the process of image data acquisition system, there may occur the inaccuracy of the image data and non-real-time, thus bringing the system to control certain degree of error, and affecting the decision-making of judgments. This article describes FPGA in image data acquisition processing system design, and makes design research with the existing image data acquisition and processing system based on FPGA technology, through the image analog signal changing into digital signal, and using the FPGA image data acquisition process to monitor, thus providing effective solutions to the deviations in the image data acquisition process.

Keywords FPGA · Image data · Acquisition system · Design and development

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8.1 Introduction

Image processing is using computer to make image analysis in order to achieve the desired technological achievements, which is also known as image processing. The general index of the image processing is text and image processing [1]. The digital image is to use digital cameras, scanners and digital sampling to get a two-dimensional array. This array element is called pixels, and its value is an integer, known as the gray value [2]. Image processing technology, including image compression, strengthen and restore match the description and identification of three parts [3, 4]. They apply with the common digital image, image coding, image enhancement, image restoration, image segmentation and image analysis, image processing, the general index of words and image processing [5]. As for image acquisition, its function is to signal acquisition of the computer image in the form of data files stored in the hard disk. This is our image processing essential hardware devices, through which we can make the computer archive from the camera the camera's video signal, and by the use of video editing software, video digital signal processing, such as the post-edit a picture of the shear filter subtitles and audio to join a variety of video effects and special effects, so in the final step, we will add and edit the video signal which is converted into a standard VCD, DVD and Internet media formats [6, 7].

With the rapid development of image processing technology and its wide use in all walks of life, we are making more and more requirements for image acquisition and processing system to improve the level of production automation, and thus the image acquisition and processing system has unprecedented large-scale development, but also facing the scientific and technological challenges, and its complement and development must adopt a new theory of knowledge [8]. At present, the image acquisition processing system is the use of frame grabbers and image capture card is part of the interface of image acquisition and image processing. Quantified later converted to a digital image and enter the image after sampling, stored in frame memory process which is called acquisition. Its principle is to get the signal from the video source, after the video interface, then capture the card and the first advanced signal analog–digital conversion, and then sent to a digital decoder for decoding.

This article describes the FPGA in image data acquisition processing system design [9, 10], and makes design research on the existing image data acquisition and processing system based on FPGA technology, using the image analog signal changing into digital signal, and through the FPGA image data acquisition process to monitor, thus providing effective solution to the deviations in the image data acquisition process.

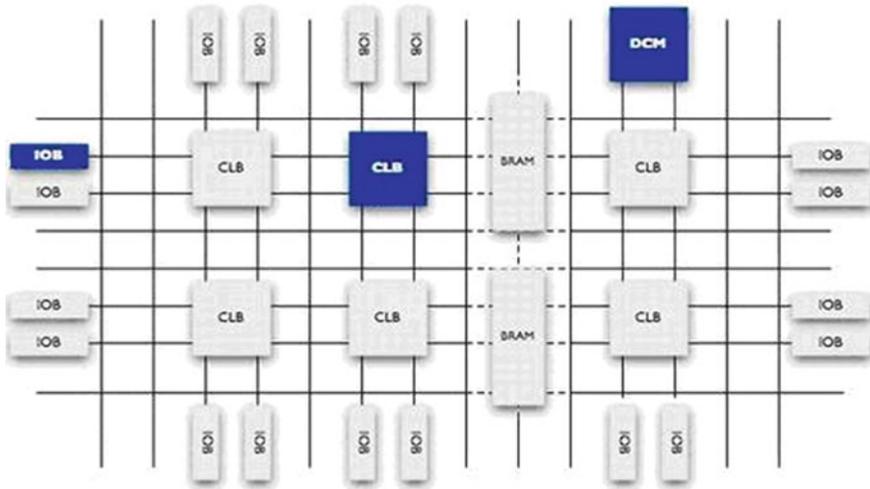


Fig. 8.1 Internal structure of the FPGA chip

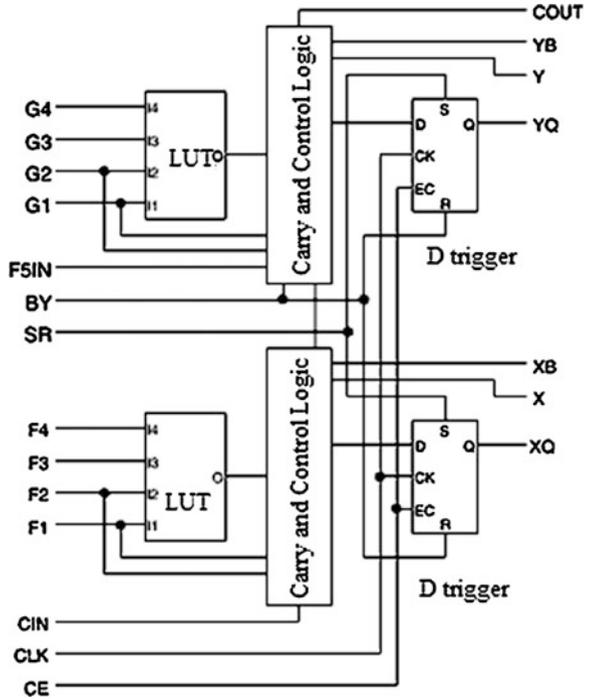
8.2 The Overview of Field Programmable Gate Array

FPGA is a field variable length gate array referred to in English as the Field-Programmable Gate Array [11], which is a programmable device. All walks of life commonly used FPGA technology is still based on the lookup table, and has gone far beyond the basic performance of the previous version, and the integration of common functions (such as RAM, clock management, and DSP) hard core (ASIC type) module. Figure 8.1 shows the internal structure of the FPGA chip. Using the PGA input LUT is generally applied to the four-input; each LUT can be seen as a 16×1 RAM and each RAM consists of four address lines. Principle chart or HDL language to describe a logic circuit, FPGA development software will run automatically and be able to calculate all possible outcomes of the logic circuit so as to achieve the purpose of automation, and then by COMS the calculation result of things stored into the RAM modules, so that the logical operations of each of the input signal is input an address checklist, and then find the appropriate contents of the address, and thus the final output data. Figure 8.2 shows the typical input Slice schematic.

8.3 The Design of Image Acquisition System Based on FPGA

Figure 8.3 shows the overall design of FPGA-based graphics acquisition and processing system; this system is designed with a total of three modules, respectively, for the image sensor module, FPGA module and PXA310 module. Among them, the image sensor module for enterprise automation image acquisition, data

Fig. 8.2 Typical four-input Slice schematic



analysis, and converted into digital signals. FPGA module’s main task is to design a CMOS image sensor chip, the CMOS sensor chip with the outside circuit interface contact; PX310 module’s main task is to design a system of internal and external environment of the image data exchange, the image sensor acquisition and analysis of image data into a digital signal through the CMOS chip, and thus the exchange of image information and data transfer. Entire system during the runtime, first by the image sensor acquisition and analysis of image information and data through the FPGA CMOS image data is stored in SRAM, and then the data stored in the PXA310 will read and collect, and dump the SDRAM, the last the PXA310 CMOS image sensor chip to the data stored in the information sent to the host computer through the circuit.

8.3.1 The Power Supply Design of the FPGA

FPGA power requirement is it should within the range of from 214.2 V to 5 V output voltages, output current range from tens of milliamps to several amps. Quasi-three power low dropout regulator (LDO) low-dropout linear regulator, switching DC-DC voltage regulator and the switching power supply modules

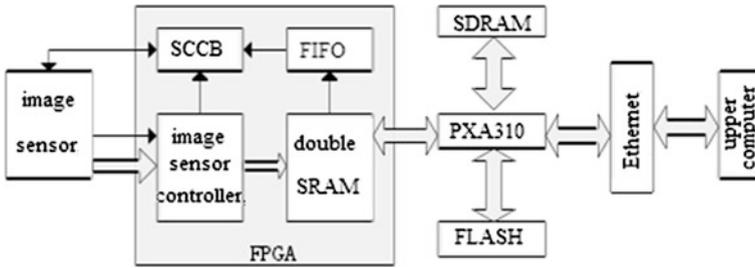


Fig. 8.3 Overall designs of FPGA-based graphics acquisition and processing system

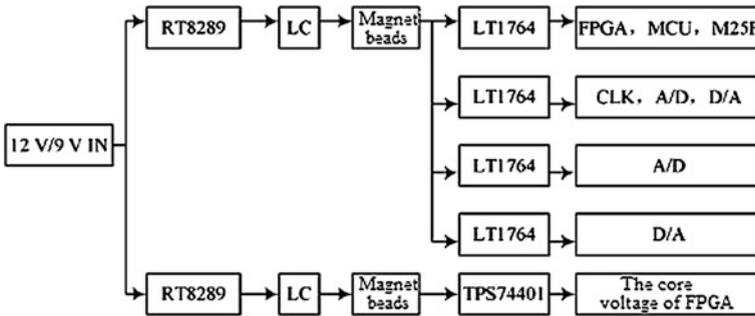
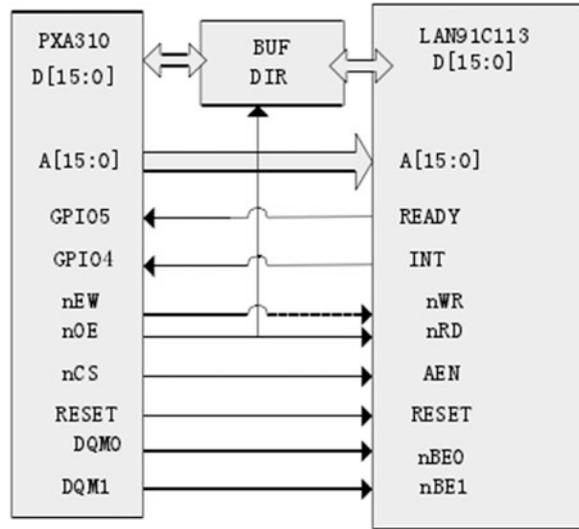


Fig. 8.4 Overall framework design of system power supply

available. The final choice of the power system, the system budget and the market need time. In order to ensure the correct power to the kernel for the VCCINT voltage should rise slowly within the time frame specified by the manufacturer [12]. For the FPGA, because the VCCINT has more time before the transistor turn-on threshold value, such a long slow rise time may lead to the starting current for a long time last year. If the power has to provide high current FPGA, a long time to rise slowly will be caused by thermal stress. ADI's DC-DC regulator offers adjustable soft start and slow rise, you can control through an external capacitor. Slow rise time of a typical value of 20-100 ms range. If board space is a primary consideration, and it is very important, then the request or input voltage changes in system requirements for low output noise and fast load transient response, it should use the LDO regulator. LDO is less effective (because it is a linear regulator) can only provide a low output current. The input capacitance can usually reduce inductance and noise LDO input. LDO output also needs to increase the capacitor, which is mainly used for the transient of the processing system and maintain system stability. You can also use the dual output LDO module used on the VCCINT and the VCCO the power above. FPGA image acquisition and processing system, due to the special requirements of the FPGA power, can be designed as is shown in Fig. 8.4 as the overall system power framework.

Fig. 8.5 The interface circuit of Ethernet module and the PXA310



RT is the chip power conversion efficiency can reach 90 % to meet the energy requirements of the design of the system power supply, under normal circumstances, the input power of 5.5–32 V to the output of 5 A current. The LT1764 and the TPS74401 are power chips, can achieve the requirements of a wide range of continuous output current of 3 A. Generally speaking, the block diagram of the system power supply design is relatively clear, the circuit is not complicated at all, while convenient for the latter part of the commissioning work, the energy supply of power to meet the overall image acquisition and processing system requirements.

8.3.2 Ethernet Transmission Module of FPGA

The Ethernet module is connected to the Q series PLC and host system interface module. The main function is as follows: (1) The PLC CPU data collection and modify the MELSEC communication protocol and communication; (2) Send arbitrary data to an external device and to receive any data from external devices, and the use of fixed buffer memory or random access buffer memory to communicate. The Ethernet module is for the use of this system PXA310 and LAN91C113. Figure 8.5 is the interface circuit of Ethernet module and the PXA310.

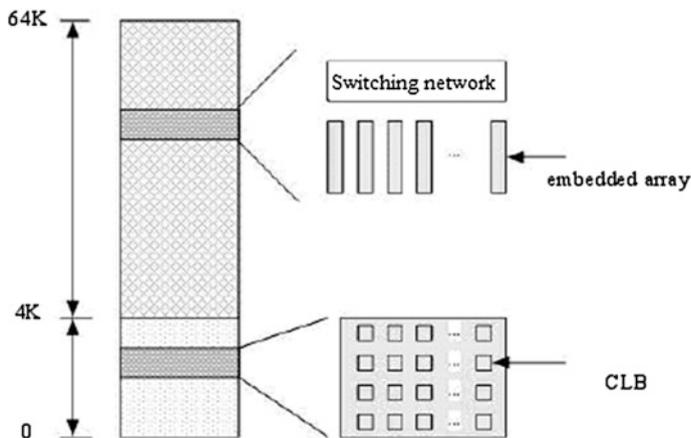


Fig. 8.6 Image acquisition control

8.4 The Achievement of Image Acquisition System Based on FPGA

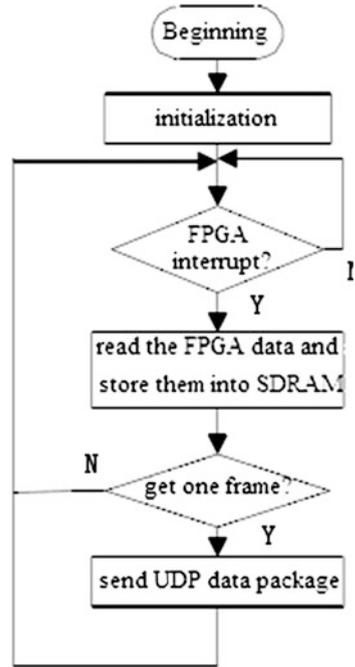
8.4.1 FPGA Image Acquisition

For image acquisition’s raw data input format, each pixel has only one color, and the odd scan lines output RGRG then output the OV9650 camera data, and even scan lines of the output GBGB FPGA image sensor data collection is responsible for this. After power on, the system is initiated first to determine the operating mode CMOS image capture chip OV9650 camera’s memory of these parameters for internal control, by controlling the SCCB bus FPGA to complete the configuration parameters. The driver of the FPGA module old to control the entire image acquisition, data analysis and storage, when the amount of data in the FPGA Module to achieve the maximum storage capacity, the system will automatically send a warning signal interruption, then the driver of the FPGA module to accept instructions selection and processing of the storage capacity of the system, as is shown in Fig. 8.6.

8.4.2 Ethernet Data Transmission Control

To achieve network transmission of image data, the system development should be based on the PXA310 UDP/IP-based program to the storage of image data in the SDRAM. The Ethernet module is connected to the Q series PLC and host system interface module. A complete data frame formats, including Ethernet, IP header, UDP header and image data line. After power, the system will wait for FPGA

Fig. 8.7 The Ethernet data transmission flow chart



interrupt, the interrupt generated data and FPGA The PXA310 SDRAM read and write, and then determine whether to read the image data of a system for reading and analytical review, and then sent via Ethernet data memory of UDP packets, data and image data will be sent to the PC, or continue to transmit until the driver waiting for FPGA Module instruction interrupt. The Ethernet data transmission flow chart is shown in Fig. 8.7.

8.5 Conclusion

With the rapid development of image processing technology and its widely use in all walks of life, there are more and more requirements for image acquisition and processing system to improve the level of production automation, and thus the image acquisition and processing system has been unprecedented large-scale development, but also facing the scientific and technological challenges, and its complement and development must adopt a new theory of knowledge. With the rapid development of technology for system monitoring, the use of the image data transmission can control the operation quickly, but in the process of image data acquisition system, there may appear to the inaccuracy of the image data and non-real-time in order to convey system to control a certain degree of error, affecting the decision-making of judgments. This article describes FPGA in image data

acquisition processing system design, and research on the design of the existing image data acquisition and processing system based on FPGA technology, the image data signal converted to digital signals by COMS image processor chip, the FPGA image data monitor the collection process in order to effectively solve the deviations in the image data acquisition process.

References

1. Piao X, Xiong J, Shen S (2008) Acquisition system based on the design of FPGA-speed data. *Computer* 24(2):209–211
2. Liang Z (2006) ARM Linux-based high-speed data acquisition technology, vol 3(12). Beijing Jiaotong University Press, Beijing, pp 561–567
3. Yang T (2010) Multimedia processor PXA310 application in smart phone, vol 3(4). Shanghai Jiaotong University, Shanghai, pp 49–56
4. Gong L (2010) Detailed explanation of ARM embedded Linux system, vol 21. Tsinghua University Press, Beijing, pp 38–48
5. Liu M (2006) Interface design of embedded systems with Linux drivers, vol 12. University of Aeronautics and Astronautics Press, Beijing, pp 350–359
6. Niu X, Yang Y (2011) Software radio technology, vol 56. Beijing University of Posts and Telecommunications Press, Beijing, pp 569–575
7. Shen L (2003) The technology of real-time system, vol 112. China University of Science and Technology Press, Hefei, pp 236–239
8. Diao M (2009) The principle of TV receiver, vol 3(9). Academy Press, Beijing, pp 534–537
9. Li G, Meng X (2000) Programmable ASIC design and application, vol 67. Electronic Science and Technology University Press, Chengdu, pp 443–445
10. Yang P, Zhang X (2003) FPGA control video image of the imaging system acquisition. *Comput Meas Control* 11(6):451–453
11. Zhong L, Han J (2011) FPGA and ARM-based image acquisition system design. *Comput Knowl Technol* 8(1):211–213
12. Zhang Y, Yang H (2011) FPGA-based digital frequency selection design. *Mod Electron Technol* 35(1):88–91

Chapter 9

Research on Channel Estimation of MIMO–OFDM System

Wei Li, Xiaoping Wang, Pei Gu and Dongqing Wang

Abstract Channel estimation is effective in resisting to the frequency selective fading in Wireless channel, and accurate channel estimation can guarantee the quality of the MIMO–OFDM system transmission. Through establishing the mathematical model of the MIMO–OFDM system, the research was based on the channel estimation algorithm of block-type pilot frequency and comb-type pilot frequency, and made the simulation analysis on the performance of the algorithm. Chose the LS algorithm with the minimal is resource consumption, the least complexity, and better performance. Then adopted SOPC to realize the LS algorithm, and finally achieved the right channel estimation results.

Keywords MIMO–OFDM · Channel estimation · SOPC

9.1 Introduction

MIMO and OFDM are the key technologies of mobile communication in the future. If MIMO and OFDM technology can be combined perfectly, it can effectively improve the channel capacity and transmission rate, resist the multipath fading channel, and restrain the interference.

Channel estimation technology refers to estimating the impulse response from the receiving signal in wireless channel, which is the basis of MIMO–OFDM system for coherent detection, demodulation and equalization [5]. Channel estimation plays a decisive role in system design. Generally speaking, common

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channel estimation methods consist of three categories: blind channel estimation, channel estimation based on pilot frequency, and channel estimation based on the training sequence [4]. This paper mainly studies the channel estimation algorithm which is based on pilot frequency.

9.2 MIMO–OFDM System Mode

There is the introduction of MIMO–OFDM system mathematical model, which involves only one of the MIMO channel communications link, including N_R receiving antennas and N_T transmitting antennas. Each receiving antenna corresponds with every transmitting antenna through a statistics independent fading channel and additive Gaussian white noise (AWGN) disturbs the receiving signals. Furthermore, this noise is independent distribution in receiving antennas and transmission cycle.

In order to facilitate the description, the symbol “ p ” is the subscript of sample time, and the complex symbol $x_i(p)$ means being sent by N_T transmitting antenna and then being received by the “ j ” receiving antenna. The symbol “ j ” is a sequence number standing for a receiving antenna. Therefore, using $r_j(p)$ could be represented [2]:

$$r_j(p) = \sum_{i=1}^{N_T} h_{ij}(p) * x_i(p) + n_j(p) \quad (9.1)$$

In the formula (9.1), $h_{ij}(p)$ means the fading channel where the “ i ” transmitting antenna compounds with the “ j ” receiving antenna at that time, and the time is presented as “ p ”. The symbol $n_i(p)$ refers to zero-mean after Gaussian white noise, and its variance is shown as $N_0/2$.

After using OFDM modulation in the MIMO system, the formula (9.1), transformed by FFT at the “ K ” point, and the formula of the frequency domain could be shown as below:

$$R_j(k) = \sum_{i=1}^{N_T} H_{ij}(k)X_i(k) + N_j(k) \quad 1 \leq k \leq K \quad (9.2)$$

In the formula (9.2), the symbol $R_j(k)$ refers to the expression of the frequency domain belonging to the “ k ” subcarrier which is in the receiving signal of the “ j ” receiving antenna. The symbol $H_{ij}(k)$ means the transmission gain of reply way in the “ i ” transmitting antenna and the “ j ” receiving antenna. The symbol $X_i(k)$ presents the transmitting signal of the “ i ” antenna. Furthermore, the symbol $N_j(k)$ shows the noise signal of the “ j ” receiving antenna.

9.3 Channel Estimation Algorithm Based on the Pilot Frequency

9.3.1 Structure of the Pilot Frequency

Common pilot frequency types consist of comb-type, block-type and rectangle type. The block-type pilot frequency is normally applied for the slow fading channel and it is not sensitive to frequency selectivity. But the comb-type pilot frequency is sensitive to frequency selectivity, and it is suitable for the fast fading channel. The rectangle type pilot's frequency signal is evenly distributed in time and frequency axes and its pilot frequency number is less than that from the other two types. But its computing complexity is higher.

9.3.2 Channel Estimation Algorithm Based on the Block-Type Pilot Frequency

9.3.2.1 LS Channel Estimation

Though Least Square (LS) channel estimation algorithm ignores the effect of noise, it has its own advantages: simple structure, small calculation, and not need to know the statistical information of the channel. The formula is shown as below:

$$\hat{H} = X^{-1}Y \quad (9.3)$$

In the formula (9.3), Y is the output signal matrix after demodulation, and X is transmitting signal matrix.

9.3.2.2 Linearity Minimum Mean Squared Error Channel Estimation

Linearity Minimum Mean Squared Error Channel Estimation (LMMSE) channel estimation algorithm is the simplified type of minimum mean squared error (MMSE). It needs the statistical property of the channel, and the calculation is complicated. The formula is shown as follows:

$$\hat{H}_{LMMSE} = R_{HH}(R_{HH} + \frac{\beta}{SNR}I)^{-1}\hat{H} \quad (9.4)$$

In the formula (9.4), R_{HH} means the auto covariance matrix of the Channel transmission function; SNR refers to the average Signal to Noise Ratio; " I " is unit matrix; β is a constant depended on the modulating signal constellation chart.

9.3.2.3 Singular Value Decomposition Channel Estimation

LMMSE channel estimation algorithm has a high calculation load. The spectrum energy of the channel frequency response mainly concentrates in the low frequency part. That is it mainly concentrates in the former part of “ m ” order. And the “ m ” here should be slightly higher than the sample value interval number corresponding to maximum multipath delay of the channel. So SVD can be used here [3].

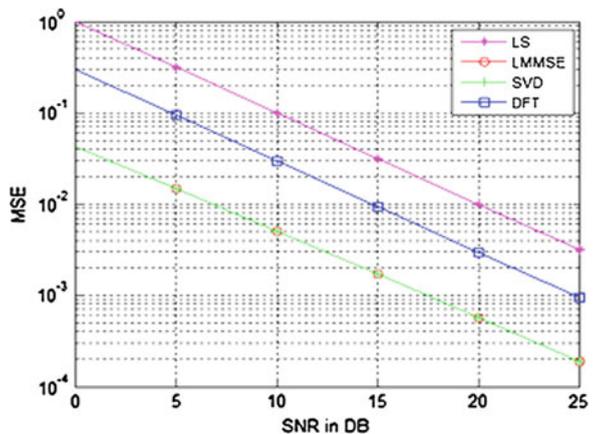
9.3.2.4 Transform Domain Channel Estimation

DFT channel estimation algorithm is mainly used in the frequency domain filtering processing. The basic idea refers to transforming the initial channel in the position of frequency domain guide frequency into the time domain by IFFT. After filling with zero in the time domain, it can be transformed into frequency domain by FFT. Then it can get the frequency response in all position of the channel. It is mainly based on FFT/IFFT and filling with zero algorithms for channel estimation algorithm [2].

According to the analysis mentioned above, MATLAB program can realize several channel estimation algorithms which are based on the block-type pilot frequency. It uses the Rayleigh fading channel, the QPSK modulation and the mean square error (MSE) to measure the performance of several channel estimation algorithms. The simulation figure is shown in the Fig. 9.1.

From the Fig. 9.1, the performance of LMMSE is better than that of LS. And the performance of LMMSE and SVD-LMMSE is similar. There is almost no difference in the simulation figure. Because the MMSE algorithm can be simplified

Fig. 9.1 MSE comparisons through several channel estimation algorithms of QPSK modulation



in LMMSE and SVD-LMMSE algorithm, the accuracy of the performance is achieved by complex operation. The performance of DFT is better than LS, but less than LMMSE algorithm.

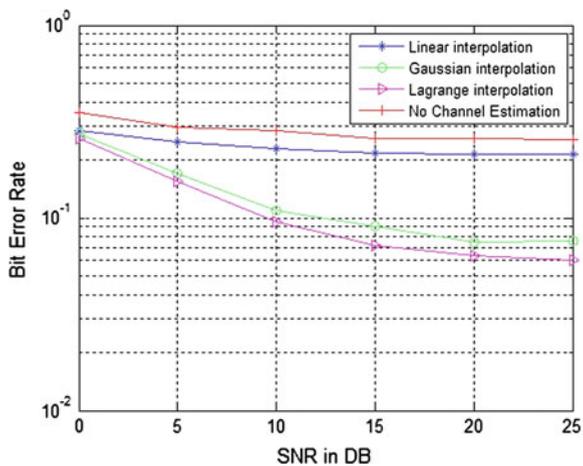
9.3.3 Channel Estimation Algorithm Based on the Comb-Type Pilot Frequency

In the MIMO-OFDM system of comb-type pilot scheme, it usually adopts interpolation algorithm to estimate channel information in the no data position. In this paper, it uses the linear interpolation, Gaussian interpolation and Lagrange interpolation algorithm to realize channel estimation.

The linear interpolation utilizes the channel response in the adjacent two pilot frequencies to linearly estimate the channel response in data position. Gaussian interpolation utilizes the adjacent three pilot frequency signals to do interpolated estimation. Lagrange interpolation utilizes adjacent several pilot frequency channel responses to do the estimation, and it makes full use of the correlation among several pilot frequencies. The simulation result of several algorithms is shown in Fig. 9.2. The channel uses Rayleigh fading channel, QPSK modulation and bit error rate (BER) to measure the performance of several channel estimation algorithms.

From the Fig. 9.2, the BER smooth layer of no channel estimation is the highest. The Linear interpolation and Gaussian interpolation take second place. The BER smooth layer of Lagrange interpolation is the lowest. Hence compared with other algorithms, Lagrange interpolation algorithm has great advantages in performance.

Fig. 9.2 BER comparisons by several channel estimation algorithms of QPSK modulation



9.4 The Realization of Channel Estimation Algorithm by SOPC

In accordance with the analysis mentioned above, LS algorithm has the following advantages: the smallest calculated amount, the lowest complexity, and better applicability. Besides, it is easy to be achieved through hardware. So it is fit to be applied in the actual system. Therefore, this paper introduces the realization of LS channel estimation algorithm by SOPC.

SOPC system design adopts the tool Quartus II developed by Altera Company. Using SOPC Builder is to build software debugging platform for SOPC system and to generate NiosII system, and then the NiosII system is integrated into Quartus II project where a schematic document whose suffix is.bdf will be built [1]. After that the document will be inserted into the generated NiosII module and input and output pins will be inserted as well so as to complete drawing system circuits and compiling and loading could be achieved afterwards. After hardware system is successfully loaded, the system can be programmed and debugged in NiosII IDE integrated environment. This paper presents that designing C program is utilized to achieve the main functional modules of MIMO-OFDM system which are responsible for sending and receiving, and which include serial-parallel and parallel-serial conversion modules, (inverse) fourier transform module,channel estimation module,QPSK modulation and demodulation modules. By this means, the accurate results of channel estimation can be achieved at last, which is described as follows.

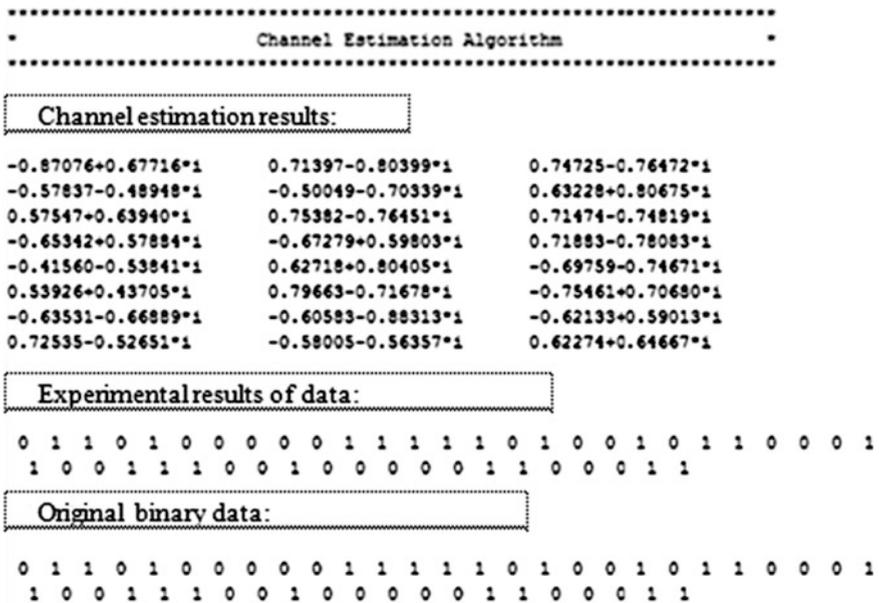


Fig. 9.3 Results of channel estimation

According to the Fig. 9.3, the original binary data from transmitting terminal is in line with the data which is demodulated through channel estimation. Hence under the condition of the interference from Gaussian noise, the LS channel estimation algorithm has high accuracy, low complexity and better applicability.

References

1. Altera Corporation (2005) NiosII Software Developer's Handbook. 43:424–430
2. Bai Y (2006) Channel estimation technique in MIMO–OFDM system. Xi Dian University, 293:218–224
3. Edfors O, sandell M, Van de Beek J-J, Wilson SK (1996) OFDM channel estimation by singular value decomposition. In: Proceedings of the IEEE 46th vehicular technology conference, Atlanta, GA, USA 4:923–927
4. Hu Y, Yin C-C (2007) A kind of brand-new MIMO–OFDM channel estimation and pilot frequency scheme. J Beijing Univ Post Telecommun 30(1):100–104
5. Xiao-Lin S (2008) New kind of MIMO–OFDM of channel estimation method based on pilot frequency. J Xian Inst Post Telecommun 13(3):5–8

Chapter 10

Abdomen CT Image Segmentation Based on MRF and Ribs Fitting Approach

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and Xiangrong Zhou

Abstract Aiming at the segmentation of liver image with fuzzy edge, a new algorithm based on Markov Random Field and ribs fitting approach is proposed. The new algorithm consists of three main steps. Firstly, an abdominal image is pre-processed to fit ribs and remove the obstructive region. Then, lifting wavelet transform is adopted to decompose an image in different resolutions, and an image segmentation algorithm based on MRF is manipulated to the low frequency sub-images; lastly, morphology operation is adopted to obtain the liver region. The algorithms of the initial and multi-level segmentation in wavelet domain are K-means and MAP/ICM. Several experiments have been carried out and the experimental results show that the proposed algorithm has a good robustness and higher segmentation accuracy than the traditional MRF approach.

Keywords Image segmentation · Markov random field · Ribs fitting · ICM · Wavelet transform

10.1 Introduction

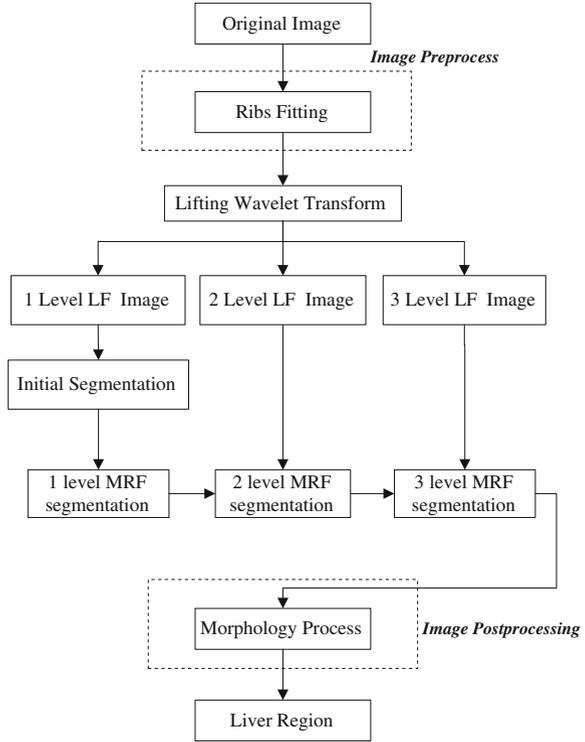
With the rapid development of modern medical technology, digital medical image has been widely used in disease diagnosis for clinical doctors and experts. The accurate segmentation of diverse tissues in the CT image is not only a necessary premise before extracting features of diseases, but also a basic of the image three-dimensional reconstruction and the medical image visualization [1].

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Human anatomy of different individuals is distinct, and the accuracy and time of the medical image segmentation approach are highly demanded by the clinical application. For this reason, there are massive methods proposed in research literatures, such as threshold-based method, edge-based method, clustering method, region-based method, and Markov Random Field (MRF)-based method, Level Set method, etc. The threshold-based method is widely used in image segmentation with simple structures, but it is sensible to noise and the threshold; Edge-based methods depend on the edge detect operator to find the edge of an image, and these edges identify discontinuous locations of gray-level, colour and texture in an image [2, 3]. The edge-based method is commonly combined with some prior knowledge to avoid the effect of noise [4]. The most frequently-used clustering methods are K-means clustering and FCM clustering. Both of them need an initial cluster centre which greatly influences the final segmentation result, and the algorithm possesses a bad robustness; Region-based methods can effectively eliminate the noise by taking into account both the similarity of the pixels and the spatial adjacent relationships among them [5]. However, it is sensible to the chosen of the initial seed; MRF-based approach is a kind of region-based algorithm, which takes into account connections of pixels with their neighbour pixels. It sufficiently considers the mutual relationships among pixels. MRF-based algorithm usually models an image in a suitable model, and makes use of the equivalence of Gibbs-Markov to achieve image segmentation. The algorithm commonly uses some optimization algorithms to achieve robustness result, like Iterative Conditional Mode (ICM), Mean Field Annealing (MFA) and Simulated Annealing (SA), etc. Different optimization algorithms will significantly affect the segmentation result. Level set is a sort of curve evolution approach, which owns good robustness. However, the curve evolution time of level set is long and the segmentation accuracy of image with fuzzy object edge is low [6].

This paper presents a new medical image segmentation algorithm based on MRMRF model with ribs fitting approach [7]. Firstly, an original image is pre-processed to implement ribs fitting with a series step, like threshold process, morphology operation, centre demarcation, and curve fitting. Secondly, a three level LWT is executed to an original image [8, 9]. Then we use this result to accomplish the multi-level segmentation of the destination area. During the modelling of MRF, Finite Gauss Mated Model (FGMM) and Potts model are respectively used to characterize the feature field and label field, Expectation—Maximization (EM) is adopted to estimate the parameters in the models [10, 11]. During the multi-level segmentation procedures, we choose the ICM algorithm and make use of the equivalence between the Maximum a Posterior (MAP) and energy minimization. We use a variable weight to combine the feature field and the label field in each iteration procedure, which can efficiently coordinate the potency between the feature field and the label field [12, 13]. Lastly, we manipulate the segmentation result in MRF model with some morphology operation to revise the result. Figure 10.1 shows an outline of the proposed algorithm. LF is short for low frequency.

Fig. 10.1 The outline of the proposed algorithm

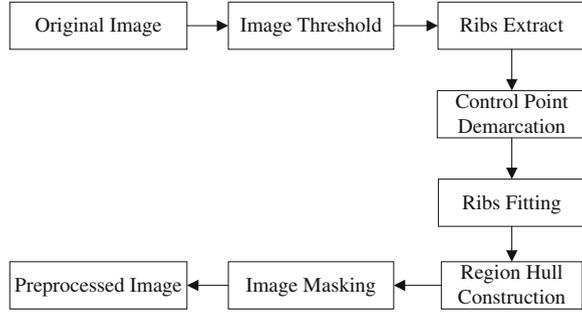


The rest of the paper is organized as follows: in the next section, a fully describe of the proposed algorithm is introduced, including the image pre-process with threshold process, morphology operation, centre demarcation, and curve fitting, the image segmentation with image lifting wavelet transform, the modelling of MRF in wavelet domain, the image post-processing with morphology operation. In Sect. 10.3 the validity of the proposed algorithm compared with other methods is given. Some conclusions are given in Sect. 10.4.

10.2 The Proposed Algorithm

The proposed algorithm consists of three modules: image pre-process, image segmentation based on MRF approach, and image post-processing based on morphology method.

Fig. 10.2 Flow of the image pre-process procedure



10.2.1 Image Pre-Process

Image pre-process is an important step in image segmentation. The flow of the pre-process procedure is shown in Fig. 10.2. During the procedure, firstly a threshold is chosen to separate ribs in an original image, as the luminance of ribs is higher than other regions. Secondly, region proportion is based to wipe out other regions except of ribs. Thirdly, according to different image, we choose several control points automatically or manually. Fourthly, we construct a hull by the control point and get a mask image. Lastly, after getting the mask image, we can obtain a pre-processed image.

10.2.2 Image Segmentation Based on MRF Approach

According to MAP criterion, the image segmentation based on MRF can be formulated as:

$$\begin{aligned}
 \hat{x} &= \arg \max_x \{P(W = \omega, X = x)\} \\
 &= \arg \max_x \left\{ \prod_{n=0}^{J-1} \prod_{(i,j) \in I_{2^n}} P(\omega_{ij}^{(n)} | x_{ij}^{(n)}) P(x_{ij}^{(n)} | x_{ij}^{(n)}) \right\}
 \end{aligned} \tag{10.1}$$

The Eq. (10.1) can be translated into Eq. (10.2) according to the equivalence of energy minimization and MAP criterion. In this paper, we use ICM-MAP to achieve the energy minimization based on the Eq. (10.2).

$$\hat{x} = \arg \min \left\{ \sum_{n=0}^{J-1} \sum_{(i,j) \in I_{2^n}} [E_{\omega_{ij}^{(n)} | x_{ij}^{(n)}} + E_{x_{ij}^{(n)}}] \right\} \tag{10.2}$$

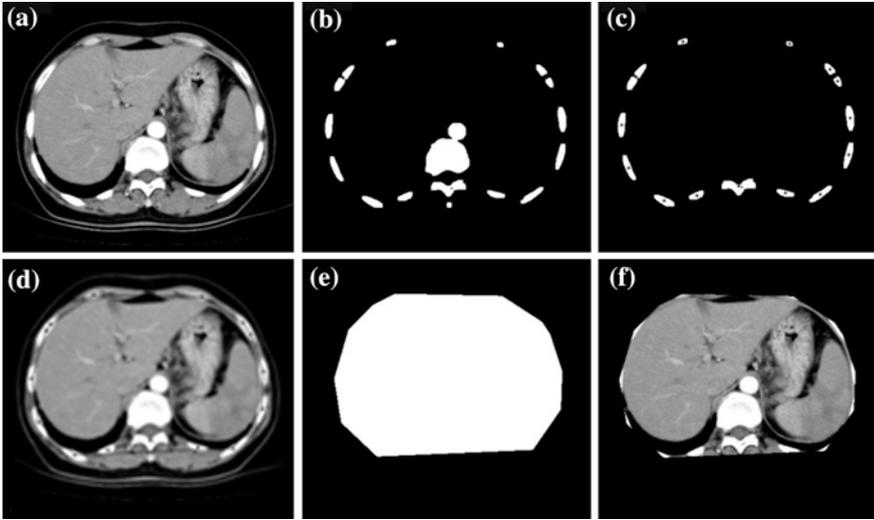


Fig. 10.3 Results of image pre-process

10.2.3 Image Post-Processing Based on Morphology Method

Morphology method is a useful tool in image process, which can effectively wipe out diminutive regions in an image. During our work, when an image is segmented with MRF, a morphology open operation is used to remove the organs connects with the left lobe of liver, and a morphology close operation is used to modify the segmentation result.

10.3 Experimental and Analysis

The experimental data is 30 abdomen CT image with format of DICOM derived from a 64 row CT machine in a domestic large hospital which space resolution is 512×512 . Figure 10.3 gives the pre-processed result of one set of abdomen CT image segmentation. (a) is an original image, (b) is the result after image threshold process, (c) is the result of ribs extract with control points (d) is the result of ribs fitting, (e) is the result of hull construction, and (f) is the pre-processed image.

We carry out experiments with liver CT images to demonstrate the performance of the proposed segmentation approach, and compare the proposed results with the results of some traditional methods. Figure 10.4b shows the segmentation result using single-scale MRF without pre-process procedure. The boundaries of regions are not very smooth, and many pixels around the left lobe are misclassified, which is shown in some white rectangles. Figure 10.4c shows the segmentation result of

Fig. 10.4 Comparison of segmentation results on abdomen CT image

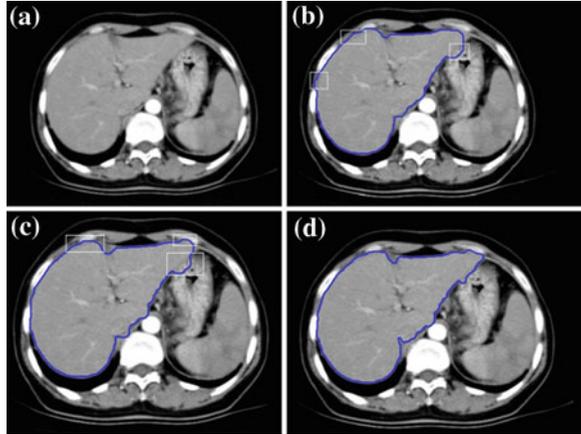


Table 10.1 Comparison of performance among the above algorithms

Method	Iteration time	Time/s	Accuracy (%)
SMRF	12	65.1	72.6
MRMRF	8	51.2	63.6
NMRF	4	32.4	85.7

applying multi-scale MRF without pre-process procedure, the boundaries of liver in the right is rough, and the pixels around the left lobe are also misclassified. As shown in Fig. 10.4d, the result of the proposed algorithm demonstrates a visually significant improvement and robustness to noise, and preserves better edge information than the former two approaches. The number of misclassified pixels is less than those of the contrastive algorithms.

Table 10.1 shows an average case of 30 sets of abdomen CT images in time, iteration times and segmentation accuracy. SMRF is short for the single scale MRF approach, MRMRF is short for the multi-scale MRF approach, and NMRF is short for the proposed algorithm. The segmentation accuracy is shown in the Eq. (10.3). In Eq. (10.3), S_1 denotes the target liver region produced by the proposed algorithm, S_2 denotes the liver region manually partitioned by a doctor.

$$precision = \frac{S_1 \cap S_2}{S_1 \cup S_2} \quad (10.3)$$

10.4 Conclusions

Aiming at the segmentation of liver image with fuzzy edge, this paper proposes a new medical image segmentation algorithm based on MRF and ribs fitting algorithm. We characterize the segmentation problem as a kind of optimization problem.

Firstly, we manipulate an image with several steps, which aims to remove some regions connected to ribs. Secondly, we use lifting wavelet transform to characterize an image in wavelet domain. Then, we accomplish initial and multi-level segmentation to low frequency sub-image. During the configuration of MRF, FGMM and Potts model are respectively used to establish the feature field and label field, and EM algorithm is used to estimate the parameters in the model. Lastly, morphology technique is used to obtain the liver region. Experimental results show that the proposed algorithm possesses a good robustness, and the segmentation accuracy is higher than the traditional MRF approaches. However, there still exists some limitations in the proposed algorithm, and the segmentation accuracy still needs to be improved aiming at some CT image with complicated organs.

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References

1. Sahoo PK, Soltani S, Wong AKC, Chen YC (1998) A survey of thermoelectric techniques. *Comput Vis Graph Image process* 41:233–260
2. Basak J, Chanda B (1994) On edge and line linking with connectionist models. *Pattern Anal Mach Intell* 22:413–428
3. Chen CW, Luo JB, Parker KJ (1998) Image segmentation via adaptive K-mean clustering and knowledge-based morphological operations. *IEEE Trans Image Process* 7:1673–1683
4. Chang YL, BLX (1994) Role of the cytoplasmic tail of ectopic Maloney murine leukemia virus Endpoints in fusion pore formation. *IEEE Trans Image Process* 3:868–872
5. Cohen FS, Copper DB (1987) Homophonic between cells expressing hemoglobin of influenza virus and planar membrane can precede the formation of fusion pores that subsequently fully enlarge. *IEEE Trans Pattern Anal Mach Intell* 9:195–219
6. Chan TF, Vese LA (2001) A Multiphasic level set framework for image segmentation using the Malformed and Shah model. *IEEE Trans Image Process* 10:266–277
7. Geman S, Geman D (1984) Stochastic relaxation, gibus distributions, and the bayesian restoration of images. *IEEE Trans Pattern Anal Mach Intell* 20:721–741
8. Lin JS, Chen RM, Huang YM (1997) In: *International conference on image processing (ICIP'97)* vol 2, pp 855–858
9. Laarhoven P, Aarts E (1987) *Simulated annealing: theory and applications*. Springer, NewYork
10. Aitkin M, Rubin DB (1985) Estimation and hypothesis testing in finite mixture models. *J Roy Stat Soc* 47:67–75
11. Tu Z, Zhu SC (2002) *Image Parsing: Segmentation, Detection, and Recognition*. *IEEE Trans Pattern Anal Mach Intell* 24:657–673
12. Kiryu H (2011) Sweets information services ovoid technologies. *Bioinformatics* 7:2346–2353
13. Simchony T, Chellappa R, Lichtenstein Z (1990) Pyramid implementation of optimal-step conjugate-search algorithms for some low-level vision problems. *IEEE Trans Inf Theory* 36:608–613
14. Li QS, Liu GY (2010) *Pattern analysis and machine intelligence*. *Iccasm2010* 9:342–346

Chapter 11

Sunglasses Styling Optimization System Based on User Interactions

Haiying Li, Xiaodong He, Jianfeng Wu and Xiaojian Liu

Abstract Considering sunglasses' design features like large capacity, short period, quick modification, being difficult to accurately capture the user demand and so on, this paper achieved the optimal design of sunglasses form, and developed a prototype system based on interactive genetic algorithm, which realized the optimization mechanism from three aspects, as lens form coding, visualized population construction and users' interactive evaluation model design. The algorithm program is developed based on three-dimensional design platform Solid works, and running as macro. The software extracts parameters from the user defined model and automatically generates new designs with the parameters, and then displays them for user's evaluation which drives the optimization process to go circularly.

Keywords Sunglasses · Optimization · User interaction · Interactive genetic algorithms

11.1 Introduction

Sunglasses, as a fashion product, its design, production and consumption patterns are similar to the general fashion products, it design is provided with large capacity, short period, quick modification, being difficult to accurately capture the

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user demand and so on [1, 2]. Especially, for the last point, the sunglasses designer now have to test the market and the consumer attitude through a lot of designs, which led to adverse conditions of large design workload and poor time-sensitive. Faced with these features, it is necessary to incorporate the users into innovative design process of sunglasses, thus to have a deep and synchronous involvement into product design process. This paper achieved the optimal design of sunglasses form, and developed a prototype system based on interactive genetic algorithm.

Interactive genetic algorithm is a branch of evolutionary computation with the main feature of individual fitness value being determined by users' interactive evaluation (rather than formula). Because there is no need for an explicit fitness computational formula, IGA is more suitable for handling optimization problem implicit or with fuzzy evaluation index [3, 4], especially those decision-making with perceptual factors like emotion, intuition, and preferences, including product design, artistic creation, composition, and other forms of intelligent innovation. This applied interactive genetic algorithm in sunglasses form design, the approach can be described as follows: a large number of design proposal could see the image directly automatically generated by the software, the users choose some of satisfactory ones, the software generates a batch of new program for the users after improvement, and cycling like until the generation of satisfactory solution.

Interactive genetic algorithm applied in this paper is to design the key technologies in three areas: First, the sunglasses form coding design, the second is the building of visualization product solutions population, and the third is the use s' interactive evaluation model.

Because of the involvement of users, evolution algebra of interactive genetic algorithm is limited; the research was based on fitness estimation algorithm for reducing users' fatigue, which can be divided into three categories, modeling method, projection method and the knowledge embedding [5, 6].

Modeling method is to model the users' evaluation standard, establish fitness function model to replace individual evaluation of the user. Commonly used modeling tools includes neural network [7], support vector machines [8], Bayesian learning [9], etc. The basic idea is to use the individuals have been evaluated as a sample to train fitness function models, and to form update process model on-line along with evolutionary process. Projection method is to project related individual's fitness value through the individuals have been evaluated, such as hybrid fitness allocation method proposed by Sugimoto [10], using distance-based methods to mix several fitness values of the individuals have been evaluated; scholars also have proposed multi-candidate individuals [11] and fitness inheritance [12] and other methods. Knowledge embedding is though embedding prior knowledge into the evolutionary process to reduce the search space and speed up the convergence rate. Fitness landscape is a tool to predict individual fitness with the use of user knowledge [13], by analyzing the fitness landscape of users' selection information construction's external evaluation environment to predict the fitness of new individual. Jong-Ha Lee et al., based on fitness landscape, used direct individual operation mode to implant user intent or prior knowledge based

individuals for the populations [14], to guide the evolution direction of populations, and conduct specific application verification in fashion design.

11.2 Interactive Optimization Mechanism

This paper mainly focuses on the optimal design of sunglasses lens form, this section will describe the principle of optimization mechanisms from three aspects, lens form coding, visualized population construction and users' interactive evaluation model design.

11.2.1 The Encoding Scheme Design of Sunglasses

Express the form of sunglasses with a series of real numbers combination, which is shown as Fig. 11.1.

The outline form of sunglasses lenses can be expressed by 6 arcs, 6 arc connected end to end and tangent with each other. Outline form of sunglasses lenses can be completely defined by 10 real numbers, so the lens form coding can be expressed as:

$$X = \{x_1, x_2, \dots, x_{10}\} \tag{11.1}$$

As the diversity of design elements' data types, in order to facilitate genetic manipulation, on the basis of the original encoding to conduct second encoding, thus to obtain products gene encoding in binary form, as shown in Eq. (11.2):

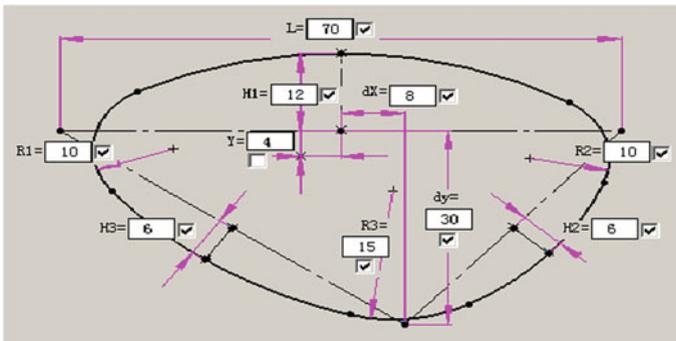


Fig. 11.1 Sunglasses shape's definition

$$\begin{aligned}
 X_B &= \{b_1, b_2, \dots, b_{10}\} \\
 b_i &= \begin{cases} N(x_i)_B, & x_i = \text{enum} \\ \text{Int}\left(m_i \frac{x_i - x_{i\min}}{\Delta x_i}\right), & x_i = \text{int, real} \end{cases} \quad (11.2)
 \end{aligned}$$

where: b_i is a binary value, when x_i is the enumerated type value (such as style code), b_i is to express integer number with binary system; when x_i is an integer or real number, its value range is discredited or into several segments, b_i is to express value section's integer number with binary system, m_i is the number of segments of the value, $x_{i\min}$ is lower bound for the range, Δx_i is the length of range.

Color encoding adopts RGB format or CMYK format, expressing as a coordinates point within three-dimensional or four-dimensional color space, as shown in Eq. (11.3):

$$C = \{(r_1, g_1, b_1), (r_2, g_2, b_2), \dots, (r_{10}, g_{10}, b_{10})\} \quad (11.3)$$

where: (r_i, g_i, b_i) is color space coordinates (taking RGB color for example).

One model of design encoding is composed by the above two parts.

A population including n models programs is composed by its program encoding:

$$\text{Group} = \{D_1, D_2, \dots, D_n\} \quad (11.4)$$

11.2.2 Formulas

The construction of visualized population is to allow users make evaluation based on intuitive sense to ensure the authenticity and reliability of evaluation results.

The construction of visualized population involves two steps: First is to generate a number of different codes in batch; second is to converse the sample codes into a visual product form. Batch generation of code sample mass is obtained by changing the encoding parameter value in Eq. (11.1), the changes depends on the used genetic manipulation methods. Codes conversing is to be achieved by generating visualized phenotype though decoding of visualized form (i.e., model) to codes.

The encoding of all individuals in the population will be stored in an Excel spreadsheet. The Program reads the data from the table, which will be endowed to the original model built by the designers, thus the form data of the model experiencing corresponding changes, then save the changed model a copy. All populations will be generated for the user to evaluate by displaying side by side. Figure 11.2 shows the visualized populations of sunglasses form:

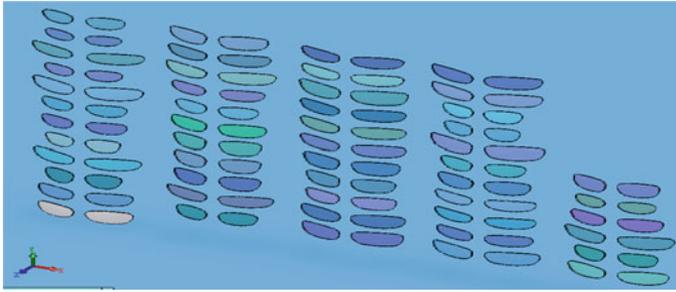


Fig. 11.2 Visual population of sunglasses

11.2.3 Footnotes

Users’ interactive evaluation is an important process optimization to determine the populations’ model of evolution, optimization efficiency and quality of the final results, but also one of the core content of interactive genetic algorithm. There are three keys for evaluation model design: First, the form design of evaluation data; second is the storage of users’ evaluation data; third is the implementation of algorithm for generating new codes based on users’ evaluation data. This paper is to implement data processing based on the Excel spreadsheet, and a variety of genetic manipulation for encoding.

Two kinds of users’ evaluation are used in the sunglasses design: First, traditional scoring method, the users score each individual in the population one by one, the program will record the scores in Excel spreadsheet after the encoding of the individual; second, the users select the individual in the population one by one according to the merits order, the program calculate as arithmetic progression according to the sequence and distribute individual scores. The accuracy of the latter is worse than the former, but the scoring efficiency is 5–10 times higher than the former, for the optimization problem with higher algebra evolution, the latter has obvious advantages.

Selection based fitness value allocation algorithm is shown as follows:

$$F_s(X) = [F] \left(1 - \frac{s_r}{n} \right) \tag{11.5}$$

where: $[F]$ is the highest score, usually it is 1; s_r is the selecting sequence, $s_r < n$; n is the total number of individuals in population.

According to Eq. (11.5), two different evaluation methods can generate the evaluation scores in same form, thus the optimization process can be run under a unified data format.

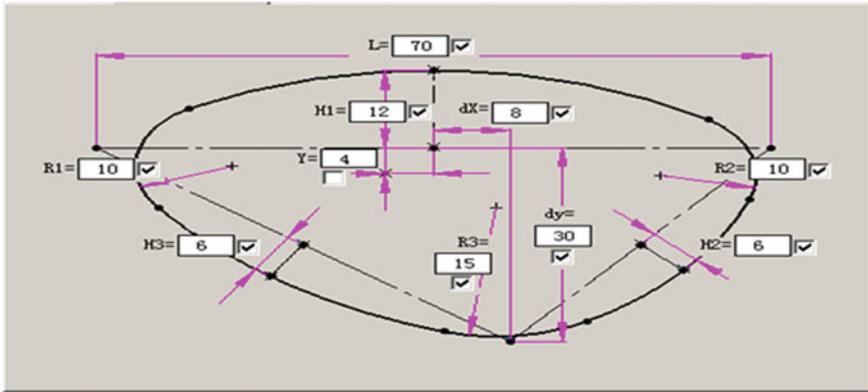


Fig. 11.3 Interface for the 3-point glasses shape design

11.3 The Achievement of Sunglasses Form Optimization Design System

The algorithm routine in this paper is to develop based on three-dimensional design platform Solid works, running with a macro form. From the encoding to decoding of phenotype is achieved by Excel series parts design table driven, the software extracts parameters from the table and automatically generate a new three-dimensional model in accordance with parameters, and then displaying with assembly mode side by side. The intermediate information in evolution process, individual encoding, information selecting, fitness value, statistical data and others, all are stored in the Excel document, data analysis and genetic manipulation is simultaneously carried out with the mean of OLE through VBA macros in Excel.

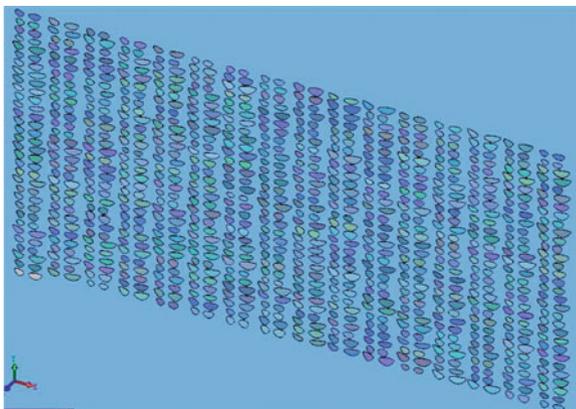
Dialog box shown below pops up after system startup.

“Basic parameters” panel is the basic parameters used to set the lens form, including pupil distance, nose width, lens angle, arc radius, arc shapes, and levels outer angle and so on. Users can set the basic parameters on the panel. The users can input the numbers of the program need to be generated and the magnitude of random variation in the randomized controlled field.

The system uses three methods to establish the model profile of the lens, respectively are two-point mode, three and four-point model, its complexity and form control parameters were increased. Select different forms of profile in profile bar, the corresponding panel will be displayed behind of “basic parameters” panel according to users’ selection. Save the file field with the file name and path for the establishment the model, where the user input.

Figure 11.3 is the parameters defining interface for three-point lens. Users can change the number in the marking box and choose whether the parameter will participate in the random variation, the values of selected parameter in different

Fig. 11.4 A population that contains 500 glasses shapes



programs are not the same. The one not being selected will maintain the value entered by the users in the program. While selecting “all parameters involve in random variation” at the bottom right, all the parameters on the panel will participate in the random variation. After parameter setting, click the “lens model” button to begin the batch constructions of three-point profile lens model. Figure 11.4 is the parallel displaying of lens form population with the capacity of 500.

11.4 Conclusion

The system constructed in this thesis is a CAID system for sunglasses design. Compared with existing technology, this project has the following advantages:

- (1) It is the first time to propose the multi-schema innovative design technology for sunglasses’ concepts. For the sunglasses’ shape design, it has realized the multi-schema design from both parameters and colors. And it allows users to choose a number of satisfactory plans interactively, then optimize on the basis of that. It is a strong impetus for design technology of intelligent concepts.
- (2) It realizes the visualization of conceptual design process, in which all the design projects can be presented in a visual form. That allows customers, consumers, marketing stuff and others who are not professionals to participate in the design process by interactive selecting evaluation, to ensure the reliability of design process.

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References

1. Takagi H (2001) Interactive evolutionary computation: fusion of the capabilities of EC optimization and human evaluation. *Proc IEEE* 89(9):1275–1296
2. Parmee IC, Bonham CR (2000) Towards the support of innovative conceptual design through interactive designer/evolutionary computing strategies. *Artif Intell Eng Des Anal Manuf* 14(1):3–16
3. Kim HS, Cho SB (2000) Application of interactive genetic algorithm to fashion design. *Eng Appl Artif Intell* 13(6):635–644
4. Gu ZY, Tang MX, Frazer JH (2006) Capturing aesthetic intention during interactive evolution. *Comput Aided Des* 38(3):224–237
5. Cho SB (2004) Emotional image and musical information retrieval with interactive genetic algorithm. *Proc IEEE* 92(4):702–711
6. Gong DW, Hao GS (2007) *Interactive genetic algorithms theory and applications*, vol 77. National Defense Press, Beijing, pp 8–10
7. Biles JA, Anderson PG, Loggi LW (1996) Neural network fitness functions for a musical IGA. *Int Symp Intell Ind Autom Soft Comput* 90:39–44
8. Wang SF, Wang XF, Xue J (2005) An improved interactive genetic algorithm incorporating relevant feedback. In: *Proceedings of 2005 international conference on machine learning and cybernetics*, vol 9. Guangzhou, pp 2996–3001
9. Wang LH (2007) A comparison of three fitness prediction strategies for interactive genetic algorithms. *J Inf Sci Eng* 23(2):605–616
10. Sugimoto F, Yoneyama M (2002) Hybrid fitness assignment strategy in IGA: a method to compose fitness. In: *Proceedings of the 2002 IEEE workshop on multimedia signal processing*. ST Thomas, Virgin Islands, pp 284–287
11. Rasheed K (2000) Informed operators: speeding up genetic-algorithm-based design optimization using reduced models. *Proc Genet Evol Comput Conf* 55:628–635
12. Abboud K, Schoenauer M (2002) Surrogate deterministic mutation. *Artif Evol* 99(1):103–115
13. Merz P, Freisleben B (2000) Fitness landscape analysis and memetic algorithms for the quadratic assignment problem. *IEEE Trans Evol Comput* 4:337–352
14. Lee JH, Cho SB (2002) Analysis of direct manipulation in interactive evolutionary computation on fitness landscape. In: *Proceedings of the 2002 congress on evolutionary computation*, vol 87. Honolulu, pp 460–465

Chapter 12

Design of Maintenance System for UPS

Feng Zhao, Qin Wang and Jian He

Abstract According to the present operation of UPS in electric railway, sum up the three key problems existing in its application as follows. First, UPS performing a self-test automatically is unable to absolutely detect the failure battery. Second, in electrified railway, UPS battery keeps in the floating charge state for a long time, which reduces battery lifetime. Third, discharge time of battery is determined on the basis of battery capacity. The accurate measurement of battery capacity is getting more and more important to avoid deep discharge. However, with complex chemical properties of battery, to achieve accurate measurement of battery capacity is impossible at present. So, to solve the three problems above, an experiment has been conducted and a system has been designed on the basis of experimental data.

Keywords UPS · Battery capacity · Electrified railway · Battery discharge

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12.1 Introduction

UPS, as a crucial piece of equipment in electrified railway, is widely used in providing high-quality power supply for the interlocking system and Dispatching Management Information System. It can eliminate so called “power pollution” such as current surge, high transient voltage, low transient voltage, frequency offset and so on, improving the quality of power supply. In that sense, UPS, being a protective power supply, is able to guarantee railway equipments security and stability operation except that UPS, due to its malfunction, can lead to failure of railway equipment. In practical application of UPS, most of its malfunction is due to battery failure [1]. And the cost of the battery is accounts for a large proportion of that of UPS. So prolonging the life of UPS batteries would make great sense. In recent years, researchers has done much to find how to prolong batteries’ lifetime, how to absolutely detect the failure batteries and how to control battery discharge. According to the influencing factors of battery lifetime, this paper has put forward methods to prolong battery’s lifetime. Because of insufficiency of self-test function of UPS, this paper has proposed solution to this problem, to avoid UPS malfunction caused by battery. In consideration of the lack of accuracy in measurement of battery capacity, design experiment to find the best way to control battery discharge [2, 3].

12.2 Current Situation and Existing Problems of UPS

As a protective power supply, UPS plays a crucial role and is widely used in electrified railway. As far as the function of UPS, it can work as emergency power supply and anti-interference purification power [4, 5]. On one hand, it can eliminate so called “power pollution”. On the other hand, UPS ensures the operation of essential equipments in the event of power failure. Site operation results of UPS show the property of purification power is enough to railway equipment. UPS can meet an emergency to supply power for load, which depends on whether battery can discharge properly. According to data from spot, most malfunctions of UPS are caused by battery. And the cost of the battery is high, taking a great part in the cost of UPS [6]. So prolonging the life of UPS batteries and minimizing maintenance would make great sense. Through a survey to UPS applied in electrified railway, summarizing three aspect questions as follows.

The first problem UPS performing a self-test automatically is unable to absolutely detect the failure battery.

UPS performs a self-test automatically when turned on and every two weeks thereafter. This function of self-test is to detect failure battery. The self-test principle: in the event of power failure, test whether the UPS can ensure power

supply for load. If it can, the battery is considered alright, otherwise it is bad. Once the failure battery is detected, the flashing light flashing issues a “battery failure” alarm. The battery needs to be replaced. The self-test is a very short process, about one min [7]. So as long as the UPS battery can last about one min, this battery is considered alright. The self-test can provide rough detection for battery. It is unable to absolutely detect the failure battery. As capacity of the battery will decrease with time and usage, the battery can discharge properly until its capacity decreases to a certain level, when the battery can’t provide uninterrupted power supply, causing power failure for railway equipments. Battery discharging for one min is not enough for operation of essential services. So this self-test is unreliable.

Second. In electrified railway, UPS battery keeps in the floating charge state for a long time, which reduces battery lifetime.

In electrified railway, its power supply uses two ways of the city electricity, which are mutual standby. In this case, power failure seldom occurs, battery rarely discharges. So battery keeps in the floating charge state for a long time. In order to extend the battery life, so as to reduce costs, it is an effective method to make battery regularly discharge.

The second problem Discharge time of battery is difficult to control.

In the process of battery discharge, excessive discharge can reduce battery lifetime. This situation should be avoided. The present control method of battery discharge is through monitoring residual capacity of battery. When the battery discharges up to 60 %, it stops discharging. Even though the technology of battery capacity monitoring has developed quickly in recent years, to achieve accurate measurement of battery capacity is impossible at present. In this case deep discharge may occur. To avoid deep discharge, conducting experiment of battery discharge in this paper is to answer the question that how to control battery discharge effectively.

12.3 Working Principle and Function of the Maintenance System

According to the three aspect problems mentioned above, a maintenance system has been designed. Its schematic is shown in Fig. 12.1 This system has following functions:

The first function Making battery regularly discharge

To solve the problem that UPS battery keeps in the floating charge state for a long time, design the discharge circuit shown in Fig. 12.1 The maintenance process: open the switch 2, close the switch 3, it is electricity that supplies power for

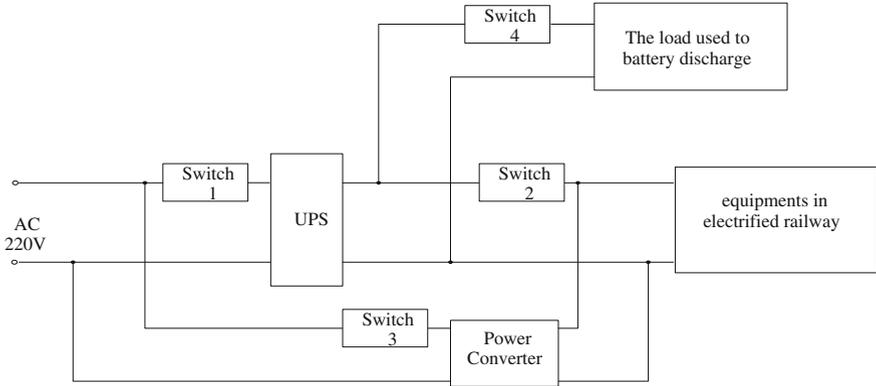


Fig. 12.1 The schematic of maintenance system for UPS

load instead of UPS; failure; open the switch 1, close the switch 4, it is up to UPS battery to supply power for load at this time. When the battery discharges up to 60 %, then it stops.

The second function Failure detection for the battery

According to the unreliability of the self-test, failure detection circuit (shown in Fig. 12.1) has been designed in this paper. Repeat the process of Maintenance process mentioned above. Make the UPS battery discharge and monitor the discharge time. If the time monitored is not enough for railway equipments, the battery is considered failure. Then the flashing light flashing issues a “battery failure” alarm. The battery needs to be replaced. This test is more reliable than the self-test, which can avoid power failure due to that the discharge time of battery is too short.

The connection between UPS and its maintenance system is shown in Fig. 12.2 It indicates the maintenance system is ancillary equipment for UPS.

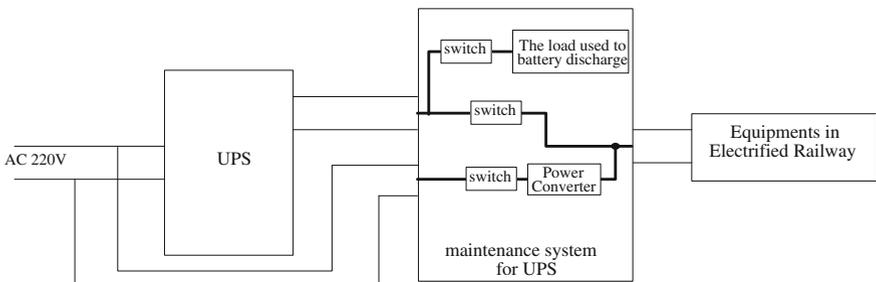


Fig. 12.2 The connection between UPS and its maintenance system

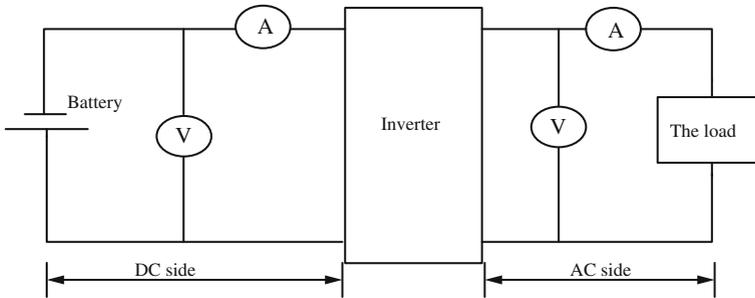


Fig. 12.3 The simplified experiment circuit

12.4 The Control of Battery Discharge

Battery discharges up to 60 %, then stop. If the measurement of battery capacity is inaccurate, battery would battery up to 70, 80 %, or even more. Deep discharge may occur. This will damage battery.

The purpose of the experiment: the purpose of the experiment is to find how to control the battery discharge in a better way.

The simplified experiment circuit: the simplified experiment circuit is shown in the Fig. 12.3.

Experimental data (Table 12.1).

The summary of the experiment the analysis of experiment data:

In the process of battery discharge, alternating voltage holds steady at 228 V and alternating current holds steady at 0.92 A. Even though the load changes, alternating voltage remains. This indicates performance of UPS inverter is high.

The DC voltage changes in the process of battery discharge, as shown in Fig. 12.4.

The DC current changes in the process of battery discharge, as shown in Fig. 12.5.

To prolong battery lifetime, it is important to avoid deep discharge. Taking 12 V batteries for example, its discharging end voltage should be above 10.5 V. If it is under 10.5 V which is called safe voltage of battery, UPS battery will be damaged. Accompanied with deep discharge, battery end voltage of battery will be certainly under 10.5 V. So battery discharge can be controlled on the basis of DC voltage. In the process of battery discharge, when the DC voltage dips to 10.5 V, battery discharge stops. This control method is secure and simple.

Table 12.1 The experimental data

DC voltage (V)	DC current (A)			Hold time (min)	AC voltage (V)	AC current (A)
	Min	Max	Average			
24.3	10.9	11.18	11.04	2.3		
24.2	10.97	11.23	11.1	2.13		
24.1	11.05	11.29	11.17	2.2		
24	11.08	11.35	11.215	2.02		
23.9	11.27	11.35	11.31	2.12		
23.8	11.28	11.37	11.325	1.46		
23.7	11.32	11.42	11.37	1.3		
23.6	11.34	11.43	11.385	1.3		
23.5	11.37	11.47	11.42	2.03		
23.4	11.39	11.55	11.47	1.13		
23.3	11.47	11.55	11.51	1.39		
23.2	11.49	11.76	11.625	1.38		
23.1	11.49	11.78	11.635	1.35		
23	11.52	11.79	11.655	1.3		
22.9	11.58	11.79	11.685	1.18		
22.8	11.71	11.8	11.755	1.56		
22.7	11.72	11.92	11.82	1	228	0.92
22.6	11.8	11.94	11.87	1.32		
22.5	11.82	11.96	11.89	0.58		
22.4	11.86	12.11	11.985	1		
22.3	11.88	12.07	11.975	0.5		
22.2	12.02	12.15	12.085	1.08		
22.1	11.99	12.08	12.035	1		
22	12	12.24	12.12	0.52		
21.9	12.02	12.23	12.125	1.1		
21.8	12.16	12.23	12.195	0.4		
21.7	12.12	12.27	12.195	0.3		
21.6	12.26	12.39	12.325	0.45		
21.5	12.27	12.38	12.325	0.3		
21.4	12.26	12.4	12.33	0.46		
21.3	12.36	12.48	12.42	0.35		
21.2	12.39	12.46	12.425	0.14		
21.1	12.44	12.51	12.475	0.12		

The experimental data when the rated power of load is 190 W
 Parameters of UPS battery: output voltage is 24 V; capacity is 10 A h (17 A h)

Fig. 12.4 The DC voltage curve

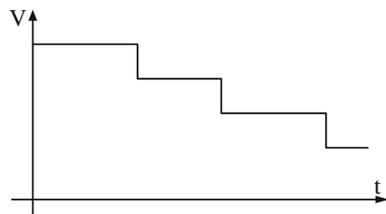
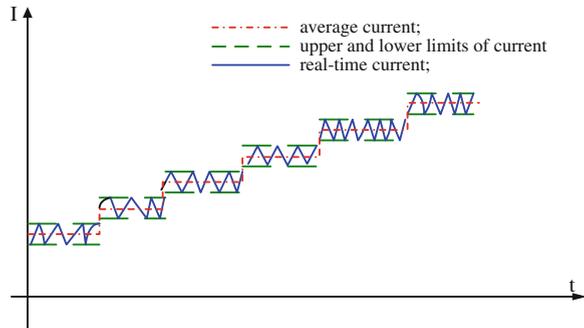


Fig. 12.5 The DC current curve



12.5 Conclusion

The maintenance system for UPS designed in this paper realizes the function that battery is able to discharge regularly, it consummates the self-test of UPS and it can control battery discharge in a better way. What's more, this system can replace artificial maintenance, saving labor.

References

1. Sklieau RD (1994) A diagnostic testing program for large lead acid storage battery banks. *IEEE Trans Ind Appl* 21(10):31–34
2. Li YP, Liu QZ (2011) The relation between discharge voltage and residual capacity of VRLB in stand-alone PV system. *Battery* 87:99–120
3. O MS (2004) The present situation and the development of capacity estimation of VRLA. *Battery* 55(2):59–63
4. Thomas L (1994) Comprehensive noninvasive battery monitoring of lead-acid storage cells in unattended location. In: *IEEE international communications and energy conference*, vol 88. pp 594–601
5. Carle RH (2007) An overview of UPS systems: technology, application and maintenance. *Ind Appl Mag IEEE* 1(6):159–191
6. Holt DJ (2000) High power valve regulated lead-acid batteries for new vehicle requirements. *Automot Eng Int* 33(4):24–37
7. Breeher C, Rseberg LA (2000) A method for identifying the full charging point and the degree of deterioration of lead-acid batteries. In: *Twenty-second international telecommunications energy conference*, vol 12(11). pp 609–614

Chapter 13

Characteristics and Methods of Southern Henan Power Grid Planning

Menglan Huang and Yaoxian Li

Abstract Electricity market is to establish higher demands on network planning, network planning will face more difficulties and challenges in network planning would involve a lot of technical problems, such as: load forecasting, electrical calculations. This paper analyzes and clarify the idea of planned work in this case the grid and look forward to the use of reasonable methods to minimize the cost of inputs to maximize the efficiency of power supply, and emphasis on network planning needs to master two important boundary of load development and power planning conditions, strengthen the work of the rolling adjustment of network planning.

Keywords Electricity markets · Network planning · Load forecasting · Power

13.1 Introduction

With the gradual deepening of the reform of southern Henan Power, power plants and power grids will be completely separated and independent power generation companies and has a natural monopoly power grid companies. Grid Corporation as the system operator and transmission asset owners and shoulder power balance operators, transmission service and transmission facilities, maintenance, expansion and investment functions [1]. Due to power grid companies are natural monopolies, regulated by the government and other agencies. With the power of market mechanisms to establish and improve the competitive electricity market there will be new

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requirements on the grid, the grid environment will change; the idea of network planning will also be adjusted [2]. Grid planning to the following plan: (1) the grid load forecasting, network planning to bear on the grid before the electricity load, and for the voltage layout, the grid scale of construction, equipment selection, to provide the necessary basis. (2) Electric power and energy balanced design, the balance of power consumption, to ensure that the economy of the grid operation. (3) network structure, which is the entire network build design ideas, that is how the way to plan the structure of the entire grid, including the design of reliability, the network of the way, the neutral point operation mode, the track laying design, the reactive power balance [3]. (4) electrical computation, this is mainly the stability of the grid analysis, power flow calculation, short-circuit current calculation, its role is to simulate the operation of the grid, computing grid operation parameters in different operating conditions [4], thus the grid the feasibility of the simulation analysis, and design to conduct feasibility studies to determine the final network design.

13.2 Characteristics of Network Planning in the Electricity Market

A major task of the traditional network planning is in line with the power supply planning, on the basis of the growth of the planning period load and power planning program, in order to meet the electricity supply and demand determine the optimal network development plan, so that the power grid construction and minimum running costs. Therefore, the benefits of grid investment in the electricity market will be the determinants of network planning. In the competitive electricity market, the economic operation of power grid is first and foremost, a variety of constraints and operating systems are economic in nature, while the system security and reliability in the electricity market operations cannot be ignored.

13.3 The Challenges of the Electricity Market in the Traditional Network Planning

Traditional network planning, on the basis of the known power load forecasting programs and power construction program, to meet the electricity sent out and demand development, feasibility studies to determine the optimal network structure of the planning level, to ensure that the power safe and reliable to be sent to users, and power grid construction and operating costs minimum. As the enterprise of the old system of power generation, transmission, power supply integration, network planning, construction and operation of only the internal behavior of power enterprises, load forecasting, power construction and other factors are uncontrollable factors. Electricity market is established, hair, transmission and

distribution, the separation of the sale link, network planning will be faced with the uncertainty of market factors, including the development of load, power construction, the system trend change needed to meet the user on the grid “economic, security, flexible and open” requirements, network planning in the electricity market than traditional electricity planning face more difficulties and challenges.

13.3.1 The Future Uncertainty of the Load Change

In the electricity market, the factors affecting the development of the electric load increases, the load there is a big uncertainty. In the traditional power system, power load and the regional economic development have a greater relationship, power companies are always to meet the electricity demand growth is the primary task, and electricity prices basically unchanged for years. Network planning in the electricity market in addition to long-term load forecasting tradition, but also consider the impact of the electricity market the electricity load. With the deepening of reform of the electricity market, the market will be open to the user side, the electricity price fluctuates with the electricity supply and demand in the market, and in different regions due to the different transmission costs, and electricity prices there are also different. Consider the user’s level of demand elasticity; the load will change with the fluctuation of electricity price, which put forward higher requirements for load forecasting in the network planning.

13.3.2 The Large Uncertainty of Power Supply Planning and Construction

Because for Chang Wangfen, power supply planning and network planning the appropriate separation, relatively independent. Power construction is completely determined by the power plant investors, construction principles must be investment to maximize profits. The current after Chang Wangfen home, who do power planning, is no consensus. By the relevant government departments responsible for the preparation of power planning, but planning and implementation of who controls, planning who is going to adjust, remain outstanding. Power planning depends largely on the market electricity price fluctuations, changes in national policy, energy prices and the change of load factors. Therefore, the new units (or plants) the type, location, capacity, and put into operation, as well as the old unit and the decommissioning of old power plants or outage situation is basically determined by power generation companies own, and this information often cannot advance released in the market for network planning uncertainty to the grid plan of the larger difficulties.

13.3.3 Increases in the System Uncertainty of Power Flow and Uneven Distribution

Electricity market gives retailers and large users of power purchase option, increasing the uncertainty of the system, the trend at the same time, power bidding system trend of uneven distribution. May occur due to the direct trading of electricity users and electricity producers, large-scale long-distance transmission grid have sufficient transmission capacity. As the power supply side bidding, unlike the traditional operation scheduling, operation mode will be a variety of circumstances, the requirements of the transmission channel.

13.3.4 Power Construction, Grid Planning and Construction Coordination Difficult

At present, the reform of China's power system is only to complete the separation of generation stage, the grid company is a single purchaser of the electricity market, the set of transmission, distribution and sale of electricity one. At this stage, the user side does not have the self-regulating capacity with electricity, the lack of reasonable transmission price formation mechanism, network planning more difficult. Network planning in the electricity market is facing so many challenges, as the grid planning and grid managers must adjust their thinking, change the mode of network planning, to adapt to the needs of the electricity market.

13.4 Planning Techniques in the Power Network

13.4.1 Load Forecasting Techniques

The forecast load grid planning in an important prerequisite is the most important early work; reasonable predictions can be accurate guidance on the entire supply network planning in order to determine the size and mode of operation of the grid. Load forecasting methods used in traditional prediction: method of unit consumption, electricity elasticity coefficient method, the per capita electricity law, issued in chronological order, lateral similar comparison. These methods in practical applications have certain hungry limitations. In recent years there have been some of the more advanced forecasting methods, such as: gray prediction, fuzzy clustering identification method, and the load characteristics of the prediction method.

13.4.1.1 Fuzzy Clustering

This approach is through analysis of historical data and processing to extract a number of models of the electricity load changes, and then use the images load change development trends to determine the load of the planning area is the kind of mode, in order to reach the long-term planning purpose. Specific planning and implementation should be to produce short, population growth, primary industry, secondary industry, tertiary industry GDP of these five factors as an important factor of the image power load, considering the load forecasting. Specific predictions are: environmental factors, the overall analysis of the historical growth in electricity demand, and further establish the variation of environmental factors in the future forecast year, in order to select the closest environment model from the model, and to determine the grid electricity development.

13.4.1.2 The Load Characteristics Prediction Method

This approach is in the urban economic base is weak, the electricity base, its expected to occur in the future development of larger power consumption changes, depending on the economic development brought about by changes in the industry. Therefore, when the electricity load forecast, historical data cannot fully reflect the local load characteristics, then they should understand the direction and planning of the regional economic construction in the planning and construction of large-scale electricity projects parallel investigation into the planning load forecast, in order to plan the program planning of the high and low, and decompose the calculations to arrive at the next annual average maximum load, and then choose the best option, depending on the situation.

13.4.2 The Balance of Power and Electricity Technology

Should carry out the necessary balance of power in the planning, the main principles are: to balance the seasonal peak load; the maximum capacitance of the system is the largest unit; underestimate the load to reduce pro rata in accordance with the standards of the peak period, such as the use 50 %; within the power grid to provide electricity to make the necessary conventions. Such as the introduction of the station power supply, the power balance in the wet and dry seasons, and calibration equipment of the wet period of the electricity network performance, power transmission economy, and the dry season deal with balance of power is to lack of electricity in case of grid operation.

13.4.3 Network Architecture Planning Techniques

Mainly used for the method of the hierarchical partition of load planning electric power network, its main criteria is the prediction of the hierarchical partition, planning and design standards, etc., according to the relevant requirements to implement the basic ideas of the hierarchical partition of layers and the district needs to clear the burden of the supply area to avoid overlapping. During the entire planning of the network used, shall be in accordance with the standards and principles of overall planning, grid security, reliable, complete structural specifications (power scale, wiring), substation capacitor load specification, short circuit protection specification grid neutral point operation principles, reactive power balance.

13.4.4 Electrical Computing Technology

Electrical calculation included the trend calculations, stability calculations, short circuit current calculation. This calculation, the use of computer-aided, namely the use of computer simulation of the entire planning process after the implementation of operating conditions, such as: the use of AC power flow calculation, simulation of a variety of operating conditions, so that you can verify the feasibility of the grid. Is the expected load of the grid program and planning to add up to test the design of the network, from a fundamental view of the working conditions of the simulations, in order to calculate a variety of network indicators, such as: power supply capacity, voltage level trend of the flow of network loss, ability to protect specific data for planning specific guidance data.

13.5 Network Planning Ideas on Market Conditions

A viable network planning program must be able to meet the requirements of the future electricity market grid capacity to ensure the reliability of grid operation and safely recover their investment costs. Network planning steps: measuring the power planning and load trends; predict the future electricity market conditions and price level; analysis and screening of a variety of planning programs; asked the candidate planning scheme; to estimate the possible gains; risk assessment and investment analysis.

The new power system, the power grid to maintain a monopoly business, but does not mean that power providers and users must yield to the power grid. Power grid enterprises to provide transmission service, which means that reliable power providers and users of electricity transactions must meet the requirements; goal of the global power sector reform in the power industry to break the monopoly and

introduce competition, reduce costs, improve efficiency, optimize allocation of resources, power grid construction and operation must follow the principle of “economic”, and how to reduce the cost of construction of power grids, to reduce transmission operating costs is an important goal of network planning.

13.6 Conclusion

Electricity market reform has changed the traditional power grid planning ways and means. Network planning in the electricity market must take into account the considerable uncertainties, including the planning of future power supply, load changes, market transactions lead to the trend of change. The same time, the economic evaluation of the grid investment will have a more important role in network planning. Grid investors will face a higher risk of investment; the development of appropriate risk management tools will have significance. The grid of the electricity market economy and security of the grid is far more than the traditional meaning to build an “economic, safe, flexible and open” is the basic guarantee of the electricity market operator. Therefore, in addition to the rational scientific planning techniques should also be timely to increase the factors of economic development, optimize the design of the program, so that economic rationality, in line with long-term development.

References

1. Zhang QA (2010) Characteristics of the power grid planning. *China new Technol Prod* 2(1):199–204
2. Xu XD (2010) Present situation and prospect of network planning. *China New Technol Prod* 5:87–92
3. Gu YL, Nuo X, Wang XT (2007) The difficulties and improvements of the genetic algorithm utilization in the power grid planning. *Power Syst Technol* S1:29–34
4. Shi LIB, Xu GY (2000) A new method of self-adaptive evolutionary programming on multi-objective optimal operation of power system. *Proc CSEE* 08:31–37

Chapter 14

Analysis of Different Connection Modes in MV Distribution Systems

Xiao Qin

Abstract The paper analyzes and compares features of various wiring modes in the distribution network and power supply reliability. Meanwhile, based on quantitative analysis and synthetic consideration, some useful schemes are proposed. Furthermore, under the conditions of different load density of power-supply areas and different substation capacity, connection modes for distribution systems are calculated and analyzed to get their trends with load density and substation capacity varied.

Keywords Medium voltage · Distribution systems · Connection mode

14.1 Introduction

The city power grid ever-expanding choice of what kind of wiring in this process is a very worth exploring, it involves not only a grid construction economy, but also related to the reliability of electricity supply. At the same time, our transmission and distribution system is a high line loss rate of 8.77 % in 1995, 1997 8.20 % distribution system loss is particularly acute, Japan, Germany, France and other countries line loss was only about 5.6 %. Level, China's distribution system in 1997 net loss equivalent to more than foreign loss of 18 billion KW · h of electricity, equivalent to the loss of annual generating capacity of 3–4 million kW class power plants [1, 2].

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10 kV distribution network as the main part of the pressure grid in the city, its position is very important. In order to achieve the power grid safety, economic operation, and to achieve the standardization of the wiring, unified requirements necessary under different load density, the capacity of the different 110 kV/10 kV substation, 10 kV grid in order to grid planning, operation, provide a useful reference.

14.2 Technical and Economic Analysis of 10 kV Distribution Network Connection Modes

14.2.1 kV Distribution Network Connection Modes

10 kV medium voltage distribution network by a high voltage of 10 kV substation power distribution equipment, switches, power distribution and overhead lines or cable lines and other components, its function is to electrical safety, reliability, economy, reasonably assigned to the user [3].

In general, the city's distribution network consists of a mixture of overhead lines and cables, to adopt a network structure in a specific supply area of 10 kV distribution network overhead lines and cable lines separate study, so without loss of generality [4]. Taking into account the practical feasibility of overhead lines in the area of study power supply wiring mode, we studied four kinds of representative wiring mode, that is a single power cord radiation wiring, loop wiring outlet in different bus, different bus back the ring terminal of the line, as well as three segmented contact wiring, respectively, as shown in Fig. 14.1

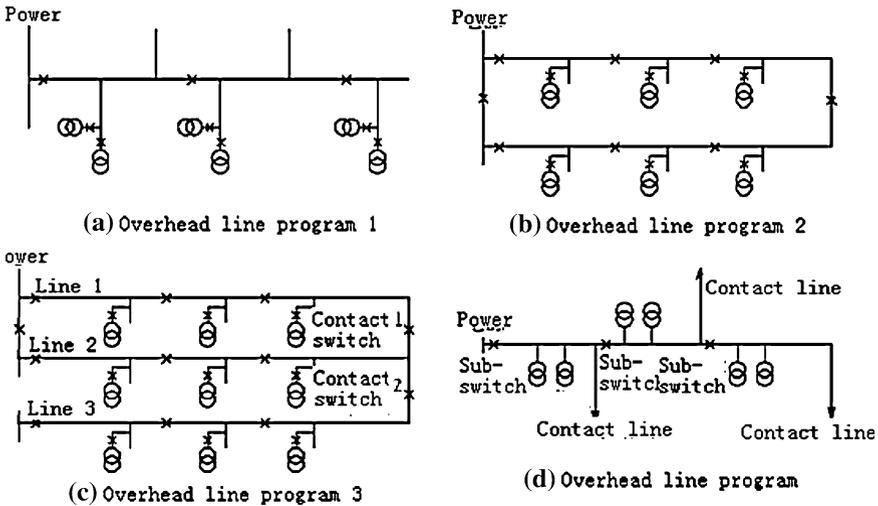


Fig. 14.1 Overhead line program

14.2.2 Distribution Network Connection Modes

Distribution network connection modes can be divided into parallel four kinds of radiation, ring network, network and multi-loop structure. Radiation after a lack of fault, the network transfer capability in less reliable, basic distribution system planning using the ring network and network structures is mainly used in medium voltage power structure in two kinds [4]. Common distribution network connection mode of radiation, two-shot, single-loop, double loop, #-shaped, parallel to the direct supply, two for one prepared by the 4×6 network, as shown in Figs. 14.2, 14.3, 14.4, 14.5, 14.6, 14.7, and 14.8.

14.2.3 Distribution Grid Technical and Economic Analysis

User-oriented distribution network, so in the actual analysis that the distribution network composed by a number of cell and each cell by a 110 kV distribution station, 10 kV transmission line, switching equipment, etc.; the same time, in order to facilitate the research that each cell are the 110 kV distribution station and substation power supply radius is the radius of the circular supply area. Technical and economic analysis of the 10 kV distribution network, it is more economical and reliability aspects [4]. Economic analysis of ideas is: comprehensive investment of 110 kV distribution station and 10 kV outlet investment by the annual value method converted to the annual value, plus annual operating costs of the 110 kV substation and 10 kV outlet line loss, and then according to the annual cost of the unit load to compare the different options of investment size.

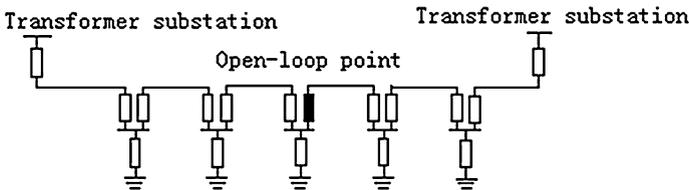


Fig. 14.2 Single ring of the cable line

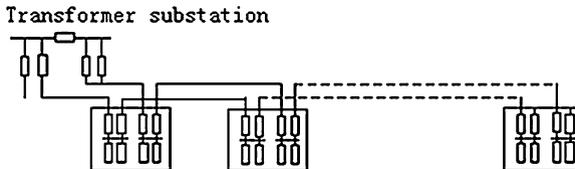


Fig. 14.3 Bijection network connection modes

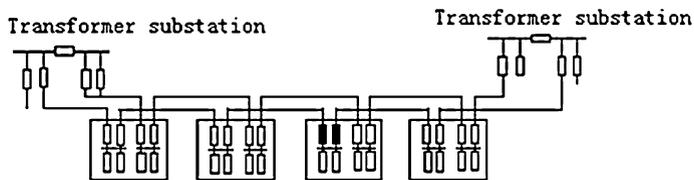


Fig. 14.4 Double loop networks mode

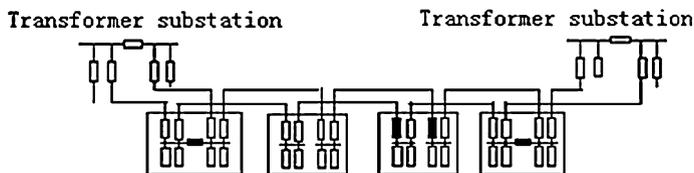


Fig. 14.5 #connection mode

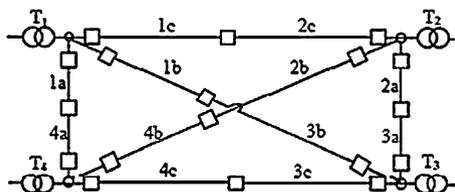


Fig. 14.6 4*6 networks connection mode

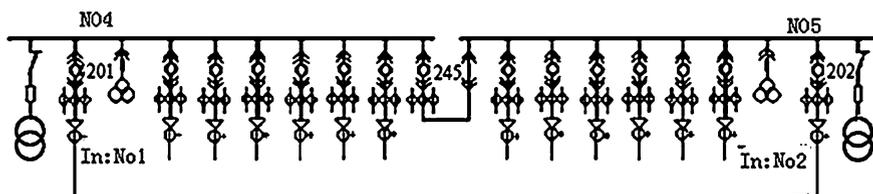


Fig. 14.7 Dual-loop parallel to the power supply

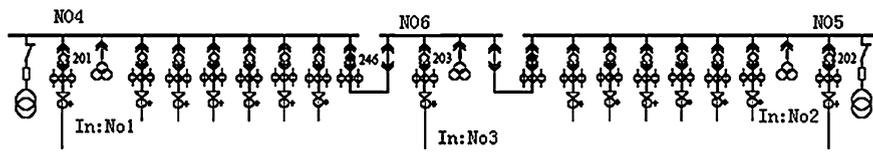


Fig. 14.8 Two supply and one backup power supply mode

According to the diagram of the supply scheme described in a variety of connection modes: power supply scheme of the radiation of a single power cord wiring (overhead line or cable), segmented contact wiring power programs (overhead lines) different bus outlet connection to the program of opening and closing the power supply wiring (cable), power supply scheme of the different bus ring cables (opening and closing), (cable).

14.3 Medium Voltage Distribution Network Economic Analyses

The basic idea is: economic calculation of the distribution program in different load density, the combination of a 110 kV transformer capacity and number of units to determine the substation supply areas in the supply area to consider several practical 10 kV overhead line and cable network structure, and each program to calculate the annual cost of the unit load, and finally, depending on the size of the unit load of the various programs the cost to determine its economic.

Specific to calculate the reference power supply scheme map, the region of each of the selected power supply distribution stations, lines and other power distribution equipment investment costs. Calculated taking into account the running costs of the line losses and transformer losses, respectively substation costs and line costs, and then press the “present value of the annual value method” [3], into the substation costs and line costs, the two together again divided by the maximum load of the substation in the program, and finally the distribution program, the annual cost of the unit load value.

14.3.1 Substation Economic Calculation Method

Substation costs by two parts of the substation investment costs, substation operating costs.

Substation integrated investment ZS including comprehensive investment transformer, power distribution equipment investment as well as unforeseen additional investment.

Substation annual running costs of the U.S. (million) including a year in energy loss of the transformer charges and maintenance, maintenance fees, namely:

$$U_s = \partial \Delta A_s \times 10^{-4} + U_{s1} \quad (14.1)$$

Among: U.S. 1 substation maintenance and maintenance costs (in million); electricity tariff, 0, 41 Yuan/(KW · h); Δ AS substations throughout the year electricity losses worth (KW · h).

China's power industry recommended "minimum cost method" for dynamic economy. The formula is:

$$F_{NS} = Z_s \left[\frac{r_0(1+r_0)^{n_s}}{(1+r_0)^{n_s} - 1} \right] + U_s \quad (14.2)$$

Where: the F_{NS} is evenly distributed in the substation of n years the annual cost; Z_s Substation investment; n_s , the economic useful life of the substation, take 25 years; r_0 return on investment for the power industry, at this stage to take 0.1.

14.3.2 Line of Economic Calculation Method

Constitute the cost of the line and substation consists of two parts of the comprehensive investment costs, operating costs.

Line operating costs U_L (million) mainly consists of a energy loss in the line of fees and maintenance, maintenance fees, namely:

$$U_L = \partial \Delta A_L \times 10^{-4} + U_L \quad (14.3)$$

Where: the U_L for line maintenance, maintenance fees (Unit: Yuan); ΔA_L line full-year gross energy losses (KW · h).

For the line economic, economic and substation comparison, but also a dynamic economic comparative law, and its formula is:

$$F_{NL} = Z_L \left[\frac{r_0(1+r_0)^{n_L}}{(1+r_0)^{n_L} - 1} \right] + U_L \quad (14.4)$$

Where: the F the NL average distribution in the line of n years, the annual cost; of Z_L is the line integrated investment; n_L for the economic useful life of the lines, overhead lines to take 30 years, the cable line to take 40 years.

Unit load in calculating the substation and line charges, but also to calculate the distribution program costs the value of the F_N :

$$F_N = (F_{NS} + F_{NL})/P \quad (14.5)$$

Where: P for this program substation load. F_N values smaller programs on the economics of comparative advantage.

14.3.3 The Distribution Network of Economic Calculations

Specific analysis and calculation, in order to get the general law of the load density (in units of MW/km²) were taken 0, 5. 0, 20.0, 40. 0, 110 kV substation capacity of 2×25.0 MVA, 2×31.5 MVA, 2×40.0 the MVA, 2×50.0 MVA, 2×63.0

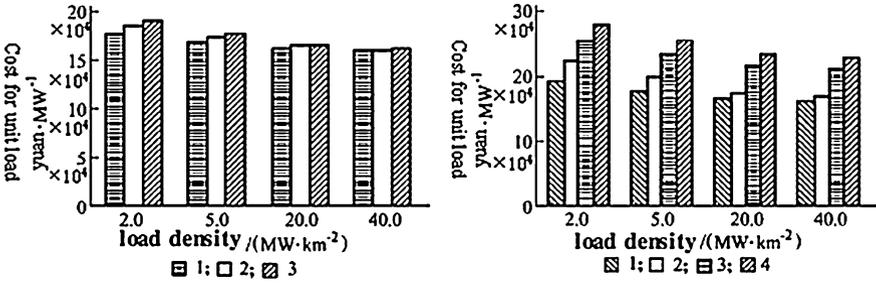


Fig. 14.9 Curve of relation between year cost for unit load and load density

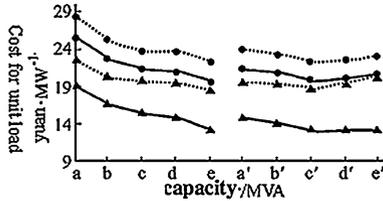


Fig. 14.10 Curve of relation between year cost for unit load and substation capacity

MVA, 3×25.0 MVA, 3×31.5 MVA, 3×40.0 MVA, 3×50.0 MVA and 3×63.0 of the MVA. On this basis, the overhead lines and cable lines in several different connection modes, to study the economic trends with load density and substation capacity, and density of the same kind of load and substation capacity under the conditions of different connection modes of inter-comparison.

Figure. 14.9 show the capacity of 2×25 MVA, Substation different distribution network connection modes (overhead lines for the three kinds of cable lines for the four kinds of) the annual cost of the unit load situation. Different patterns under the same load density adjacent column diagram represent several different costs of the program indicators.

Figure. 14.10 is a load density of 2 MW/km^2 in conditions different

Distribution network connection modes, the annual cost of the unit load. Adjacent to the curve represents the cost index of several different programs.

From Figs. 14.9 and 14.10 can be seen in the substation capacity, the annual cost of the unit load, overhead lines and cable lines, distribution networks for the same kind of connection modes with the increase of the supply area load density decreases; in a certain load density for the same kind of connection modes, the annual cost of the unit load with the increase of the substation capacity decreases. In addition, in the same substation capacity and load density, the annual cost of the unit load of overhead lines several connection modes from low to high order of the radiation of a single power cord connection modes, different bus outlet ring connection modes or different bus back ring terminal of the line model, segmented three-contact connection modes; cable lines several connection modes annual cost

of the unit load from low to high, followed by radiation of a single power cord connection modes, different bus outlet ring connection modes, different bus outlet wiring connection opening and closing mode, the bus ring network wiring (three open and close) mode.

14.4 Conclusion

Based on the medium voltage distribution network economic analysis of the results, after comprehensive consideration, from which to draw general conclusions:

- (a) in the area of the high reliability requirements such as the bustling city center district, the 10 kV network connection modes generally use the cable connection, at this time recommended that the cable wiring bus ring network wiring (three open and close) mode or the bus outlet connection opening and closing the connection mode.
- (b) in the area requiring high reliability such as the general urban areas such as the 10 kV network connection mode of the proposed different bus cable wiring ring terminal mode or overhead wiring outlet three segmented contact wiring pattern can also be different bus overhead wiring outlet ring wiring patterns and different bus back line of the ring terminal mode.
- (c) the reliability requirements for high areas such as suburbs, etc., the 10 kV network wiring pattern suggests a different bus overhead wiring outlet ring ring wiring pattern or a different bus back line connection modes.

References

1. Xiong J (1994) Urban power network planning statute. Energy Dep Constr Dep PRC 16:357–362
2. Keng Y, Guangyi L, Jingyang Z (1998) Economy analysis of different connection modes, vol 12. Science Press, Beijing, pp 67–73
3. Zhangchao C, Deguang T (1998) Urban power network planning and reconstruct, vol 3(05). China Electric Power Press, Beijing, pp 243–247
4. Hui N, Haozhong C, Zhang Y (2000) Review of reliability and economy problems in transmission expansion planning. Autom Electr power Syst 24(1):51–56

Chapter 15

Fault Diagnosis of Power Electronic Circuits Based on BP Neural Network

Danjun Wu, Li Ping and Youping Fan

Abstract Based on neural BP network theory, a new online fault diagnosis method for Rectifier electronic circuits is presented. A neural BP network is founded, which is able to diagnosis faults of three phase rectifier effectively, and keeping a high speed of diagnosing relative to the capacity of the computer. The outcome of simulating shows that this method is feasible.

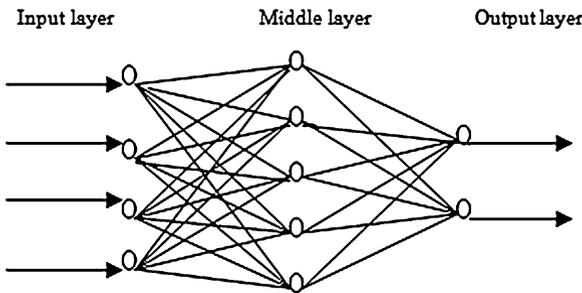
Keywords Fault diagnosis · BP neural network · Rectifier circuit

15.1 Introduction

This paper studies the application of neural network theory for fault diagnosis of power electronic circuits, power electronic circuit failure; experienced experts can determine a point in the circuit voltage or current waveform point of failure. If you can take advantage of the learning ability of neural networks, the relationship between the fault waveform and the cause of the failure by the neural network learning to save in its structure and the right, then will learn a good neural network for fault diagnosis, neural networks can be passed analysis of the voltage or current waveform obtained the cause of the malfunction in order to achieve fault-line automatic diagnosis. The following inductive load three-phase rectifier circuit fault diagnosis, for example, to study the neural network fault diagnosis method based on waveform analysis.

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Fig. 15.1 BP ANN module



15.2 Neural Network Model Used to Diagnose

Now dozens of neural networks models have been developed, such as Hopfield model, Feldmann, the connected network model, Hinton, and other glass Erci Man machine model, and Rumelhart’s multi-layer perceptron model and Kohonen self-organizing network model and so on. In many neural network models, the most widely used multilayer perceptron neural network. Multilayer Perceptron neural network research began in the 1950s, but has been little progress. Error back-pass learning algorithm (BP operator) until 1985, Rumelhart et al., Minsky’s multi-layer network scenario is shown in Fig. 15.1.

BP algorithm is not only the input layer nodes; the output layer nodes can have one or more hidden layer nodes. For the input signal, the first forward propagated to the hidden layer nodes, after the role of function, then the hidden output signal transmitted to the output node, and finally given the output. The role of the node activation function is usually to select the S-shaped function, such as

$$f(x) = \frac{1}{1 + e^{-x/Q}} \tag{15.1}$$

Forward propagation process, the input information from the input layer by the implicit layer processing, and transfer to the output layer. The state of the neuron in each layer affects only the status of the next layer of neurons.

Sigmoid type, the characteristics of each node set containing an arbitrary network of n nodes. For simplicity, the specified network has only one output y, the output of any node i, O_i , and has N samples $(x_k, y_k) (k = 1, 2, 3...N)$, a input x_k , network output y_k , the output of node i, the O_{ik} , node j input net $net_{jk} = \sum_i W_{ij}O_{ik}$ and

the error function is defined as $E = \frac{1}{2} \sum_{k=1}^N (y_k - \bar{y}_k)^2$ which \bar{y} the actual output for the network, define

$$E_k = (y_k - k)^2, \delta_{jk} = \frac{\partial E_k}{\partial W_{ij}}, \text{ and } o_{jk} = f(net_{jk}) \tag{15.2}$$

So

$$\frac{\partial E_k}{\partial W_{ij}} = \frac{\partial E_k}{\partial net_{jk}} \frac{\partial net_{jk}}{\partial W_{ij}} = \frac{\partial E_k}{\partial net_{jk}} O_{ik} = \delta_{jk} O_{ik} \quad (15.3)$$

When j is output node, $O_{jk} = \bar{y}_k$

$$\delta_{jk} = \frac{\partial E_k}{\partial \bar{y}_k} \frac{\partial \bar{y}_k}{\partial net_{jk}} = -(y_k - \bar{y}_k) f'(net_{jk}) \quad (15.4)$$

If j is not the output node,

$$\begin{aligned} \delta_{jk} &= \frac{\partial E_k}{\partial \bar{y}_k} \frac{\partial \bar{y}_k}{\partial net_{jk}} = \frac{\partial E_k}{\partial O_{jk}} \frac{\partial O_{jk}}{\partial net_{jk}} = \frac{\partial E_k}{\partial O_{jk}} f'(net_{jk}) \\ \frac{\partial E_k}{\partial O_{jk}} &= \sum_m \frac{\partial E_k}{\partial net_{mk}} \frac{\partial net_{mk}}{\partial O_{jk}} \\ &= \sum_m \frac{\partial E_k}{\partial net_{mk}} \frac{\partial}{\partial O_{jk}} \sum_i W_{mi} O_{ik} \\ &= \sum_m \frac{\partial E_k}{\partial net_{mk}} \sum_i W_{mj} = \sum_m \delta_{mk} W_{mj} \end{aligned} \quad (15.5)$$

So

$$\begin{cases} \delta_{jk} = f'(net_{jk}) \sum_m \delta_{mk} W_{mj} \\ \frac{\partial E_k}{\partial W_{ij}} = \delta_{mk} O_{ik} \end{cases} \quad (15.6)$$

If the M layer containing only the output node, the first layer of input nodes, the BP algorithm is:

The first step, select the initial weights W .

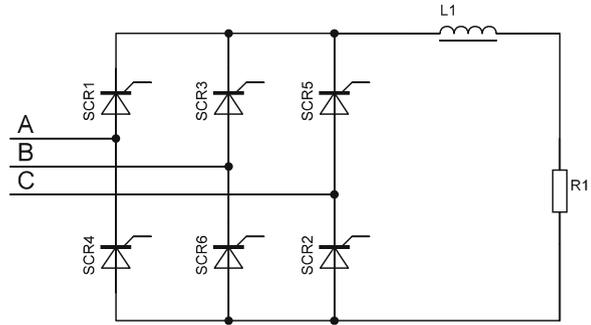
The second step, repeat the following process until convergence:

- a. for $k = 1$ to N
 - a). Calculate, net_{jk} and \bar{y}_k value (Forward the process of);
 - b). for each layer from M to 2 reverse calculate (Reverse process);
- b. for same node $j \in M$, based on (34.1) and (34.2) calculated δ_{jk} ;

Third, Modified weights, $W_{ij} = W_{ij} - \mu \frac{\partial E}{\partial W_{ij}}$, $\mu > 0$, in which $\frac{\partial E}{\partial W_{ij}} = \sum_k \frac{\partial E_k}{\partial W_{ij}}$.

It can be seen from the above BP algorithm, the BP model a set of sample i/O problem into a nonlinear optimization problem, it is the most common gradient descent optimization. If the neural network as input to output mapping, this mapping is a highly non-linear mapping.

Fig. 15.2 Rectifier circuit module



15.3 Three-Phase AC Circuit Rectifier Fault Model

Based on this, the first fault-free circuit transient analysis, the test point voltage standard database, and then based on the actual situation of the power electronic circuit simulation failure to establish the library of the failure of the test points. As shown in Fig. 15.2. First determination of the circuit under normal circumstances, the voltage u_d , and then the standard model into the fault element, and then tests the output voltage u_d . Assume that three-phase controlled rectifier circuit, the thyristor bridge arm conduction failure, up to two thyristor open faults [1, 2], then the fault can be divided into five categories.

Class 0: thyristors are working properly.

Class 1: circuit in a single thyristor failure. It can be divided into six kinds of failure, v_1 , v_2 , v_3 , v_4 , v_5 and v_6 , respectively, a thyristor failure.

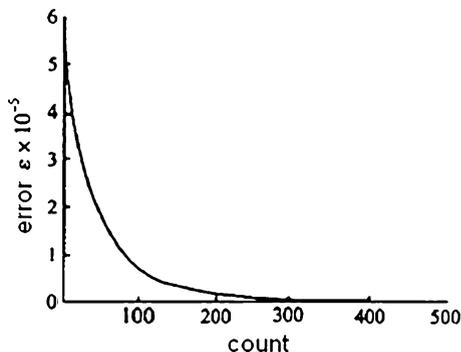
Class 2: circuit, two different groups of in-phase thyristor failure, it can be divided into three kinds of failure, v_1 and v_4 , v_3 and v_6 , v_5 and v_2 , respectively, at the same time failure.

Class 3: two with different phase thyristor three categories: circuit fails, it can be divided into six kinds of failure, i.e., v_1 and v_3 , v_2 and v_5 , v_4 and v_6 , v_1 and v_2 , respectively, at the same time failure.

Class 4: two different groups of different phase thyristor of four categories: circuit failure, it can be divided into six kinds of failure, i.e., v_1 and v_2 , v_3 and v_4 , v_5 and v_6 , v_1 and v_6 , respectively, at the same time failure.

The circuit can simulation software Multisim10 computer simulation of a simulation of the five kinds of failure u_d output waveform. Figure 15.3 shows the voltage waveforms of more than five failures = 30.

Fig. 15.3 Convergent curve of precision for the error



15.4 Intelligent Positioning of Faulty Components in the Circuit

The positioning of faulty components, you can collect the appropriate time (phase), the output voltage value, and then the neural network to determine [3]. The nodes of the neural network input layer is equal to one cycle of the ud voltage sampling the number of values, a cycle of sampled values of all the voltage is a learning sample, a learning sample corresponding to the output encoding. Failure to learn the set of samples, real-time voltage of the the ud voltage waveform sample value, using the trigger the angle from 0 to 120 changes, the circuit output voltage is sampled values under various fault conditions [4]. Voltage sampling samples constitute a sample set, the output code that corresponds to the fault element. The neural network output nodes should be equal to the number of thyristors in the circuit. Trouble-free output 0; circuit t thyristor failure, the output vector t elements of the $C_t = 1$ others are 0; the p and q thyristor, while failure, the output of $C_p = 1$ and $C_q = 1$, and the remaining elements to 0. And so on, as the neural network output expectations. After the neural network learning and training to make it reach a certain precision, in order to achieve thyristor failure intelligent positioning.

15.5 Diagnosis Example

50 Hz, 22 V three-phase rectifiers circuit, for example, to enter the neural network training and the diagnostic process. Trigger angle were take 0, 30, 60, 90, 120, various types of fault circuit obtained by Multisim10 simulation waveforms of the output voltage ud, Fig. 15.3 shows the firing angle of the 30, 5 kinds of fault conditions, the output voltage ud of the waveform. Data acquisition, data collected by the various types of failures (including normal) after data processing as a neural network learning sample set, as shown in Fig. 15.3. Table 15.1 is based on the learning neural network, the firing angle of were taken 0, 30, 60, respectively, set the T3 fault, T1-T4 failure and T2 and T6 fault diagnosis.

Table 15.1 Output of neural network diagnosis

Phase	Fault point	Realy output						Expect output					
		y1	y2	y3	y4	y5	y6	c1	c2	c3	c4	c5	c6
0	T3	0.0036	0.0033	0.9911	0.0025	0.0036	0.0054	0	0	1	0	0	0
	T1 T4	0.9902	0.0023	0.0014	0.9956	0.0025	0.0012	1	0	0	1	0	0
	T2 T6	0.0255	0.9952	0.0021	0.0074	0.0021	0.9965	0	1	0	0	0	1
30	T3	0.0101	0.0011	0.9952	0.0001	0.0002	0.0014	0	0	1	0	0	0
	T1 T4	0.9901	0.0002	0.0031	0.9978	0.0025	0.0014	1	0	0	1	0	0
	T2 T6	0.0018	0.9989	0.0001	0.0072	0.0001	0.9907	0	1	0	0	0	1
60	T3	0.0011	0.0114	0.0001	0.9985	0.0002	0.0005	0	0	1	0	0	0
	T1 T4	0.9925	0.0001	0.0024	0.9984	0.0025	0.0014	1	0	0	1	0	0
	T2 T6	0.0122	0.9952	0.0002	0.0004	0.0001	0.9925	0	1	0	0	0	1

15.6 Conclusion

Online fault diagnosis of power electronic circuits is often difficult, the operating personnel is difficult in the short period of power outage from failure to determine the faulty components or location. In this paper, the nonlinear mapping features of the neural network to store the voltage value of the various fault types of power electronic circuits, power electronic circuit fault diagnosis of intelligent online by the neural network. Experiments show that the method of BP neural network for fault diagnosis for power electronic rectifier circuit is feasible and effective, and has practical engineering value.

References

1. Zhu YF, Wang W, Tong SC (2010) Application of back propagation neural network in fault diagnosis of three-phase full-bridge controlled rectifier. *Electr Value* 3:42–46
2. Luo X, Wang Y (2006) Research on analog circuit fault diagnostic method based on wavelet-neural networks and information fusion. *Comput Meas Control* 14(2):146–149
3. Li CM (2000) Neural network approach to analog circuit fault diagnosis. *J inner mongolia. Pol Yt Ethnic Univ* 02(11):03–06
4. Zheng Z, Hu Yunan (2006) The application of wavelet neural network in analog circuit faults diagnosis. *Microcomput Inf* 06(1):06–09

Chapter 16

Study on Leaves of Three-Dimensional Modeling Technology Based on CAXA

Xinjian Xu

Abstract This paper with Profili and CAXA solid designing software for the platform, for small wind turbine blades of parameterized modeling methods are given. To improve modeling accuracy and efficiency, using the EXECL software solution for blade section method for modeling of three dimensional coordinate space location. CAXA manufacturing engineer for further research on machining of blades, solid design is given in the file output approach.

Keywords CAXA · Leaf · Modeling

16.1 Introduction

Leaves are wind turbines, turbine, propulsion, and other key components of the device, is a three dimensional distortions of the surface of the leaves, each section of the long string, twist angle, airfoils are different, complex configuration, processing difficulty and impossible parts design and manufacture of the traditional method [1]. With the development of CAD/CAM technology, design and manufacturing of precision blade surface becomes a reality [2].

CAD/CAM technology is computer-aided design and manufacturing techniques [3], its rapid development, is promote manufacturing management from product design and manufacturing to technology a series of profound changes, widely used in aerospace, aviation, marine, automotive, energy and other industries. Therefore,

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application and popularization of CAD/CAM software for technical support is becoming more necessary [4]. Three dimensional design of wind turbine blades using the software to be solved.

CAXA is made of the best CAD/CAM software. CAXA entity design 2011 is a unique set of innovative design, engineering design, and cooperative design in one of the next generation of 3D CAD software solutions. Design easy to learn and easy to use, fast, and compatible together is its best feature. It includes three dimensional modeling, simulation and analysis, and other features that work together, its unmatched ease of operation and design helps engineers more energy on product design, rather than the software. This article is based on CAXA software, study leaves of three-dimensional modeling technology.

16.2 Wind Turbine Blade Parameters Selection and Calculation

Calculate the rotor diameter d , determine the number of b , each blade profile chord length c , of thickness t , blade twist angle of θ , and select the airfoil blade profile. As shown in Table 16.1

Profili airfoil design software is a professional design of Airfoil analysis software, there is a wealth of wing-type database, easy to learn and use Windows interface. This article is based on the software selection and NACA4412 of Airfoil to Airfoil data output of the DAT file.

Early NACA airfoils are in the late 1930 of the 20th century by the United States National Space Agency (abbreviated NASA) predecessor, the National Advisory Committee (abbreviated NACA) made. NACA Airfoil thickness arc and stacking.

NACA four-digit Airfoil expressions for the NACA XXXX. Times the value of the first number represents the maximum relative curvature: second number represents 10 times the value of maximum camber relative position; the last two times the value of the numeric representation maximum relative thickness t . For example NACA4412 Airfoil, the maximum relative curvature of 4 %; maximum camber relative positions of 40 %; maximum relative thickness of 12 %.

Table 16.1 Parameter selections of wind turbine blades

Design power/w	Number of leaves	Wind wheel RADIUS/m	Reduction ratio λ	Starting wind speed/m/s	Rated wind speed/m/s
300	3	2.4	6	2	4

Table 16.2 Leaf design parameters

RADIUS	0.24	0.36	0.48	0.60	0.72	0.84	0.96	1.08	1.2
r (m)									
Chord length	0.189	0.154	0.127	0.106	0.09	0.078	0.069	0.062	0.056
C (m)									
Setting angle	0.326	0.229	0.159	0.11	0.075	0.051	0.031	0.017	0.005
θ (Radian)									

16.3 Design Ideas

Blade design is mainly concentrated in the 0.2 R-R section, 0.2 R part of the main wheels meet the needs and strength. Now calculate the effect of the leaf of chord length and angle. RADIUS from 0.2 R (0.24 m) the r (16.2 m) is divided into 8 segments, each 0.12 m. Blade design parameters as shown in Table 16.2.

16.4 Leaves All Cross-Space Coordinate Transformation Theory

- 1) Building a wing of the original two-dimensional images, original Two-dimensional coordinate of the image origin, to leading edge chord for the x axis, and then translate the airfoil data transformation, keep the chord fo the x axis, move the origin to the aerodynamic Center.
Transformation formula: $(X1, Y1) = (X0, Y0) - (Xq, Yq)$
In the formula: (Xq, Yq) for the aerodynamic Center coordinates (Fig. 16.1).
- 2) After translation transforms the original data, because the coordinates of the point is in chord length value for coordinates, so need to be multiplied by the chord length, $(X1, Y1)$, converted to a corresponding string strengths each discrete point coordinates $(X2, Y2)$, the set c is the chord length.
Transformation formula: $(X2, Y2) = C * (X1, Y1)$
- 3) $(X2, Y2)$ after a rotation transform to be actual leaves space coordinate (X, Y, Z) under a series of discrete points. Transformation formula:

$$X = X1 * \cos \theta - Y1 * \sin \theta$$

$$Y = X1 * \sin \theta + Y1 * \cos \theta$$

16.5 Wing Using EXCEL Calculation Leaves Space Coordinates

- 1) Enter the coordinates X0, Y0
Open the NACA4412.dat file, and then entered in the EXCEL column e, f column. As shown in Fig 16.2.

Fig. 16.1 Actual coordinates cross-space solution diagram

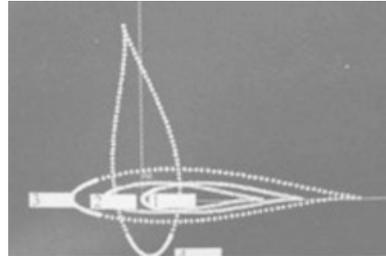


Fig. 16.2 X file data entry EXCEL

NACA4412		E	F
1.00000	0.00130	1	0.0013
0.95000	0.01470	0.95	0.0147
0.90000	0.02710	0.9	0.0271
0.80000	0.04890	0.8	0.0489
0.70000	0.06690	0.7	0.0669
0.60000	0.08140	0.6	0.0814
0.50000	0.09190	0.5	0.0919
0.40000	0.09800	0.4	0.098
0.30000	0.09760	0.3	0.0976
0.25000	0.09410	0.25	0.0941
0.20000	0.08800	0.2	0.088
0.15000	0.07890	0.15	0.0789
0.10000	0.06590	0.1	0.0659
0.07500	0.05760	0.075	0.0576
0.05000	0.04730	0.05	0.0473
0.02500	0.03390	0.025	0.0339
0.01250	0.02440	0.0125	0.0244
0.00000	0.00000	0	0
0.01250	-0.01430	0.0125	-0.0143
0.02500	-0.01950	0.025	-0.0195
0.05000	-0.02490	0.05	-0.0249
0.07500	-0.02740	0.075	-0.0274
0.10000	-0.02860	0.1	-0.0286
0.15000	-0.02880	0.15	-0.0288
0.20000	-0.02740	0.2	-0.0274
0.25000	-0.02500	0.25	-0.025
0.30000	-0.02260	0.3	-0.0226
0.40000	-0.01800	0.4	-0.018
0.50000	-0.01400	0.5	-0.014
0.60000	-0.01000	0.6	-0.01
0.70000	-0.00650		
0.80000	-0.00390		
0.90000	-0.00220		
0.95000	-0.00160		
1.00000	0.00000		

2) Input string length, angle, the aerodynamic center point coordinates

Setting angle to enter long strings, column a column b, first calculate chord length is 0.189 m, when the angle is 0.326 point coordinates of the first section. Second input string up to 0.154 m, when the angle is 0.229 point coordinates of the second section; Last input string up to 0.056 m, the installation angle is 0.005 8th section of the point coordinates. Pneumatic center point x coordinate y-coordinate

Fig. 16.3 First section of the chord length, angle, the aerodynamic center point coordinates

	C1	=0.3*A1		
	A	B	C	D
1	0.189	0.326377	0.0567	0
2	0.189	0.326377	0.0567	0
3	0.189	0.326377	0.0567	0
4	0.189	0.326377	0.0567	0
5	0.189	0.326377	0.0567	0
6	0.189	0.326377	0.0567	0
7	0.189	0.326377	0.0567	0
8	0.189	0.326377	0.0567	0
9	0.189	0.326377	0.0567	0
10	0.189	0.326377	0.0567	0
11	0.189	0.326377	0.0567	0
12	0.189	0.326377	0.0567	0
13	0.189	0.326377	0.0567	0
14	0.189	0.326377	0.0567	0
15	0.189	0.326377	0.0567	0
16	0.189	0.326377	0.0567	0
17	0.189	0.326377	0.0567	0

input column c, enter the d column. Edit the formula C1 = 0.3 * A1,D = 0 entered. As shown in Fig 16.3.

G edit the formulas in column G1 = E1 – C1 represents the X1;

H edit the formulas in column H1 = F1 – D1 represents the Y1;

Edit formula in column j J1 = G1 * COS (B1) – H1 * SIN (B1) on behalf of X;

K edit the formula in the column K1 = G1 * SIN (B1) + H1 * COS (B1) represent Y.

Use smart drag functionality of EXCEL calculate the coordinates of the other of the first section. As shown in Fig 16.4.

Because the order x, y data units are meters, you need to multiply by 1,000 converted to mm. Calculation process as shown in Fig. 16.5

Data to be saved as a TXT file, named 1.txt file name. The same way, the output data for the remaining sections, built 2.txt, 3.txt, ..., 8.txt.

16.6 CAXA Entity Design Modeling

In General, create surfaces from curves to start. You can create curve through the points to create a surface, or by extracting or using view create a surface feature edge already. The creation process is shown below.

- 1) First of all create a curve. You can create a curve using measured point cloud or from a raster image curve required to draw users in.
- 2) Under creating curves, straight lines, curves options such as grids, sweep, creating a major or large areas of the surface of the product.

Fig. 16.4 The first section (X1, Y1) coordinates, (X, Y) coordinate

G	H	J	K
0.9433	0.0013	0.893086528	0.9433
0.8933	0.0147	0.841429801	0.300327937
0.8433	0.0271	0.790093688	0.296042673
0.7433	0.0489	0.688383302	0.284630514
0.6433	0.0669	0.587891247	0.269618957
0.5433	0.0814	0.488521338	0.251292164
0.4433	0.0919	0.390433884	0.229176531
0.3433	0.098	0.293757128	0.202893173
0.2433	0.0976	0.199164359	0.170452949
0.1933	0.0941	0.152925999	0.151107044
0.1433	0.088	0.107521234	0.129298392
0.0933	0.0789	0.063078309	0.10464811
0.0433	0.0659	0.019885776	0.076303708
0.0183	0.0576	-0.00113339	0.060426529
-0.0067	0.0473	-0.02151132	0.04265493
-0.0317	0.0339	-0.04089536	0.021946979
-0.0442	0.0244	-0.04968966	0.008940815
-0.0567	0	-0.05370681	-0.01817878

Fig. 16.5 After converting the first section (X,Y,Z) coordinates

L	M	N
893.0865	943.3	360
841.4298	300.3279	360
790.0937	296.0427	360
688.3833	284.6305	360
587.8912	269.619	360
488.5213	251.2922	360
390.4339	229.1765	360
293.7571	202.8932	360
199.1644	170.4529	360
152.926	151.107	360
107.5212	129.2984	360
63.07831	104.6481	360
19.88578	76.30371	360
-1.13339	60.42653	360
-21.5113	42.65493	360
-40.8954	21.94698	360
-49.6897	8.940815	360
-53.7068	-18.1788	360
-57.9919	-27.7167	360

- 3) Use Bridge, second section, soft rounded edges, n-surface option, adjacent to transition to the surface that you created earlier, edit or smoothing treatment. End up with a complete product model.

Open CAXA entity design 2011, click on the “build” menu > “the curve” > “three dimensional curves”, click the “three dimensional curves” > “type spline curves”, enter 3D spline curves dialog box appears. Click on the “Browse” enter 1.txt, then convert the d curve sketch curve, so enter the other 8 files, converted, respectively.

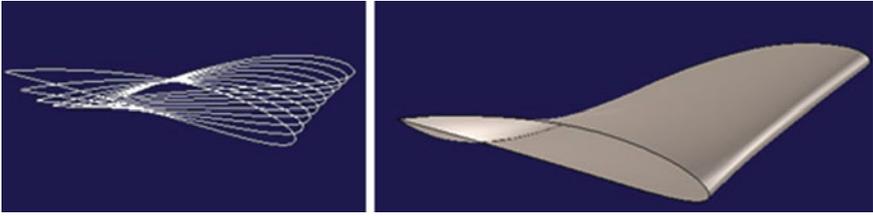


Fig. 16.6 Leaves of three dimensional models

Fig. 16.7 Load applications

set



Select all curves “layout” pop-up “created from a two-dimensional outline created loft features” dialog box, type select “surface”, select OK Leaf surface. As shown in Fig 16.6.

16.7 CAXA Entity Design Data Output

Due to further research on the leaf surface of parts machining, CAXA entity design data needs to be output in CAXA manufacturing engineer. The steps are described below:

- (1) click on the “Tools” > “load”, the system loads the application dialog box appears. Select the “ExportSldToME” application, and then click OK. As shown in Fig. 16.4.
- (2) click on the “Tools” > “custom” bomb from the system-defined dialog box. Click on the tool bar, select “ExportSldToME TB 1”, click Close. Load the application toolbar appears. Click away. As shown in Fig. 16.5.
- (3) in CAXA manufacturing engineer, select “file” > “CAXA entity design data” entity design just studying the data output to CAXA manufacturing engineer. As shown in Fig. 16.7

16.8 Conclusion

Through the leaves of the modeling, explains:

Optimized design. Building models using CAD/CAM technology to direct meet the needed requirements and can be easily modified to meet the needs, to achieve the optimum design.

Shorten the design cycle of research and development of products, improved production efficiency. If we are researching products, such as CAD/CAM technologies to complete, will shorten the product development cycle, and increase productivity. The traditional design and development of methods and procedure, through graphic design, then manufacture, test, the entire cycle is quite long.

Again, strong product development. CAD/CAM technology to visually reflect the actual shape of the part, easy to use design and simulation for complex surfaces, and parameterized design of electronic forms and expressions to easily modify, improvements to the structure are not satisfied, again developed.

For two-dimension General convenience. Expression of surface two-dimensional engineering drawings up is not easy to identify, but combined with three dimensional graphics, it's much easier to identify.

Provide facilities for modern manufacturing. Analysis technology using CAD/CAM technology, you can easily get the part outline of geometry, so as to get program data, make the process more convenient.

References

1. Xu H, Zhu Y, Han J (2011) Study on a new small wind turbine blades modeling methods. *Electr Manuf* 23:567–569
2. Zou T, Jianhua Z, Lu J (2004) Modeling and machining of blades based on the UG. *J Beijing Polytech Univ* 08:39–43
3. Yang Tao, Li W, Zhang D (2010) Wind turbine blade aerodynamic design and study on three-dimension solid modeling. *Mech Des Manuf* 7:232–238
4. Tao W (2011) Composite turbine blade modeling and finite element analysis. *J Sci Commun* 14:328–334

Chapter 17

Variational Half Bridge Series Resonance Intermediate Frequency Induction Heating Power Supply

Wei-gong Kong, Li-rong Li and Hui-shan Han

Abstract With the variational series resonance load circuit, people can design a kind of intermediate frequency induction heating power supply for the Injection molding machine. The article has analysed the basic operation principle of the variational half bridge series resonance inverter, and introduce the main circuit structure and switch tube driver protection of induction heating power supply, and also raised the engineering design method. The frequency of operation of this electromagnetism induction heating power supply is 20 kHz with the output power of 10 KW, and it can be used in the injection molding machine and to heat the charging barrel of comminutors. The experimental results show that this power can provide good sine-wave current, the performance of which has met the design requirements, and the power supply has been operated in industrial field.

Keywords Induction heating · Inverter · IGBT1

17.1 Introduction

Heating is a non-contact heating method, which makes the metal heat by itself. The heating method has been widely used in the melting, casting, hardening, hot forging and welding industries that need the heat treatment for its advantages of high efficiency of heating surface, fast and good controllability [1].

Intermediate frequency switching power supply is the key equipment of induction heating, and usually its main circuit uses the resonance inverter.

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According to the resonant load, we can divide the main circuit into series resonant inverter and parallel resonant inverter. It not easy for the parallel resonant inverter to start, because it needs to precharge the direct current filter big inductance before it starts and it can only work in the self-excitation state [2]. Once the drive signal frequency is not equal to the inherent resonance frequency load frequency, the machine can not start. While the same thing is easier to series resonant inverter, and it can work in both self-excitation state and other-excitation state, which will make it easy to start. At the same time, the reliability of parallel resonant inverter is not so good that the equivalent impedance and other parameters of load will change during the heating process, and the resonant frequency will also have a corresponding change. Once the inverter control circuit can not follow the tracks of resonant frequency accurately, the inverter may stop vibration and even meets the stoppage of inverter subversion. While the series inverter will not face the problem and it also has better reliability. When the resonant frequency is changing with the heating process, even the control circuit failed to follow up the frequency changes, which will only make the power-factor of load change, while the inverter will not stop vibration and the stoppage of inverter subversion will not happen [3].

After the compositive comparison of the merit and demerit of series resonant inverter and parallel resonant inverter, considering that injection molding machines or comminutors need to start and stop the firing equipment frequently during the productive process, so people use the series resonant inverter to design a 10KW/20 kHz electromagnetic heating power, as the structure of half-bridge converter is simple, it has been through the practice and get the satisfactory results [4].

17.2 Analysis of Resonant Circuit

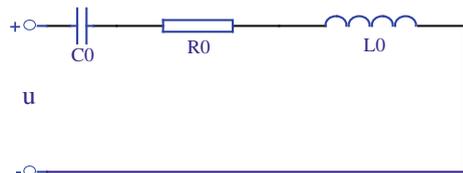
The picture one has showed the LC series resonant circuit load circuit and the exchange square wave created by Inverter Bridge is input the circuit.

According to the Fig. 17.1, we can know that the impedance of the resonance circuitis

$$Z(\omega) = j\omega L_0 + R_0 + 1/j\omega C_0 \tag{17.1}$$

In that, R_0 is internal resistance of the resonance coil, change the formula 1 to

Fig. 17.1 Resonance circuit



$$Z(\omega) = R_0 + j\left(\omega L_0 - \frac{1}{\omega C_0}\right) \tag{17.2}$$

When the $\left(\omega L_0 = \frac{1}{\omega C_0}\right)$, there is resonance in the circuit, and the inductance coil will make some syntonistic voltage current signal.

17.3 Operating Principle of the Half Bridge Series Resonant Inverter

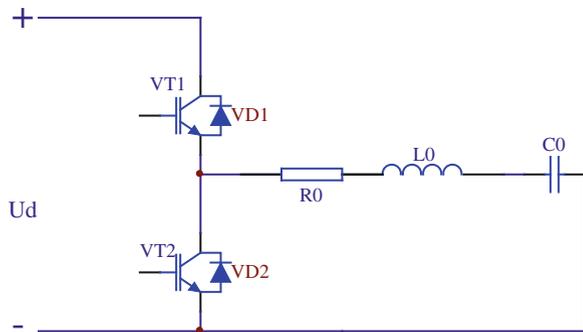
Figure 17.2 has showed the simplified circuit of the half bridge series resonant inverter. The structure of this series inverter is similar with series resonant inverter, the only difference is that is reduced one resonance capacitance C, and it also belongs to the voltage inverter. The characteristic of this circuit is the output voltage u is not limited by input voltage U, which makes greater leeway for the choice of parametrics of resonant circuit.

According to the operating principle of circuit in the picture 3, two switches VT1 and VT2 make breakover alternately, if we ignore the dead zone time, duty cycle of VT1 and VT2 is $D = 0.5$. However, in the actual work, in order to avoid the direct connection of two pipes, people have to keep some dead zone time between the two tube drive signals. But usually the dead zone time is shorter than the time of switch cycle, so it can be ignored in the abstract.

When the switching frequency is f_s , the midpoint voltage of the switch pipeline bridge is the pulse square wave with frequency f_A and duty cycle $D = 0.5$. Suppose that the input voltage is U_{in} angular frequency is ω , we resolve the voltage of this point with Fourier series, and we can get the expression

$$u = \frac{U_{in}}{2} + \frac{2U_{in}}{\pi} \sum_{n=1}^{\infty} \frac{1 - (-1)^n}{2n} \sin(n\omega t) \tag{17.3}$$

Fig. 17.2 Half bridge series resonant inverter



From the expression (17.3) we can find that the output voltage of inverter can be divided into dc voltage, fundamental wave and a series of odd harmonic voltages. And the direct voltage will be separated by C_0 of the circuit. For this inverter, its resonant circuit has to work in the perceptual state, so once the resonant frequency of the resonant circuit is large, ultra harmonics can be also ignored.

In the cases of perceptual load, the inverter can make the ZVS open of two of the switch tubes, so that it can effectively reducing switch loss and improve the switch frequency. The midpoint voltage and current wave of bridge arm are respectively Square wave and sine wave, and the current lags are behind the voltage.

We can adjust output power through adjusting the switching frequency. Once the load is in the perceptual state, the improvement of switch frequency can reduce output power. However, in order to make the load not in capacitive state, it needs to set minimum switch frequency greater than resonant frequency.

17.4 Parameters Design and Component Selection for the Induction Heating Power Supply

17.4.1 Main Circuit Design

The three-phase alternating-current supply is changed into 514 V dc with three-phase controllable bridge rectifiers.

According to the requirements of output power and the working frequency, Rectifier Bridge is the BridgeSemi three-phase high frequency converter MDS100/16E filter capacitance C_1 is the 8 $\mu\text{F}/1000\text{VAC}$ CBB61 metallized polypropylene film capacitor, which has stable capacitance, good ability for impulse current and tough overload ability. Resonance capacitance C_0 is 0.26 μF , we can use two 0.47 $\mu\text{F}/1000\text{V}$ ACCBB61 metallized polypropylene film capacitor series, resonance inductance L_0 for 240 μH . Switching tube VT1 and VT2, considering the affection of surge voltage and current, we choose the fast recovery rectifiers IGBT module DM2G100SH12AE to make the circuit structure more simple. Vibration inverters have a weakness that voltage current stress of resonant components is much large, which makes it difficult to choose the devices, what's more, high frequency raises.

High demands for frequency characteristic of the device. And the resonance capacitance C_0 of the circuit adopts the Metallized polypropylene film capacitor (MKP) that can bear high pressure and has good high-frequency characteristics.

Inductance is created with certain length of the wire that twines on the charging barrel. In the high frequency work conditions, we should not ignore the loss of these wires. Because of the affection of Set skin effect and near effect, when high-frequency current goes through the wires, effective resistance is much greater than DC resistance. So in order to reduce the loss, we can use the multipoint nickel plating copper-core high temperature resistant insulated cables (Fig. 17.3).

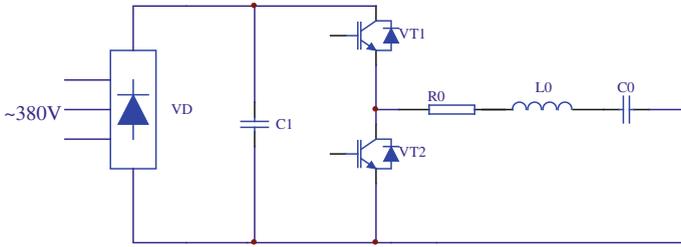


Fig. 17.3 Main circuit diagram

17.4.2 Switching Tube Drive and Protection Circuit Design

In the power circuit, reliability of switch tube driver is especially important. People need to pay attention to avoiding the link of context switch tubes of the half bridge converter, and also stopping the inverter load into capacitive state, or the switching tube will lose the ZVS conditions, which can leap the switching loss and make it burn out [5].

The circuit is based on a half-bridge converter, in which a series resonance circuit and a small saturable inductor are employed. In this converter, the series resonance circuit compensates the voltage drop due to the leakage inductance of the transformer and the small saturable inductor removes the switching noise and switching losses by impulse charging and discharging the parasitic capacitance of the switch.

We can see find that the drive signal waveform, from go up and down in turn they are up tube uQ1 control signal to control the chip production, down tube control signal uQ2, bridge the midpoint voltage street arm A sampling signal uA, up or down switch tube uT1 and uT2 grid of signal. Through such logic relationship, after shut down the top tubes, because current lags are behind, which makes uA naturally decline low voltage, and then the down tube can be breakover. On the contrary, after shut the down pipe, voltage uA has naturally risen to a high voltage, which will make the top tube be breakover. All of that can make sure that bridge legs do not appear to realize common, switch tube s realize ZVS, and when load come into the capacitive state, inverter will fail to start so that it can play a good role of effective protection.

17.5 Experimental Results

This prototype is produced according to the above theoretical analysis, and through experimental study.

The figure shows inductance current i_L waveform, we can see that i_L waveform is very close to the sine wave, after adjusting the parameters and the system has a

Table 17.1 Actual parameter of system after the temperature variation

Operating temperature (°C)	Resonant frequency (kHz)	Main loop current (A)	True power (kW)	Power deviation (%)
20	20.6	31.3	10.28	2.8
210	19.2	29.3	9.6	-4

normal starting, the resonant frequency is 20.6 kHz, as the temperature ascends, current decreases a little and the resonance frequency slightly reduces, which is fit for the phenomenon that coil temperature raised, feeling is increased. When it gets the set heating time, the induction heating system will automatically close. Through the test we find that: the fluctuation of design power of this system is lesser, in the allowed fluctuation range, there is a steady power output. Just like Table 17.1.

17.6 Conclusion

The article analyses a kind high-power induction heating intermediate frequency inverter. The core of this inverter is half bridge converter, and the switching tube can also realize ZVS, finally the article verifies the theoretical analysis with the 10 KW experimental prototypes. The experimental results show that this power can provide adjustable sine wave voltage and current. Besides, through actual use, he equipment the has good performance, and the heating effect meets design requirements, what's more it has an obvious power saving effect.

References

1. Kang M (2006) Research on parallel resonant super audio induction heating power supply, vol 7. Xi'an University of Technology, Xian, pp 399–405
2. Wang Z (2008) Design and implementation of the electric control system for high-power induction cooker, vol 5. Wuhan University of Technology, Wuhan, pp 348–354
3. Li Z, Yu L, Wang Z (2008) Power supply of new half bridge series-parallel connection high frequency induction heating capacitor. *Power Electron* 34:42–44
4. Shi Y (2007) Design and research on the safety of electromagnetic induction heating technology, vol 3, 4th edn. Northwestern Polytechnical University, Xi'an, pp 270–274
5. Wang H, Tian J, Guo H (2000) Modeling and research of the series resonant induction heating power supply system. *Power Electron* 5:45–47

Chapter 18

Translators Power Release Under Suppression of Power

Weike He

Abstract Power is everywhere, with which everyone is endowed. Power is manifested in different ways in different people. The power of translators in the Great Cultural Revolution was characterized by being suppressed and being released. Compared with the suppression, the release of translators' power was much more important because it bred the prosperity of translation after the Great Cultural Revolution.

Keywords The great cultural revolution · Translation · Translator · Power

18.1 Introduction

The Great Cultural Revolution of China (1967–1976) (the Revolution for short) is a very special yet very important period in China's history. It greatly hindered the development of many fields. The translation activities of this period became stagnant. However, it was not completely blank. This period cannot be ignored for its historical values in the translation history [1].

It is essential to explore the correlationship between translation activities and the society, especially the culture. Translators as the subjects of translation activities are inevitably the focus. Translation theorist Douglas Robinson proposes that translators be the center of translation study.

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Translation is a kind of utterance and coexists with power. The process of translation is one of power struggle. As Susan Bassnett states "... the study and practice of translation is inevitably an exploration of power relationships within textual practice that reflects power structures within the wider cultural context." [2].

This paper is to explore the power of translators during the Great Cultural Revolution within political and cultural contexts based on the theory of power.

18.2 Theory of Power

Translation carries out at the very beginning an extremely important social functions because translation is closely related to society and culture, particularly to political power and ideology. Translation is not simply the transformation of texts, but the mouthpiece of power and a means of cultural communication. Text choosing and the strategies of translation manifest the relationship of powers and ideology of a particular time. It can be said that translation is a process of power executing. Translators' power can be seen from translation activities.

It is necessary to know the theory of power before analyzing the power of translators during the Revolution.

According to Wikipedia, "Power is a measurement of an entity's ability to control its environment, including the behavior of other entities"[3]. British philosopher Thomas Hobbes defines power as a man's "present means, to obtain some future apparent good". Power is a means to control the surroundings of an individual, including others' actions. Power might be just or evil. The execution of power does not necessarily rely on forces. French philosopher and thinker Michael Foucault (1926–1984) thinks that power is something that has the ability to govern and control others' thoughts and actions, and that power is everywhere and possessed by any individual. Individuals within the power web might be the objects as well as the subjects governing and controlling power. The contemporary French politician Maurice Duverger (1917–) thinks that one of the basic characteristics of human society is that influence, ruling, power and authority are everywhere and cannot be concealed. All individuals are within webs of power of one or more kinds. "Power is often expressed as upward or downward. With downward power, a company's superior influences subordinates. When a company exerts upward power, it is the subordinates who influence the decisions of the leader" [3].

The classification of power will help understand the relationship between the subjects and objects. There are many classifications of power in the academic circle. Here in this paper the classification of power will be applied: external power and internal power. The former refers to two aspects: one is the political and cultural systems of a state; the other is the cultural psychology of a nation. The latter refers to the needs of existence and development of individuals.

Universality of power determines that power of different kinds is relevant to one another. When the external power and internal power coexist harmoniously,

they are beneficial to each other; otherwise, when they conflict, it will do harm to the existence and development of the state and individuals.

Power can be executed in many different ways. According to *wikipedia*, there are at least 13 ways of executing power [3]. The power concerned with translators includes: ascribed power, for example, translators are instructed or even ordered to do translating; expertise, i.e., translators do translating with their mastery of their native languages and foreign languages. The power which can be executed by translators is manifested in the following aspects: (1) translators have the right to choose texts and to do translating with the proper strategies of their own; (2) translators have the initiative to do translating; and (3) translators have the power to survive and therefore have the right to get rewarded for the translated works, for example, the payments or the rights of translatorship.

In sum, power is something that is characterized by domination, benefits, and human universality. Different individuals execute power in different ways.

18.3 Translators Under the Control of Power

The translation during the Revolution can be divided into two states [1]. The first stage of translation during the Revolution was between the outburst of it in May, 1966, and the “9.13 event” in 1971. The second stage was between the “9.13 event” and the downfall of the Gang of Four.

The power relationship during the Revolution was very special. The Revolution was a struggle for power [4]. The greatest struggle was between the Counterrevolutionary cliques of LIN Biao and the Gang of Four, and the Central Government. The former two represented a minority of people while the latter represented the majority. The struggle of power did great harm to the existence and development of China and the majority of people, including translators.

“Translating is a political task, and it has always been a political task” [5]. Politics is the embodiment of power. Since translation is relevant to politics, it is inevitably suppressed by power. Political ideology governs translating by constructing, controlling and supporting translation systems. During the Revolution, all the outstanding works that did not agree with the ideology of the Gang of Four were treated as reactionary works and were sent to the deepest hell [6]. Political ideology controlled translation to the extreme.

Translators’ power during the Revolution can be classified into two kinds. One was translators’ power being suppressed. The other was translators’ power being released.

Translators’ power being suppressed means that translators did not have right to choose and translate the works they liked, that translators were not allowed to display their initiatives, for example, their translation activities were under control, the translated works could not be published and some were even destroyed. This resulted in the stagnancy of the translation career.

Translators' power being released means that translators' talent was appreciated and they were given the chance to do translating—either in a passive way or in an active way. They had opportunity to choose translation texts, or they were forced to do translating of the texts which might be or not be relevant to their trades. Or they made great efforts to do translating to some extent in spite of being suppressed. All in all, translators were indeed doing translating, either actively or passively. There were two states—"open" and "underlying". "Open" means that translators did translating in a legal way. For instance, translators were organized to translate the works of Mao Zedong and Karl Marx, Friedrich Engels, Vladimir Ilich Lenin and Joseph Vissarionovich Stalin, and other scientific works. "Underlying" means translators had to do it without others' knowing it.

According to Foucault's theory of power, power is everywhere and possessed by any individual, but expressed in different ways. In the history of translation, power has never been absent, but displayed its importance. Nietzsche exclaimed that translation means conquering. Although the political power during the Revolution suppressed translators' power, yet it could not deprive all of them of all power. Some translators had to stop or even choose to quit doing translating, which was just temporary, while many more persisted in pursuing the career of translation. As Foucault pointed out, where there is power, there is revolt. The marginal power exists where the central discursive power exists [7]. Now that they were not able to fight against the strong power tit for tat, translators chose to do it in an underlying way. They expressed their discursive power in the special way. They tenaciously pursued their career of translating. They chose texts of their own values and translated them with proper strategies. In this way they combated the mainstream power. It was translators' perseverance and great efforts that created many underlying translation works, which averted the situation of being blank in the field of translation and laid a good foundation for the prosperity in translation after the Revolution. Meanwhile, due to the needs of the development of politics, diplomacy, industry, agriculture and military affairs, some translators were put to important positions. Their power was released in an open way.

18.4 Translators' Power Release During the Great Cultural Revolution

18.4.1 Entrusted with a Mission at a Critical Moment, Translators Gave Play to Their Power

During the Revolution, due to "class struggle being the key" importance was attached to translation to some extent. Some translators were put to use. Ye Junjian, who was classified into "bourgeois reactionary academic authority", the only "capitalist roader outside the Party", was invited to translate Chairman Mao Zedong's poems under the protection of Premier Zhou Enlai [8]. An army of

translators of high levels, such as KE Bonian, Jiang Chunfang, Zhou Yang and Xian Yan, were organized to translate works of Karl Marx, Friedrich Engels, Vladimir Ilich Lenin and Joseph Vissarionovich Stalin and Chairman Mao. About two hundred translators were working in the translation section translating MAO Zedong's selected poems. From 1961 to 1976, they translated Selected Works of Mao Tse-tung in eighteen foreign languages. The organized translators displayed their talents and power to some extent.

Translating foreign literature was greatly harmed. As a result, the number of translated works was very small. But objectively speaking, it was not completely blank. For "class struggle", the people in power attached importance to translation to some degree, even if it was done totally under the manipulation of the power discourse.

To satisfy Chairman Mao's reading need, Xiao Qian was called back while reforming through labor to join in translating Napoléon. Chen Xuezhao was called to translate Charles de Gaulle's Memoires d'espoir when he was to quit translating in 1971. Fei Xiaotong, Xie Bingxin, Wu Wenzao and other translators were asked to translate Herbert George Wells' The Outline of History for Jiang Qing (one of the Gang of Four). They might not have done what they wished, but at least they had the chance to do translating as translators.

18.4.2 Staying Away from Power Struggle, Translators Displayed Their Power

During the Revolution, although translators were suppressed in translating works concerning about the political ideology, they could display their power in translating works of natural science which were not closely relevant to the ideology. While class struggle was going on, the Central Government did not ignore to reconstruct new China. Many policies were made and carried to develop industry, agriculture, military affairs, science and some other fields. For this, translation was greatly needed. During the ten years, the number of translated works of natural science was always the greatest. Many advanced machines and equipments were imported and corresponding materials were translated. According to Li Jin, during the first stage, the translated works of natural science accounted for 77.1 % of all the kinds of translated works, and during the second stage they accounted for 46.35 %. So many translated works are the best evidence of translators' efforts. China did not stop progressing during the ten years, though in a slow way, translators' contribution cannot be ignored. All this should be attributed to their execution of power.

18.4.3 Being Devoted to Translation, Translators' Power Glittered

Real translators are not always passively obedient to the target culture. Translators with strong political senses tend to react to it in an active way [9]. Translation is often affected by such external factors as political ideology, however, the most active and the decisive factor is still the internal one—translators themselves, whose motives reflect their subjectivity, the power. Translating slinkingly or changing their translation trade is a demonstration of translators' exerting their power as the subjects of translating.

For example, in 1974, Ba Jin translated *Virgin Soil* by Ivan Sergeyevich Turgenev and *My Past and Thoughts* by Aleksandr Herzen while he was imprisoned. Luo Xingzhang translated *La Commune de Paris*. Jin Zhong translated *Reeds in the Wind*, which described the persecuted intellectuals fought with fascist Japanese military. Zhu Weizhi switched to translating *Samson Agonistes* after his translated manuscripts of *Paradise Lost* by John Milton were taken away without being returned. Ji Xianlin spent four years slinkingly translating *Ramayana*, Indian historic poems, while he was devalued as a door keeper. There were too many such examples.

During the Revolution, many translators were compelled to yield to the mainstream political ideology and gave up their own esthetic pursuits. However, the influence from the political ideology on translation was relative, not absolute. It seemed hard not to be influenced by it, but translators might go in an indirect way to achieve their goals with their self-cultivation, morality and conscience once they realized the influence. Such translators displayed their strong power of subjectivity. CHA Liangzheng was one of them. He selected texts of his own tastes.

Translators' power was also manifested in the battles of wits with the people in power. Sidney Shapiro, whose Chinese name was SHA Boli, was instructed to translate Chinese classical novel *Shuihu Zhuan*. He had expected to translate it into *Heroes of the Marsh*, but it was objected to by representatives of the Gang of Four. Then he replaced "heroes" with "outlaws" and explained it as "ruleless people". The name was accepted. He carried out his point without the representatives knowing that "outlaws" has another implication "true men". The English name of the novel was thus settled.

18.5 Conclusion

The power struggle during the Great Cultural Revolution deprived most translators' power, which led to the scarceness of translated works while translators' release of power made translation in some fields prosper, and produced many underlying translated works. The situations of translators' power in this period demonstrate that suppressing translators' power would bring disasters to the career of translation and the country while releasing translators' power would bring prosperity to the career of translation and new life to the country.

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References

1. Li J (2008) A survey of translation in China (1966–1976), vol 12, 2nd edn. Nankai University Press, Tianjin, pp 38–43
2. Bassnett S, Lefevere A (1990) Translation, history and culture, vol 21. London and New York, Routledge, pp 138–142
3. Power [EB/OL] (2011) [http://en.wikipedia.org/wiki/Power_\(philosophy\)](http://en.wikipedia.org/wiki/Power_(philosophy)), 4
4. Li Y, Li N (2000) The history of science translation in China, vol 13, 4th edn. Hunan Educational Press, Changsha, pp 532–538
5. Jin R (1999) On the ideological contents//WANG Hongzhi. Re-expounding “Faithfulness, Expressiveness and Elegance”: research on China’s translation in the twentieth century, vol 3. Oriental Publishing House, Shanghai, pp 48–49
6. Fang H (2005) The translation history of China in the twentieth century, vol 3. Northwest University Press, Xi’an, pp 430–435
7. Zhang G (2008) Power discourse and foreign literature translation during the great cultural revolution. *J Huanan Agric Univ* 8(4):99–103
8. Translator of Anderson’s fairy tales talking about “the Great Cultural Revolution” (2012): don’t say “A scholar prefers death to humiliation” [EB/OL] <http://news.jinti.com/redianshishi/1153419.htm> 02-06
9. Wang D (1998) On the intervening of culture into the translation process. *Chin Transl J* 11(5):8

Part II
Web Science, Engineering
and Applications I

Chapter 19

Adaptive Recommendation Algorithm Based on the Bayesian-Network

Jianqiong Xiao, Jiangjin Gao and Guoqin Song

Abstract Recommendation service could provided recommended project resources for interested preference to network users, has now been maturely used to site navigation, retrieval system in digital libraries and e-commerce etc. The article respectively introduced existing various recommendation algorithm, and analyzed the advantages and disadvantages of all kinds of algorithm, and came up with an adaptive recommendation algorithm based on the Bayesian network. The results of theoretical analysis and experiments indicated that the algorithm could make personalized recommendation for users in real-time online. Compared with other existing algorithms, this algorithm could give the recommendation set more quickly with higher precision and recall level.

Keywords Bayesian network · Personalized recommendation · Adaptive · Weblog mining

19.1 Introduction

In the last century 90's Internet came into common civilian that has been developed into a contained in various fields, massive, widespread, global information exchange and sharing platform and it also becomes an important avenue for

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information. So far, people have not worried about who not find their need information. But because the massive and dynamic nature of information on the Web, disorder and non-structural characteristics, makes users to retrieve their own variable requirements information is not so well from the Web. No one will doubt this view that the next generation of the Internet will be intelligent, and personalized. When the user access to the Internet, “unknowingly” analyze users’ interests and then provide recommendation initiative for users. So we want to consider, is mining users’ interests in web pages texts, which in turn can provide personalized service. According to the individual needs of users recommended recommend model and the algorithm became inevitable.

19.2 Introduction of Recommendation Algorithm and its Analysis

At present, there are three main types recommendation algorithm that used by recommend system: collaborative filtering recommendation algorithm, content-based recommendation algorithm and structure of the graph-based recommendation algorithm [1].

Collaborative filtering is based on the nearest neighbor users, using certain scoring rules to find out the most similar m -neighbors of the current user to predict the current user’s interest and to produce the recommended results, which can find new interested in information for users, is by far the most successful technology [2]. But it there are problems about sparse data and the initial evaluation.

Content-based recommendation algorithm is based on the resource and the similarity of users interested in filtering information and recommended the results, but it can only be found the user has been interested in similar resources, unable to find new resources of interest, which have prodigious limitations [3].

Therefore, recommend system needs to be based on the user’s accessing history, the characteristics of websites visited to infer the users may needs and points of interest, to produce the new recommendation sets. Bayesian Networks is to discover data dependencies between latent, suppressed effective tools in dealing with uncertainty knowledge representation and reasoning has a great advantage, therefore, is widely used in data mining, automated decision-making, risk analysis, and many other areas. Personalized recommendation is essentially a process of uncertainty knowledge representation and reasoning [4].

At present, there are many researches on Bayesian Networks applied to the recommended system. Through the comparison of their research, found that structure learning algorithm based on Bayesian network (Max–min hill-climbing, MMHC) has better properties than other algorithms in time and space, Therefore, the paper use MMHC algorithm combined with website describes files and log files to mining the potential, implied relationship between Web pages.

19.3 Adaptive Recommendation Algorithm Based on the Bayesian-Network

There are mainly studying stage and the application stage based on the data mining technology recommendation algorithm [5]. During the learning phase, data mining system analyzes data and establish corresponding recommend model, recommended models used to interpret the user's behavior pattern; In the application stage, recommendation algorithm provide users with recommendation service according to the established model and the user behavior. So, We can build a user interest model based on Bayesian network (Bayesian network mode, BNM), obtained user's preferences and association rules of web page through BNM, and then combined with the user's browsing history records, to provide users with more pages associated. Recommendation algorithms include Bayesian model establishment and page recommended two aspects.

19.3.1 User Interest Model Building

User interest model's basic idea is: The system tracked user every step of the operation, recorded user feedback information to the system, by Web mining technology, collecting the basic information of the user; Second, preprocess data in the server, including data cleaning, delete some useless information, transformation data coding and storage effectively data etc.; Then, the obtained data information use a certain representation said, to calculate and analysis the relationship between users' characteristics and browsing behavior patterns, so as to analyze users' goals, requirements, reaction to content, media types, display order, which can get user model; Finally, through application recommendation algorithm, study to get directed graph that show causal relationships between web pages.

In order to clearly show the process of user's interest model, give some basic defined as follows:

Definition 1 a user browsing the page W , $W = \{W_1, W_2, \dots, W_n\}$ indicates that the user browsing the site collection (n the number of pages).

Definition 2 browse affairs for t , the user's browsing affairs can be expressed as $t(i) = \langle uid, W_1(i), W_2(i), \dots, W_n(i) \rangle$, among them, U_{id} is the user i 's number ID, $W_m(i)$ indicates that the user i access the number of web pages W_m ($1 \leq m \leq n$). Because the purpose of Web mining is found implied and potential links between pages, so can ignore browsing times, using the binary representation of the $W_m(i)$, 1 for the access, 0 means no access.

Definition 3 browse affairs database t : refers to the collection of all the browsing t .

Definition 4 UserModel, $UserModel = (W, E, P)$, among them, W represents the set of pages on web site, E is directed edge in the nodes of W , P says conditional probability distribution of every node. Based on the model definition above, which can get E by the Bayesian network structure learning algorithm.

19.3.2 Adaptive Recommendation Algorithm

Bayesian network inference's main idea is the use of Bayesian network structure and its conditional probability table, under the condition of node set evidence E was given, calculate the maximum posteriori probability $P(C|E)$ of all non-evidence node, and recommended to user large posterior probability of the number of nodes to achieve the aim of recommending.

This paper adopts coupling tree algorithm (now, the algorithm is the fastest computing speed, the most widely used Bayesian network accurate reasoning algorithm), using coupling reasoning algorithm can handle different tree topology structure of the Bayesian networks, improve the stability of the recommendation algorithm and applicable range, at the same time, using the message transfer between nodes in coupling tree to realize reasoning that greatly reduces the time and space complexity of system[6, 7].

For this, we putted Bayesian network into connection tree JT by the coupling tree algorithm [8]. So, by delivering the message in coupling tree, can make the coupling tree meet globally consistent, the system achieved steady state, This time can use any variables V node C distribution function φ_c , using expression: $P(V, c) = \sum_{c \setminus [v]} \Phi_c$ to calculate the probability distribution of the variable V ,

then find out the circle set and edge in JT set, and calculate the probability of subsequent inspection for each node with the following Eq. 19.1, select according to threshold, finally get recommended set R after descending order.

$$p(V|E) = \frac{p(V, c)}{\sum_v p(v, c)} \quad (19.1)$$

According to above analysis, design adaptive recommendation algorithm:

Begin: inference (DAG, Evidence)

Input: UserModel, DAG = (V, E), Evidence, τ ;

Output: Rinferred

JT = JunctionTree (DAG); && Convert coupling tree

Search for(C, S); && Find out the circle set C and edge set S in JT

for each $V_i \in V$, read $W = \{W_1, W_2, \dots, W_n\}$, Read web sequence that user traverse in a recent browsing process and went into the queue in the order in accordance with the access time, then

Queue1 = {k1, k2 ... kn}.

Calculate $P(V_i|Evidence)$; && According to the type (1) calculation

if($P(V_i|Evidence) > \tau$) then Rinferred = Rinferred \cup { V_i };

Exit for

Repeat:

Sorted (Rinferred, down); Get recommend set R

return Rinferred;

End

Through this algorithm, combined with the user's access to records, can referring a certain number of page node to users, such as 10, 20, sites can further analyze the user's access website with combination of features and make appropriate recommendations on the basis of its own characteristics; Can also take page recommended the probability of a value greater than a given threshold for recommended the result set R.

19.4 The Analysis of Experimental Results

This paper adopted Microsoft company network log data sets, selected part of dataset to test this study algorithm and the system performance, After the data preprocessing got the training set (train) and the test set (test), among them, the Train include the 3500 records, each a record number include 50 pages, the Test have 5000 records, test weight factor $\alpha = 0.5$; Test were set into Evidence and Evaluate; Users browse web pages were took as evidence node in Evidence, use the page in Evaluate as evaluation set E (E Evaluate) to verify the effect of recommended page.

In order to verify the effect of assessment recommended, this article use the precision and recall level assess accuracy of recommended list. The ratio of elements of the recommended set R appeared numbers in evaluation set E and the number of elements in R, is called recommend precision, which reflect correct recommended degree, namely precision = $|E \cap R|/|R|$. The ratio of elements of the recommended set R appeared numbers in evaluation set E and the number of elements in e, called recall level, to reflect recommended ability that recommend system produce user might be interested content, namely recall level = $|E \cap R|/|E|$. When training set size is different, we would get different BNM model, get different recommend sets. We recommend 10 nodes with fixed here. The precision and recall level under different train dataset size showed as Figs. 19.1 and 19.2.

The Figs. 19.1 and 19.2 show that this MMHC algorithm has good accuracy, but also can find out recommend precision and recall level present convex shape curve on the whole along with the increase of the size of the training set, that is, present high among, both sides low trend. According to the definition of recommend precision and recall level, we can find that the reasons : in the same E and certain recommend numbers R, When training set is small, the intersection of E and R is smaller, this time the two parameters is only about 30 %; Along with the training set size increases, the intersection of E and R change larger, so recommend precision is high, the precision is gradually increased from 40 to 80 %; When training set size increases to certain value, because the relationship of nodes in model enhance more, namely the edge between nodes have more pertinences, which led to association arc are too sparse, lost some useful pages 'connections, the intersection of E and R decreased, and led to the recommended rate has dropped from 40 to 20 %. For further testing the performance of the algorithm designed, tested in different recommend threshold μ showed as Fig. 19.2.

Fig. 19.1 Precision under different training dataset size

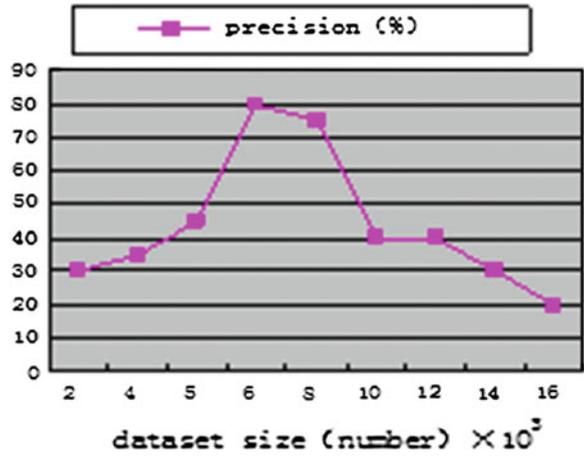
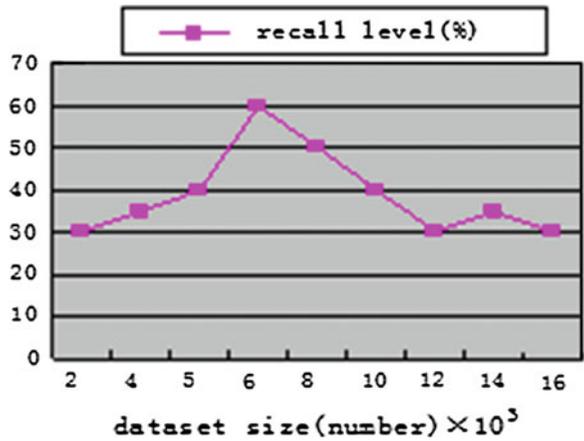
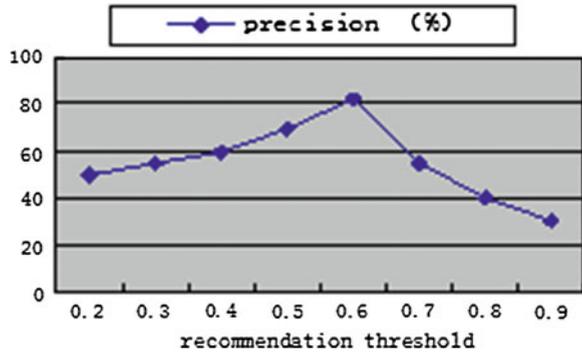


Fig. 19.2 Recall level under different training dataset size



The Fig. 19.3 shows that Recommend threshold is set to a large degree; the precision rate reduced instead. It can conclude that recommended performance of recommender systems from the foregoing, not only related to the training set size, and has a great relationship with recommended threshold size. When the specific recommended node number act as performance evaluation standard, the accuracy rate change along with the size of the training set, so when choosing a training set size, you should try to determine a suitable range.

Fig. 19.3 Accuracy rate under different recommendation threshold size



19.5 Conclusion

After analyzed the existing algorithm and system in personalized recommendation, this article put forward the Bayesian network is applied to the Web page of the recommended, designed and implemented the recommended model and algorithm, and realize the recommendation system based on this. The algorithm can get the dependent relationships BNM model between the page through the website describes files and records document processing, and combining with the user's accessing history, obtain the dependence of more accurate between evidence nodes and recommend set, and discovered high associated with the current user access history page, then realize personalized recommendation. The experiments show that the Bayesian network is applied to the Web page recommendation can obtain a higher precision and recall level.

References

1. Yang B, Zhao P (2011) Review of the art of recommendation algorithms. *J Shanxi Univ (Nat Sci Ed)* 34(3):337–350
2. Sarwar B, Karypis G, Konstan J (2005) Item-based collaborative filtering recommendation algorithms. In: *Proceedings of 10th international World Wide Web conference*, vol 239, pp 191–201
3. Bihang X (2010) A hybrid personal recommendation algorithm based on designated group interest. *J Shanghai Univ (Nat Sci)* 16:3–5
4. Tsamardinos I, Brown LE, Aliferis CF (2006) Themax-m in hill-climbing Bayesian network structure learning algorithm. *Mach Learn* 65(1):31–78
5. Guo Q, Wang Q (2010) A recommendation-system model of digital library and its realization based on web mining. *Libr J* 129:6
6. Pan X, Deng G-S, Liu J-G (2010) Effects of user tastes on personalized recommendation. *Control Eng China* 39(1):19–22
7. Xu M-Y, Wei Y-Q, Zhao J (2011) Incremental learning method of Bayesian classification combined with feedback information. *J Comput Appl* 9:12–13
8. Wang A-G, Li L, Yang J, Chen G (2011) An algorithm based on the Bayesian network for web page recommendation. *J Shandong Univ* 91:212–216

Chapter 20

On Hexagon Number Part Residue of a Positive Integer

Mingjun Wang

Abstract To study the hexagon number part residue function $a(n)$ and to generalize it. For any positive integer n , $a(n)$ is the smallest nonnegative integer such that $n - a(n)$ is a hexagon number. Based on this definition, the asymptotic properties of this function and some hybrid functions are studied using the elementary method, the asymptotic formulae are obtained, thus enriching the study and application of this function.

Keywords The hexagon number part residue · Mean value · Asymptotic formula

20.1 Introduction and Results

For any positive integer n , the Smarandache k – th power complements $b_k(n)$ are the smallest positive integer such that $nb_k(n)$ is a perfect k – th power [1]. Similar to the Smarandache k – th power complements, Zhefeng defined the additive k – th power complements $a_k(n)$ as follows: $a_k(n)$ is the smallest nonnegative integer such that $n + a_k(n)$ is a perfect k – th power [2].

Let n be a positive integer. If there exists a positive integer m such that $n = m(2m - 1)$, then we call n as a hexagon number [3]. As a generalization of [2], we define the hexagon number part residue function $a(n)$ as the smallest nonnegative integer such that $n - a(n)$ is a hexagon number. For example,

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if $n = 1, 2, \dots, 15$, we have the hexagon number part residue functions $a(n)$ as follows: 0, 1, 2, 3, 4, 0, 1, 2, 3, 4, 5, 6, 7, 8, 0.

In this paper we use elementary method to study the properties of this sequence, and give several interesting asymptotic formulae. That is, we will prove the following conclusions:

Theorem 1 Let $a(n)$ denotes the hexagon number part residue of a positive integer. For any real number $x \geq 1$, we have the asymptotic formula:

$$\sum_{n \leq x} a(n) = \frac{2\sqrt{2}}{3}x^{\frac{3}{2}} + O(x).$$

Theorem 2 For any real number $x \geq 1$, $e_p(n)$, denotes the large exponent of power p which divi—Des n , we have the asymptotic formula:

$$\sum_{n \leq x} e_p(a(n)) = \frac{1}{p-1}x + O\left(\frac{2\sqrt{2}}{p-1}x^{\frac{1}{2}}\right). \tag{20.1}$$

Theorem 3 For any real number $x \geq 1$, we have the asymptotic formula:

$$\sum_{n \leq x} \delta_k(a(n)) = \frac{2\sqrt{2}}{3}x^{\frac{3}{2}} \prod_{p|k} \frac{p}{p+1} + O\left(x^{\frac{3}{2}+\varepsilon}\right). \tag{20.2}$$

Theorem 4 For any real number $x \geq 1$, we have the asymptotic formula:

$$\sum_{n \leq x} \frac{1}{a(n)+1} = \frac{\sqrt{2}}{4}x^{\frac{1}{2}} \ln x + \frac{\sqrt{2}}{2}(\ln 2 + \gamma - 1)x^{\frac{1}{2}} + O(\ln x). \tag{20.3}$$

20.2 Some Lemma

To complete the proof of the theorem, we need the following lemmas.

Lemma 1 For any real number $x \geq 1$, we have the asymptotic formula:

$$\sum_{n \leq x} e_p(n) = \frac{1}{p-1}x + O(\ln^2 x). \tag{20.4}$$

Proof See Ref. [4].

Lemma 2 For any real number $x \geq 1$, Let M be a fixed positive integer such that $M(2M - 1) \leq x < (M + 1)(2M + 1)$. we has the asymptotic formula:

$$M = \frac{\sqrt{2x}}{2} + O(1). \tag{20.5}$$

Proof Let M be a fixed positive integer such that $M(2M - 1) \leq x < (M + 1)(2M + 1)$. from inequality $M(2M - 1) \leq x$, we have $\frac{1-\sqrt{1+8x}}{4} \leq M \leq \frac{1+\sqrt{1+8x}}{4}$

From inequality $x < (M + 1)(2M + 1)$, we have $M < \frac{-3 - \sqrt{1 + 8x}}{4}$ or $M > \frac{-3 + \sqrt{1 + 8x}}{4}$ then we can get $\frac{-3 + \sqrt{1 + 8x}}{4} < M \leq \frac{1 + \sqrt{1 + 8x}}{4}$

That is, $M = \frac{\sqrt{2x}}{2} + O(1)$.

Lemma 3 Let $h(n)$ be a nonnegative arithmetical function with $h(0) = 0$. Then, for any real number $x \geq 1$ we have the asymptotic formula:

$$\sum_{n \leq x} h(a(n)) = \sum_{m=1}^M \sum_{i \leq 4m} h(i) + O\left(\sum_{i \leq 4M} h(i)\right) \tag{20.6}$$

Proof Let M be a fixed positive integer such that $M(2M - 1) \leq x < (M + 1)(2M + 1)$.

Noting that if n pass through the integers in the interval $[m(2m - 1), (m + 1)(2m + 1))$, then $a(n)$ pass

Through all integers in the interval $[0, 4m)$, so we can deduce that

$$\begin{aligned} \sum_{n \leq x} h(a(n)) &= \sum_{n \leq M(2M-1)} h(a(n)) + \sum_{M(2M-1) < n \leq x} h(a(n)) \\ &= \sum_{m=1}^M \sum_{i \leq 4m} h(i) + \sum_{i \leq x - M(2M-1)} h(i) \\ &= \sum_{m=1}^M \sum_{i \leq 4m} h(i) + O\left(\sum_{0 \leq i \leq (M+1)(2M+1) - M(2M-1)} h(i)\right) \\ &= \sum_{m=1}^M \sum_{i \leq 4m} h(i) + O\left(\sum_{i \leq 4M} h(i)\right) \end{aligned} \tag{20.7}$$

Lemma 4 For any real number $x > 1$ and positive integer k , we have the asymptotic formula

$$\sum_{n \leq x} \delta_k(n) = \frac{x^2}{2} \prod_{p|k} \frac{p}{p+1} + O(x^{\frac{3}{2} + \varepsilon}) \tag{20.8}$$

Where $\delta_k(n)$ defined as following: $\delta_k(n) = \begin{cases} \text{Max}\{d \in N | d|n, (d, k) = 1\}, n \neq 0 \\ 0, n = 0 \end{cases}$, $\prod_{p|k}$ denotes the product over all prime numbers which divide k , and ε is any fixed positive integer.

Lemma 5 For any real number $x > 1$, we have the asymptotic formula $\sum_{n \leq x} \frac{1}{n} = \ln x + \gamma + O\left(\frac{1}{x}\right)$, where γ is the Euler constant.

Proof See Ref. [5].

20.3 Proof of the Theorem

In this section, we will complete the proof of the theorem. First we prove Theorem 1.

Proof Let $h(n) = n$, then from lemma 2 and lemma 3, we obtain

$$\begin{aligned} \sum_{n \leq x} a(n) &= \sum_{m=1}^M \sum_{i \leq 4m} i + O\left(\sum_{i \leq 4M} i\right) = \sum_{m=1}^M 2m(4m+1) + O(M^2) \\ &= \frac{4}{3}M(M+1)(2M+1) + O(M^2) = \frac{2\sqrt{2}}{3}x^{\frac{3}{2}} + O(x) \end{aligned} \quad (20.9)$$

Now we prove Theorem 2.

Proof For any real number $x \geq 1$, Let M be a fixed positive integer such that $\frac{1}{2}M(M-1) < x \leq \frac{1}{2}M(M+1)$. From lemma 1 and lemma 3, we have:

$$\begin{aligned} \sum_{n \leq x} e_p(a(n)) &= \sum_{m=1}^M \sum_{i \leq 4m} e_p(i) + O\left(\sum_{i \leq 4M} e_p(i)\right) \\ &= \sum_{m=1}^M \left(\frac{1}{p-1} \cdot 4m + O(\ln^2 4m)\right) + O\left(\frac{1}{p-1} \cdot 4M + O(\ln^2 4M)\right) \\ &= \frac{4}{p-1} \cdot \frac{M(M+1)}{2} + O\left(\sum_{m=1}^M \ln^2 4m\right) + O\left(\frac{4}{p-1}M\right) \\ &= \frac{2}{p-1} \cdot M^2 + O\left(\frac{4}{p-1}M\right) \end{aligned} \quad (20.10)$$

Now we prove Theorem 3.

Proof From the definition of $a(n)$ and lemma4 and lemma3, we have:

$$\begin{aligned} \sum_{n \leq x} \delta_k(a(n)) &= \sum_{m=1}^M \sum_{i \leq 4m} \delta_k(i) + O\left(\sum_{i \leq 4M} \delta_k(i)\right) \\ &= \sum_{m=1}^M \left(\frac{(4m)^2}{2} \prod_{p|k} \frac{p}{p+1} + O(m^{\frac{3}{2}+\varepsilon})\right) + O(M^2) \\ &= 8 \prod_{p|k} \frac{p}{p+1} \sum_{m=1}^M m^2 + O\left(M^{\frac{5}{2}+\varepsilon}\right) \\ &= \frac{8}{3}M^3 \prod_{p|k} \frac{p}{p+1} + O\left(M^{\frac{5}{2}+\varepsilon}\right) \\ &= \frac{2\sqrt{2}}{3}x^{\frac{3}{2}} \prod_{p|k} \frac{p}{p+1} + O\left(x^{\frac{5}{4}+\varepsilon}\right) \end{aligned} \quad (20.11)$$

Now we prove Theorem 4.

Proof From the definition of $a(n)$ and lemma5 and lemma3, we have:

$$\begin{aligned}
 \sum_{n \leq x} \frac{1}{a(n) + 1} &= \sum_{m=1}^M \sum_{i \leq 4m} \frac{1}{i + 1} + o\left(\sum_{i \leq 4M} \frac{1}{i + 1}\right) \\
 &= \sum_{m=1}^M \left(\ln 4m + \gamma + o\left(\frac{1}{4m}\right)\right) + O(\ln m) \\
 &= \ln M! + (2 \ln 2 + \gamma)M + O(\ln M) = M \ln M + \\
 &\quad (2 \ln 2 + \gamma - 1)M + O(\ln M) \tag{20.12} \\
 &= \frac{\sqrt{2x}}{2} \ln \frac{\sqrt{2x}}{2} + (2 \ln 2 + \gamma - 1) \frac{\sqrt{2x}}{2} + O(\ln x) \\
 &= \frac{\sqrt{2x}}{4} \ln x + (\ln 2 + \gamma - 1) \frac{\sqrt{2x}}{2} + O(\ln x) \\
 &= \frac{\sqrt{2}}{4} x^{\frac{1}{2}} \ln x + \frac{\sqrt{2}}{2} (\ln 2 + \gamma - 1) x^{\frac{1}{2}} + O(\ln x)
 \end{aligned}$$

This completes the proof of the theorems.

References

1. Smarandache F (1993) Only problems not solutions. Chic Xiquan Publ House 129:322–225
2. Zhafeng X (2004) On the additive k-th power complements research on Smarandache problems. Probl Number Theory Hexis 20:13–16
3. Wang M-J (2010) On the complement of the Hexagon number of a positive integer. Henan Sci 28(2):144–147
4. Chuan L (2004) A number theoretic function and its mean value. Res Smarandache Probl Number Theory Hexis 45:122–123
5. Tom M (1976) Apostol. Introduction to analytic number theory, vol 1. Springer, Berlin, pp 77–78

Chapter 21

Beam-Wave Interaction Simulation of Rectangular Helix Traveling Wave Tube

Chengfang Fu

Abstract The beam-wave interaction of rectangular helix traveling-wave-tube (TWT) is simulated by MAGIC. Two linearly tapered resistance couplers were applied to reduce reflections, which may replace the actual input and output structures and reduce the self-excitation phenomena. The results show that the computing model is effective to simulate the beam-wave interaction of the rectangular helix TWT. Then some nonlinearly interaction phenomena and parameters of a designed X-band rectangular helix TWT were analyzed, such as the electron bunching, the energy exchange and the output power. And the operating frequency of the designed rectangular helix TWT is from 8 to 12 GHz, the highest output power reaches 480 W, bandwidth is about 4 GHz, and the interaction efficiency is 11.8 %.

Keywords High power microwave · Rectangular helix TWT · Electromagnetic simulation · Particle-in-cell

21.1 Introduction

With the rapid development of modern electronic-war and the space applications, the study on the millimeter waves becomes to be a focus [1]. For the reason of size reduction in the millimeter wave band, the size of the slow-wave structures (SWS) become smaller, which makes many efforts have been made to design the innovative interaction structures to meet the new demand of the electric equipments.

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Thus CCR have reported several novel SWSs of this kind, this include the square helix, planar helix and the modified fold waveguide circuits [1]. These circuits can be electroplated directly or photo-litho-graphically printed on a dielectric substrate, which avoids the conventional helix support rod and barrel assembly. Thermal stability is increased since they make contact with the dielectric substrate over an enlarged surface area compared to the conventional SWS. At the same time they are amenable to operation with ribbon beams, which allows increased currents without increased current density [2].

Since the conventional round helix SWS has unique properties, such as wide bandwidth and low dispersion, however, it's not compatible with MEMS technology. So a related structure in planar geometry was considered [3, 4]. This structure, called the "Rectangular Helix (RH)". The RH is modeled after the conventional round helix, but encompasses a rectangular geometry. In our previous work we have researched the rf characteristics of the RH in free space and in the dielectric using theoretical method [5, 6]. To make up the disadvantage of the theory analysis, the purpose of this paper is to investigate the beam-wave interaction inside the RH TWT using the particle-in-cell (PIC) simulation code MAGIC. MAGIC is one of the outstanding candidates in PIC, so there are many simulation works on the microwave tubes applying MAGIC internal and overseas, but few works on the helix TWT, for it is difficulty to design the matching input and output rf structures, and the program file is tediously long [7, 8]. Literature analyzed the efficiency improvement of the helical TWT applying the sheath model approximation using MAGIC, which is the 2D equivalent of the 3D practical object. In this article the 3D tape helical model is applied to accomplish the X-band RH TWT, using the resistance couplers with linearity conductivity replacing the rf input and output structures and setting the attenuation to reduce the reflection and self-excitation oscillation [9].

21.2 Simulating Model

Considering for the dispersion and coupling impedance of the RH SWS in electromagnetic simulating software HFSS, the dimension parameter of the RH SWS is designed. Then the modeling procedure is as follows: (1) the metal shield is set, (2) the RH SWS with suitable periods is designed, The 3D MAGIC simulation model is shown in Fig. 21.1, and Fig. 21.2 is views of the RH TWT.

It is known to us that inside TWT the self-excitation oscillation always arises to disrupt the normal run, and the thoroughly solution is to reduce and eliminate the self-excitation oscillation. But in the 3D MAGIC it is infeasible to set the perfectly matching input and output structures. So to reduce the reflections and oscillation two resistor couplers with proper conductivity are set to replace the input and output structures. The designed resistor couplers will determine TWT will work regular or not, so it is important to set the conductivity function of the couplers.

Fig. 21.1 3D MAGIC simulation model (shield is omitted)

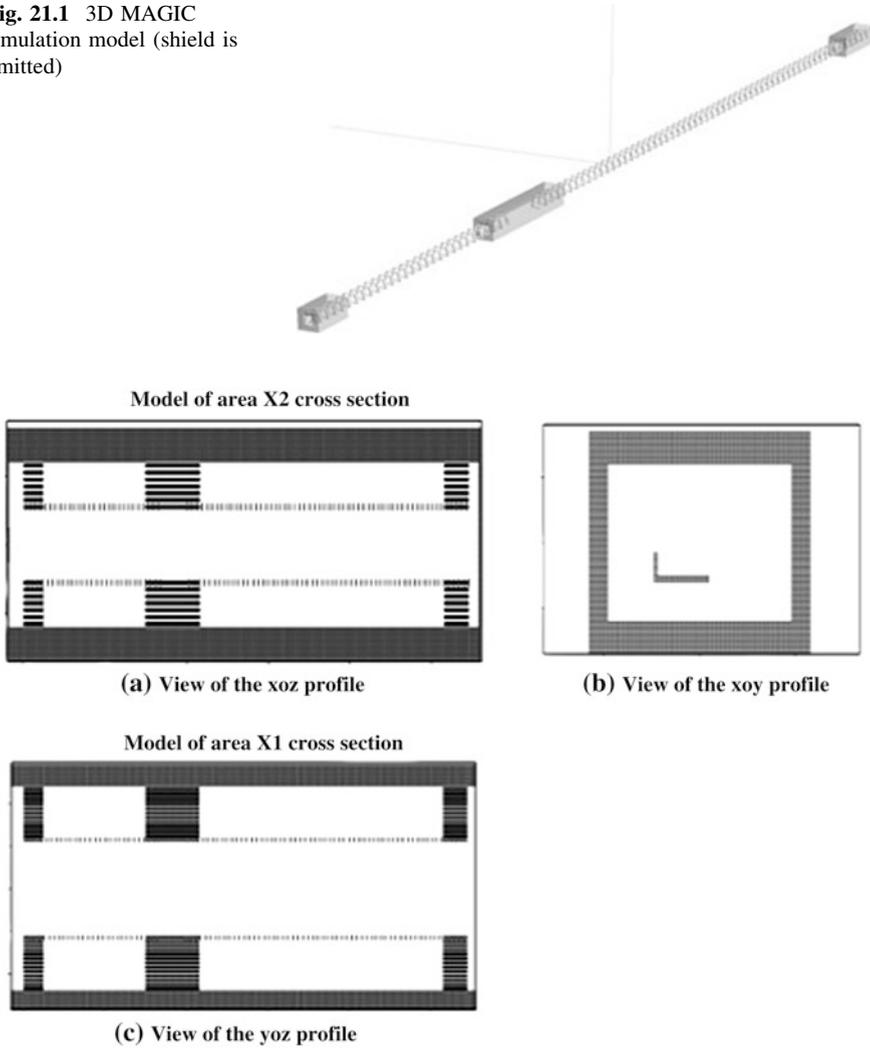


Fig. 21.2 Views of the rectangular helix TWT

After debugging and optimization many times the linear function of the conductivity is applied as:

$$\sigma_i(x, y, z) = 0.3 \left(\frac{0.25 + 2(z_1 - z)}{L_{ci}} \right) / \Omega \cdot m \tag{21.1}$$

$$\sigma_o(x, y, z) = 0.3 \left(\frac{0.25 + 2(z - z_2)}{L_{co}} \right) / \Omega \cdot m \tag{21.2}$$

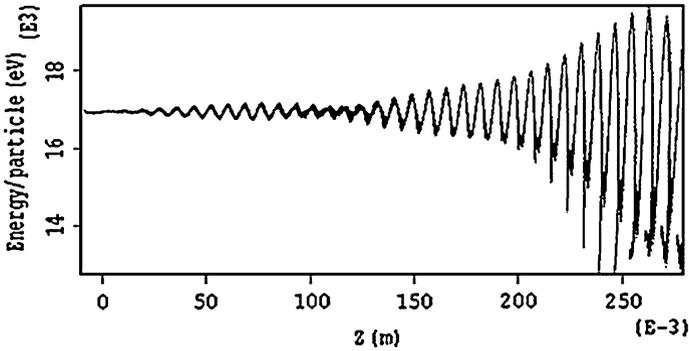


Fig. 21.3 Phase space of the axial kinetic energy

Where and are the conductivity of the input and output couplers separately, the unit is $\Omega \bullet m$; and are the length of the input and output couplers separately; and are the initial z-coordinate and terminal z-coordinate of the input and output couplers separately. Applying the conductivity function (21.1) and (21.2) the reflections will be reduced effectively.

21.3 The Nonlinear Phenomena of the Beam-Wave Interaction

The 9 GHz microwave simulating input is imported by the current differential, and the beam parameters are 17 kV and 0.25A. To investigate the beam-wave interaction inside the RH TWT using MAGIC, different parts are meshed differently to investigate the electron's bunching and the energy exchange.

Figure 21.3 is the phase space of the axial kinetic energy. It can be seen from Fig. 21.3 that the beam is modulated when it goes through the first section SWS, after going through the attenuation, the modulated beam excites the rf signal transmitting along the SWS. In the following the beam transfers energy to high frequency signal. At the same time it can be drawn that the most electrons' energy have been reduced greatly, that is the beam have transfer most energy to rf signal to amplify the signal.

Figure 21.4 is the phase space of the axial position. It can be seen from Fig. 21.4 that the beam bunches very well, and there is fault space in the beam obviously, which shows that after the beam-wave interaction parts of electrons hand over their kinetic energy to field that their velocity dropped greatly, so that them be caught up with by the following beams to form electron group.

Figure 21.5 is the output power along z-axial. It can be drawn that when the rf signal is amplified to some extent when it is passing through the first SWS, for the electrons in decelerating field transfer their energy to the signal. But the rf signal

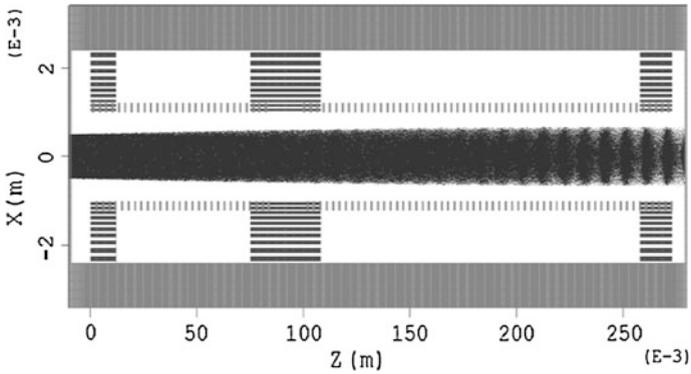


Fig. 21.4 Phase space of the axial position

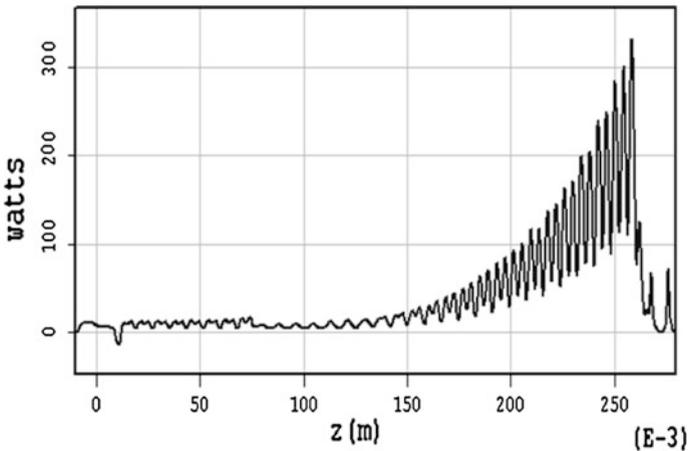


Fig. 21.5 Output power along z-axial

energy is decayed when it is passing through the attenuation. But after the attenuation the rf signal is excited again and it draw energy from the beam, which is shown in Fig. 21.5 that the output power is rising greatly. So Fig. 21.5 reflects the energy exchange between the electrons and the microwave qualitatively.

Figure 21.6 is the current through TWT. It can be seen from Fig. 21.6 that: the current fluctuates clearly in the output. The electron bunching makes the current not to be DC, and the current fluctuates greatly as the bunching increases, which causes the current through TWT becomes ups and downs. At the same time the current fluctuation verifies that the electron bunching does exist in Fig. 21.4.

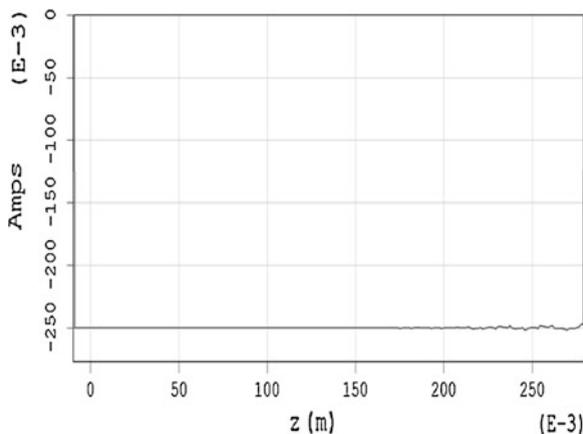


Fig. 21.6 Current through TWT

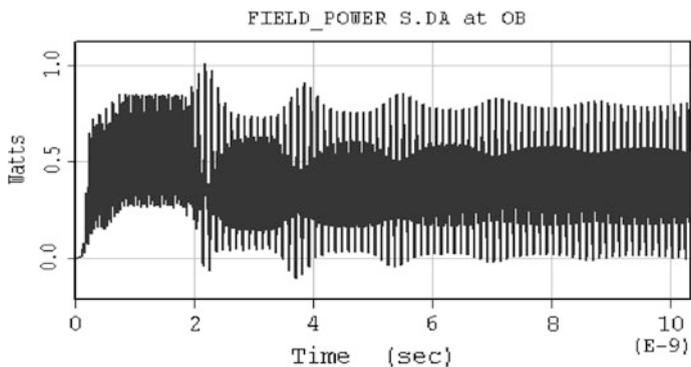


Fig. 21.7 Microwave input waveform and spectrum

21.4 Nonlinear Parameters of the Beam-Wave Interaction

Figure 21.7 is the microwave input waveform and spectrum. From Fig. 21.7 we can see that the spectrum purity of the input microwave is good, and there is no noise wave is input, which supplies fine input signal for TWT. It can also be seen from Fig. 21.8 that the input signal and input power of the TWT are stable from 4 ns.

Figure 21.9 is the output power versus frequency when the SWS and the beam parameters are fixed. It can be seen from Fig. 21.9 that the output power increases firstly then decreases as the frequency increases. For the working frequency of the SWS is 9 GHz the output power isn't large only when the synchronization conditions is met. Deviating from the working frequency most macro particles are not in the decelerating field, which even leave the bunching groups away outside to the

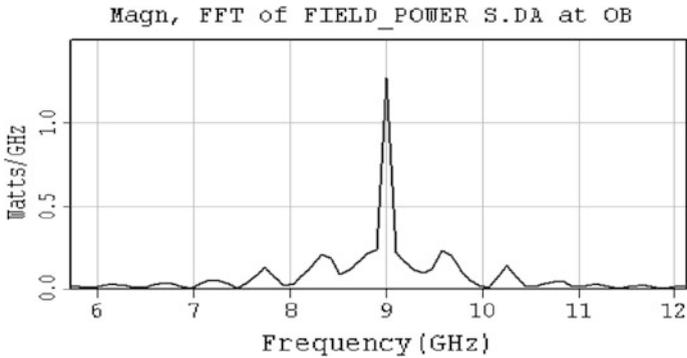
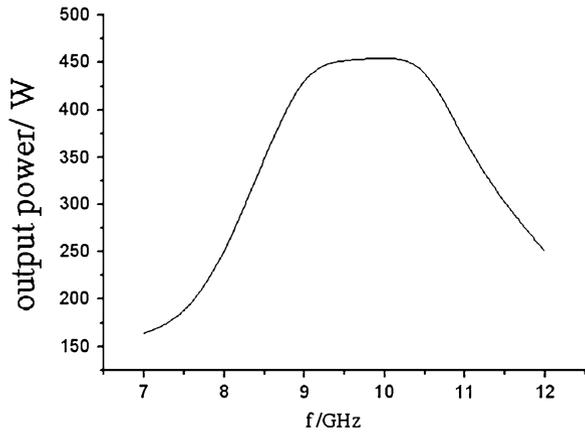


Fig. 21.8 Input signal and input power of the TWT

Fig. 21.9 Output power versus frequency



decelerating field, so the output power falls down greatly. The above conclusion matches with the results in small signal analysis of TWT. Applying the input signal of 9 GHz and the beam of 17 kV and 0.25 A the output power of the RH TWT reaches 480 W, and the 3 dB bandwidth is about 4 GHz, the interaction efficiency is 11.8 %.

21.5 Conclusions

The beam-wave interaction of rectangular helix traveling-wave-tube (TWT) is simulated using 3D particle-in-cell software MAGIC, using the linearly tapered resistance couplers to replace the input and output structures to reduce reflections, and the self-excitation phenomena. The linearly tapered function is obtained at the same time. The results show that the computing model is effective to simulate the beam-wave interaction of the rectangular helix TWT. Then some nonlinearly

interaction phenomena and parameters of the X-band rectangular helix TWT were analyzed, such as the electron bunching, the energy exchanging and the output power. And the operating frequency of the designed rectangular helix TWT is from 8 to 12 GHz, the highest output power reaches 480 W, bandwidth is about 4 GHz, and the interaction efficiency is 11.8 %.

References

1. Kory C, Ives L, Booske J et al (2004) Novel TWT interaction circuits for high frequency application. *IVEC* 51:233–236
2. Carlsten BE, Russell SJ, Earley LM et al (2005) Technology development for a mm-wave sheet-beam traveling-wave tube. *IEEE Trans Plasma Sci* 33(1):85–87
3. Pierce JR (1950) *Traveling wave tubes*. N Y Van Nostrand 1:134–137
4. Arora RK (1966) Surface wave on a pair of parallel unidirectionally conducting screens. *IEEE Trans Antennas Propag* 14:795–799
5. Fu CF, Wei YY, Wang WX et al (2008) Dispersion characteristics of a rectangular Helix slow-wave structure. *IEEE Trans Electron Devices* 55(12):3582–3588
6. Fu CF, Wei YY, Wang WX et al (2008) Radio-frequency characteristics of a printed rectangular Helix slow-wave structure. *Chin Phys Lett* 25(9):3478–3482
7. Liao P, Yang ZH, Lei WQ et al (2004) Study on 3-D MAFIA PIC simulation for microwave tube electron gun. *High Power Laser Part Beams* 16(3):353–355
8. Guo ZL, Liang Z, Yang ZQ (2001) Particle simulation on s-band relativistic two-stream amplifier. *High Power Laser Part Beams* 13(6):744–747
9. Zhu ZJ, Jia BF, Luo ZX (2007) Efficiency enhancement simulation of helix traveling-wave tube. *High Power Laser Part Beams* 19(5):815–816

Chapter 22

On Edge Szeged Index of Bridge Graphs

Fuqin Zhan and Youfu Qiao

Abstract The edge Szeged index of graphs is new topological indices presented very recently, having applications in chemistry. In this paper, a formula for the edge Szeged index of bridge graphs is obtained and some other composite graphs are considered. Applying these formulas, the edge Szeged index of several graphs is computed.

Keywords Edge szeged index · Distance in graphs · Graph invariant

22.1 Introduction

In theoretical chemistry molecular structure descriptors-also called topological indices-are used to understand physico-chemical properties of chemical compounds. By now there exist a lot of different types of such indices which capture different aspects of the molecular graphs associated with the molecules considered. A topological index of a graph G is a numerical invariant of. The Wiener index W was the first topological index to be used in chemistry. It was introduced in 1947 by Wiener [1, 2]. Gutman introduced a generalization of the Wiener index for cyclic graphs called Szeged index. The main advantage of the Szeged index is that it is a modification of W for cyclic graphs. We now introduced another topological

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index and named it Padmakar-Ivan index, and abbreviated as PI [3, 4]. Very recently, new topological index, the edge Szeged index was introduced and some of its properties were derived [5, 6].

22.2 Preliminaries

In this section, we introduce some definitions and notations which we use throughout this paper. Let G be a simple connected graph with vertex and edge sets $V(G)$ and $E(G)$, respectively. For vertices $u, v \in V(G)$, the distance $d(u, v)$ is defined as the length of the shortest path between u and v in G . Let $e = uv$ be an edge of the graph G . The distance between the vertex w and the edge $e = uv$ is defined as $d(w, e) = \min\{d(w, u), d(w, v)\}$. The number of vertices of G whose distance to the vertex u is smaller than the distance to the vertex v is denoted by $n_u(e)$. Similarly, $m_u(e)$ denotes the number of edges of G whose distance to the vertex u is smaller than the distance to the vertex v . In the other words, $n_u(e) = |\{x \in V(G) | d(x, u) < d(x, v)\}|$ and $m_u(e) = |\{f \in E(G) | d(f, u) < d(f, v)\}|$. The vertices and the edges of G with the same distance to u and v are not counted. We now define one topological index the edge Szeged index of G as follows:

$$Sz_e(G) = \sum_{e \in E(G)} m_u(e)m_v(e) \tag{22.1}$$

Another recently conceived structure descriptor [7, 8], is so-called edge Szeged index: $Sz_e(G) = \sum_{e \in E(G)} m_u(e)m_v(e)$

Let us briefly recall the definition of bridge graphs. Let $\{G_i\}_i^r = 1$ be a set of finite pairwise disjoint graphs with $v_i \in V(G_i)$ the bridge graph $B(G_1, G_2, \dots, G_r) = B(G_1, G_2, \dots, G_r; v_1, v_2, \dots, v_r)$ of $\{G_i\}_i^r = 1$ with respect to the vertices $\{v_i\}_i^r = 1$ is the graph obtained from the graphs G_1, G_2, \dots, G_r by connecting the vertices v_i and $v_i + 1$ by an edge for all $i = 1, 2, \dots, r - 1$. In the vertex PI index and Szeged index of bridge graphs have been determined. In this paper, we determine the edge Szeged index of the bridge graph. We shall present an explicit formula of the edge Szeged index for bridge graph. Then we shall apply this result to determine the edge Szeged index of some classes of graphs.

Let C_k be the cycle with k vertices. Define $G_r(C_i) = B(G_{k_1}, G_{k_2}, \dots, G_{k_r}; v_1, v_2, \dots, v_r)$, see Fig. 22.1.

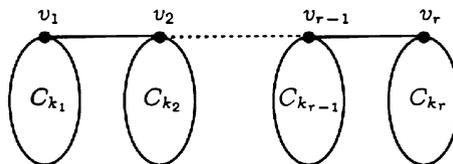


Fig. 22.1 The graph $G_r(C_i)$

22.3 The Edge Szeged Index of the Bridge Graph

Let $G = B(G_1, G_2, \dots, G_r)$ be the bridge graph. We denote the set of edges $e = uv$ in $E(G_i) \setminus Q_{v_i}(G_i)$ such that $d(u, v_i) < d(v, v_i)$ by $L(G_i)$ and the set of edges with $d(u, v_i) > d(v, v_i)$ by $S(G_i)$. To make this well-defined we choose an arbitrary direction on G_i . The results do not depend on the direction chosen.

Theorem 1 For $G = B(G_1, G_2, \dots, G_r)$ with respect to the vertices $\{v_i\}_i^r = 1$, we have

$$Sz_e(G) = \sum_{i=1}^r Sz_e(G_i) + \sum_{i=1}^r (|E(G)| - |E(G_i)|)(a_i + b_i) + \sum_{i=1}^{r-1} t_i |E(G)| - t_i - 1 \quad (22.2)$$

Where

$$a_i = \sum_{e=uv \in L(G_i)} m_u(e|G_i), b_i = \sum_{e=uv \in S(G_i)} m_u(e|G_i) \text{ and } t_i = \sum_{j=1}^i |E(G_j)| + i - 1, \text{ for all } i = 1, 2, \dots, r$$

Proof From the definitions we see that

$$\begin{aligned} Sz_e(G) &= \sum_{e=uv \in E(G)} m_u(e|G)m_v(e|G) \\ &= \sum_{i=1}^r \sum_{e=uv \in E(G_i)} m_u(e|G)m_v(e|G) + \sum_{i=1}^{r-1} m_{v_i}(v_i v_{i+1} + 1|G)m_{v_{i+1}}(v_i v_{i+1}|G) \\ &= \sum_{i=1}^r \sum_{e=uv \in Q_{v_i}(G_i)} m_u(e|G)m_v(e|G) + \sum_{i=1}^r \sum_{e=uv \in E(G_i) \setminus Q_{v_i}(G_i)} m_u(e|G)m_v(e|G) \\ &\quad + \sum_{i=1}^{r-1} m_{v_i}(v_i v_{i+1} + 1|G)m_{v_{i+1}}(v_i v_{i+1}|G) \end{aligned} \quad (22.3)$$

If $e = uv \in Q_{v_i}(G_i)$ then all the edges in $E(G) \setminus E(G_i)$ are equidistant from the ends of the edge e , thus $m_u(e|G)m_v(e|G) = m_u(e|G_i)m_v(e|G_i)$. This implies that

$$\sum_{i=1}^r \sum_{e=uv \in Q_{v_i}(G_i)} m_u(e|G)m_v(e|G) = \sum_{i=1}^r \sum_{e=uv \in E(G_i) \setminus Q_{v_i}(G_i)} m_u(e|G_i)m_v(e|G_i) \quad (22.4)$$

If $e = uv \in E(G_i) \setminus Q_{v_i}(G_i)$ then there exist the following two cases:

$$e \in L(G_i) \quad (22.5)$$

In this case we have that

$$m_u(e|G)m_v(e|G) = m_u(e|G_i) + E(G) - E(G_i)|m_v(e|G_i) \quad (22.6)$$

$$e \in S(G_i) \quad (22.7)$$

In this case we have that

$$m_u(e|G)m_v(e|G) = m_u(e|G_i)(m_v(e|G_i) + E(G) - E(G_i)) \quad (22.8)$$

Therefore,

$$\begin{aligned} & \sum_{i=1}^r \sum_{e=uv \in E(G_i) \setminus Q_{vi}(G_i)} m_u(e|G)m_v(e|G) \\ &= \sum_{i=1}^r \sum_{e \in L(G_i)} (m_u(e|G_i) + |E(G) - E(G_i)|)m_v(e|G_i) + \\ &= \sum_{i=1}^r \sum_{e \in S(G_i)} m_u(e|G_i)m_v(e|G_i) + |E(G) - E(G_i)| \\ &= \sum_{i=1}^r \sum_{e=uv \in E(G_i) \setminus Q_{vi}(G_i)} m_u(e|G_i)m_v(e|G_i) + \\ & \quad \sum_{i=1}^r \sum_{e \in L(G_i)} (|E(G) - E(G_i)|)m_v(e|G_i) + \\ & \quad \sum_{i=1}^r \sum_{e \in S(G_i)} (|E(G) - E(G_i)|)m_v(e|G_i) \quad (22.9) \\ &= \sum_{i=1}^r \sum_{e=uv \in E(G_i) \setminus Q_{vi}(G_i)} m_u(e|G_i)m_v(e|G_i) + \sum_{i=1}^r (|E(G) - E(G_i)|) \\ & \quad \sum_{e \in L(G_i)} m_u(e|G_i) + \sum_{i=1}^r (|E(G) - E(G_i)|) \sum_{e=uv \in S(G_i)} m_u(e|G_i) \\ &= \sum_{i=1}^r \sum_{e=uv \in E(G_i) \setminus Q_{vi}(G_i)} m_u(e|G_i)m_v(e|G_i) + \\ & \quad \sum_{i=1}^r (|E(G) - E(G_i)|)(a_i + b_i) \end{aligned}$$

If $e = v_i v_{i+1}$, then there exist no edge e' which is equidistant from the ends of the edge $e = v_i v_{i+1}$, thus

$$\begin{aligned} & \sum_{i=1}^{r-1} m_{v_i}(v_i v_{i+1} | G) m_{v_{i+1}}(v_i v_{i+1} | G) = \\ & \sum_{i=1}^{r-1} \left(\sum_{j=1}^i |E(G_j)| + i + 1 \right) \left(\sum_{j=i+1}^r |E(G_j)| + r - i - 1 \right) \sum_{i=1}^{r-1} t_i (|E(G)| - t_i - 1) \end{aligned} \tag{22.10}$$

Hence, we have

$$S_{Z_e}(G) = \sum_{i=1}^r S_{Z_e}(G_i) + \sum_{i=1}^r (|E(G)| - |E(G_i)|)(a_i + b_i) + \sum_{i=1}^{r-1} t_i |E(G)| - t_i - 1$$

Corollary 2. Let H be any graph with fixed vertex v . Then the edge Szeged index of the bridge graph $G_r(H, v)$ is given by

$$\begin{aligned} S_{Z_e}(G) = & rS_{Z_e}(H) + r(r-1)(|E(H)| + 1) \left[\frac{1}{6}(r+1)(|E(H)| + 1) \right. \\ & \left. + a(H) - b(H) - 1 \right] + r - 1 \end{aligned} \tag{22.11}$$

Where $a(H) = \sum_{e=uv \in L(H)} m_v(e|H), b(H) = \sum_{e=uv \in S(H)} m_u(e|H)$

Proof Let $G = G_r(H, v)$. By Theorem 5 we have

$$\begin{aligned} S_{Z_e}(G) &= \sum_{i=1}^r S_{Z_e}(H) + \sum_{i=1}^r (|E(G)| - |E(H)|)(a_i + b_i) + \sum_{i=1}^{r-1} t_{ij} (|E(G)| - t_{ij} - 1) \\ &= rS_{Z_e}(H) + r(r-1)(|E(H)| + 1)(a(H) + b(H)) + (|E(G)| - 1) \sum_{i=1}^{r-1} t_{ij} \sum_{i=1}^{r-1} t_{ij}^2 \end{aligned}$$

Note that

$$\begin{aligned} t_{ij} &= \sum_{j=1}^i |E(G_j)| + i + 1 = i(|E(H)| + 1) - 1 \\ \sum_{i=1}^{r-1} t_{ij} &= (|E(H)| + 1) \sum_{i=1}^{r-1} i - (r-1) = \frac{1}{2}r(r-1)(|E(H)| + 1) - (r-1) \\ \sum_{i=1}^{r-1} t_{ij}^2 &= \sum_{i=1}^{r-1} [i(|E(H)| + 1) - 1]^2 \\ &= \frac{1}{6}r(r-1)(2r-1)(|E(H)| + 1)^2 - r(r-1)(|E(H)| + 1) + (r-1) \end{aligned} \tag{22.12}$$

Therefore,

$$\begin{aligned}
 Sz_e(G) &= rSz_e(H) + r(r-1)(|E(H)|+1)(a(H)+b(H))+ \\
 &\quad [r(|E(H)|+1)-2]\left[\frac{1}{2}r(r-1)(|E(H)|+1)-(r-1)\right] \\
 &\quad - \frac{1}{6}r(r-1)(2r-1)(|E(H)|+1)^2 + r(r-1)(|E(H)+1) \\
 &\quad + (r-1) = rSz_e(H) + r(r-1)(|E(H)|+1)(a(H)+b(H)) \\
 &\quad + \frac{1}{2}r^2(r-1)(|E(H)|+1)^2 - (2r-1)(|E(H)|+1) \\
 &\quad + 2(r-1) - \frac{1}{6}r(r-1)(2r-1)(|E(H)|+1)^2 + r(r-1) \\
 &= rSz_e(H) + r(r-1)(|E(H)|+1)(a(H)+b(H)) \\
 &\quad + \frac{1}{6}r(r-1)(|E(H)|+1)^2(r+1) \\
 &\quad - r(r-1)(|E(H)|+1) + (r-1) = rSz_e(H) + r(r-1)(|E(H)|+1) \\
 &\quad \left[\frac{1}{6}r(r+1)(|E(H)|+1) + a(H) + b(H) - 1\right] + r - 1
 \end{aligned}
 \tag{22.13}$$

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References

1. Wiener H, Am J (1947) Safe object oriented programming of distributed real time systems. Chem Soc 69:17–20
2. Gutman I (1994) Graph theory notes New York, aspect oriented programming for a component-based real life application, vol 27. pp 9–15
3. Khadikar PV (2000) Fabrication of indium bumps for hybrid infrared focal plane array applications. Natl Acad Sci Lett 23:113–118
4. Khadikar PV, Deshpande NV, Kale PP, Dobrynin A, Gutuman I (1995) Applying Anand model to represent the viscoplastic deformation behavior of solder alloys. J Chem Inf Comput Sci 35:547–550
5. Khadikar PV, Kale PP, Deshpande NV, Karmarkar S, Agrawal VK (2001) Reversible-logic design with online testability. J Math Chem 62:25–28
6. Vapik V (2001) The architecture of the dali main-memory storage. Manager 29:143–150
7. Gutman I, Ashrafi AR (2008) Theory and application of finite element method. Croat Chem Acta 81:277–281
8. Khalifeh MH, Yousefi-Azari H, Ashrafi AR, Gutman I (2008) Agent-organized networks for dynamic team formation. Croat Chem Acta 81, 43:277–281

Chapter 23

Speech Enhancement Algorithm Based on Hilbert-Huang and Wavelet

Jin Li, Fu Liu, Huiyan Xu and Feile Wang

Abstract Combined with Hilbert-Huang transformation of the empirical mode decomposition (EMD) and wavelet analysis, we propose a new speech enhancement algorithm. The algorithm firstly with Hilbert-Huang transformation of the empirical mode decomposition to obtain intrinsic mode functions (IMF), and then combining with wavelet transform of the soft threshold de-noising method, in different intrinsic mode functions on the soft threshold time-scale filtering processing, and finally reconstruct the useful signal to achieve speech enhancement. The simulation results show that the proposed method compared to conventional hard threshold de-noising method, which has more significantly output performance, greatly improved the quality of speech enhancement, and robustness.

Keywords Hilbert-huang transform · Empirical mode decomposition · Wavelet · Speech enhancement

23.1 Introduction

Speech signal is a kind of typical non-linear and the non-stationary random signal [1]. Speech in the communication process inevitably introduces a variety of noise, and the presence of noise damage to the speech and the acoustic characteristics of

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the original model parameters, affecting the speech clarity and intelligibility. The quality of the speech signal for speech coding, speech recognition and speaker recognition and other fields plays a crucial role [2]. Therefore, the speech enhancement technology for speech processing system has important significance [3].

The purpose of speech enhancement for noisy speech is to eliminate background noise and improve speech quality, clarity, intelligibility and comfort, to improve the performance of speech processing system. For how to extract clean speech signal as soon as possible from all kinds of background noise, a lot of speech enhancement algorithms are proposed. At present, the commonly methods are spectral subtraction method, based on short-time spectral estimation method, based on signal subspace enhanced method and based on auditory model method, etc [4, 5]. These methods in essence are different degrees of speech signal violation the premise that the speech signal is non-linear and non-stationary signal, and the conclusion also destroy useful information analysis and extraction [6, 7].

In this paper, we combine with HHT of EMD and wavelet analysis to study the strong noise environment speech enhancement algorithm. The simulation results show that the proposed algorithm compared with traditional methods in low SNR environment, the speech quality has been greatly improved, and has good development potential.

23.2 Empirical Mode Decomposition

EMD is to decompose the signal peak point of time delay between adjacent points defined as time-scale [8]. Non-linear and non-stationary signals are chose to break down into different time scales, which contain a limited number of IMF and the each order IMF components are stable narrow-band signals.

For an analysis signal is $x(t)$, the implementing steps of IMF components for EMD decomposition are as follows:

Firstly find all the maximum value point and minimum value, fitted by cubic spline interpolation to obtain the upper envelope and lower envelope, ensure that all points on the $x(t)$ is between the above two envelopes, through calculation the mean value of each point, so as to obtain a mean curve $m_1(t)$, and define the signal $x(t)$ minus the corresponding point of $m_1(t)$ available new data sequence $h_1^{(1)}(t)$:

$$x(t) - m_1(t) = h_1^{(1)}(t) \quad (23.1)$$

If $h_1^{(1)}(t)$ meets the condition of IMF component, then $h_1^{(1)}(t)$ is the first-order IMF component. Otherwise, continue to repeat the above process for n times, until $h_1^{(1)}(t)$ meets the convergence criteria. So, the first-order IMF component is:

$$C_1(t) = h_1^{(n)}(t) \quad (23.2)$$

$C_1(t)$ represents the highest frequency signal sequence components. Subtract $C_1(t)$ from the original signal to obtain the first-order residual term $r_1(t)$:

$$x(t) - C_1(t) = r_1(t) \tag{23.3}$$

Then, repeat the above process for $r_1(t)$ can obtain the second-order IMF component $C_2(t)$. Through the EMD decomposition of signal again and time again, can obtain some order IMF components and a residual component r_n , then the whole decomposition process is over. After the decomposition, the original signal $x(t)$ can be expressed as:

$$x(t) = \sum_{i=1}^n C_i(t) + r_n(t) \tag{23.4}$$

Figure 23.1 gives the clean speech each order IMF component by EMD decomposition.

Figure 23.1 shows that the speech sample is adaptive decomposed into 14 order IMF. Signal from the high frequency to low frequency filtering, each order IMF component has shown a scale range of mode, and no mode overlapping phenomena.

23.3 Algorithm Description

Commonly used EMD hard threshold of filtering method think high frequency band IMF component is noise, the remaining signal components for actual useful

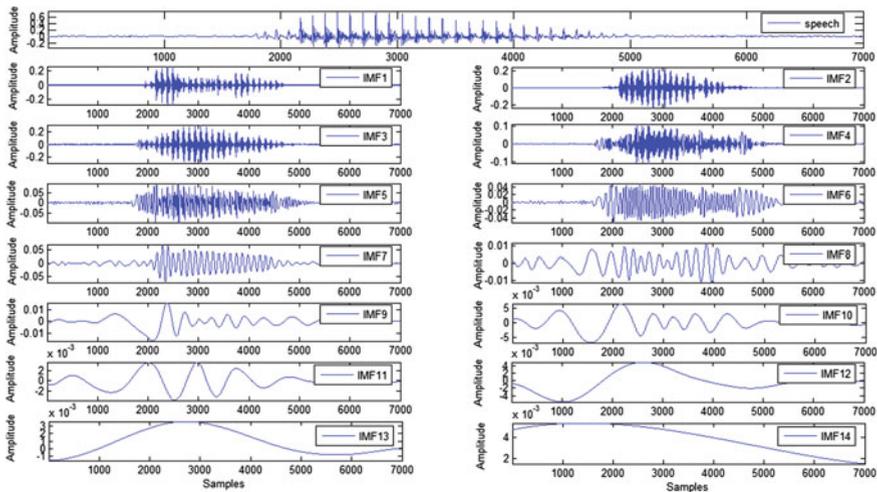


Fig. 23.1 Speech samples signal EMD decomposition

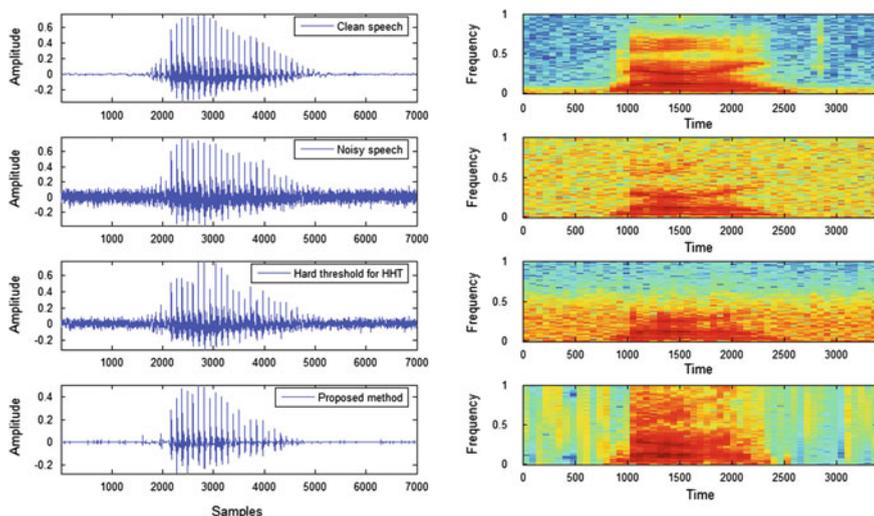


Fig. 23.2 Filtering results comparison of two methods

signal components. The method itself denied high order IMF component contains useful information, and thus in the de-noising processing and filter in addition to the original signal of the useful component, usually leads to the filter effect is not ideal.

The new speech enhancement algorithm is as follows:

The noisy speech signal with EMD decomposition, obtain to meet the requirements of the Hilbert transform of order IMF.

Combined with wavelet transform the soft threshold de-noising method to the IMF components for filtering, and reconstructing signal [9, 10].

The soft threshold function defined as follows:

$$C_i(t) = \begin{cases} C_i(t) + \lambda_i & C_i(t) \leq -\lambda_i \\ 0 & |C_i(t)| < \lambda_i \\ C_i(t) - \lambda_i & C_i(t) \geq \lambda_i \end{cases} \quad (23.5)$$

$$\lambda_i = \beta \sigma_i \sqrt{2 \log(N)} \quad (23.6)$$

Where, σ_i represents the i order component contained the noise of standard deviation, β represents the weighting factor, ranging from 0.2 to 0.5.

Simulation experiment and analysis

Figure 23.2 shows the SNR is 5 dB, the noisy speech samples of EMD hard threshold filter and the proposed algorithm simulation results diagram and spectrogram. The clean speech sample for boy pronounced “nine”, 10 kHz sampling, 16 bit quantification. Background noise comes from NOISEX-92. The SNR of the two algorithms is shown in Table 23.1.

Table 23.1 The SNR of the two algorithms

Noise	Input SNR (dB)	Hard threshold for HHT (dB)	Proposed method (dB)
White	0	6.2	8.1
White	5	9.6	12.5
White	10	13.3	15.8

Analysis of de-noising waveform and SNR show that the proposed method than the hard threshold filter method in effect is obviously improved the SNR.

23.4 Conclusion

Aimed at speech enhancement problem in low SNR environment, this paper firstly with Hilbert-Huang transformation of EMD to obtain IMF, and then combining with wavelet transform of the soft threshold de-noising method, in different IMFs on the soft threshold time-scale filtering processing.

Simulation results show that the proposed algorithm in strong noise environment is better than traditional methods. The filter results fully retain the signal itself has non-linear and non-stationary feature, to ensure the integrity of useful signal, and speech quality has improved significantly. Combine Hilbert-Huang transform and wavelet transform together for analysis of the speech signal processing to provide a new idea, and has a broad development prospects.

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References

1. Virag N (1999) Single channel speech enhancement system based on masking properties of the human auditory system. *IEEE Trans Speech Audio Proc* 7:126–137
2. Rezaee A, Gazor S (2001) An adaptive KLT approach for speech enhancement. *IEEE Trans Speech Audio Proc* 9(2):87–95
3. Ghanbari Y, Karami M (2006) A new approach for speech enhancement based on the adaptive thresholding of the wavelet packets. *Speech Commun* 48(8):927–940
4. Boll S (1979) Suppression of acoustic noise in speech using spectral subtraction. *IEEE Trans Acoust Speech Signal Process* 2:113–120
5. Berouti M, Schwartz R, Makhoul J (1979) Enhancement of speech corrupted by acoustic noise. *ICASSP* 1:208–211
6. Jabloun F, Champagne B (2003) Incorporating the human hearing properties in the signal subspace approach for speech enhancement. *IEEE Trans Speech Audio Proc* 11(6):700–708
7. Sheng L, Ming N, Jianqi W (2008) Enhancement of non-air conduct speech based on multi-band spectral subtraction method. *ICISP* 1:338–341

8. Huang NE, Shen Z, Long SR (1998) The empirical mode decomposition and the Hilbert spectrum for nonlinear and non-stationary time series analysis. *Proc Royal Soc Lond* 1:903–995
9. Lan X, Hon KK (2008) Adaptive wavelet de-noising system for speech enhancement. *IEEE Int Symp Circuits Syst* 18(5):3210–3213
10. Donoho DL (1995) De-noising by soft-thresholding. *IEEE Trans Inf Theory* 41(3):613–627

Chapter 24

Huang Diffuse Scattering from Small Planar Dislocation Loops

Zhongfu Zhou, Yaru Zhang, Adrian P. Sutton, Sergei L. Dudarev,
Michael L. Jenkins, Mark A. Kirk, George N. Greaves
and Lixin Xiao

Abstract This paper gives out a theoretical framework of electron/X-ray Huang diffuse scattering intensity at the immediate vicinity of Bragg reflection in reciprocal space. Nodal lines of two types in the simulated patterns of Huang diffuse scattering intensity are discussed in connection with a loop shape factor and the Huang diffuse scattering intensity from infinitesimal loops. It is suggested that the Huang diffuse scattering method is supplementary to the conventional TEM

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amplitude contrast imaging techniques and it has advantages in characterizing the morphology of very small dislocation loop when other methods fail.

Keywords Dislocation loops · Diffuse scattering · Huang diffuse scattering · Kinematical theory

24.1 Introduction

The properties of solid state materials are controlled largely by defects. In order to investigate the effects of the defects to materials properties, we have to gain a thorough understanding of the nature of the defects inside the materials. Dislocation loops are one of the most popular and important defects studied, they are commonly found in fusion materials, the structural components of fusion reactors are bombarded with high-energy neutrons, leading to the formation of very small dislocation loops which affect significantly the mechanical and thermal properties of the material [1, 2]. Another field which dislocation loops play a significant role is the so called “defect engineering” [3, 4]. For example, dislocation-engineered silicon has been used in light emitting diodes (LEDs) [5]. Silicon is an indirect band gap semiconductor and is fundamentally unable to emit light efficiently. Recently approaches have been made to enhance its poor light emission performance. However there is a common problem that strong thermal quenching of the silicon LEDs, leads to a very poor light-emitting performance at room temperature. The dislocation engineering method has been used to suppress the thermal quenching in semiconductor systems [6, 7]. It has been also found in recent years that dislocation loops of only a few nanometers in size can undergo one-dimensional diffusion without external stress, which highlights the study of the correlation between the properties of crystals, and dislocation generation and motion [8]. Among all these research topics, there is an issue needs to be underpinned, that is how to characterize such small dislocation loops. With the advancement of modern transmission electron microscopy (TEM) techniques [9], the characterization of majority of defects can be tackled. However, defect characterization can be very challenging when the sizes of defects are very small. It has been found that it is extremely difficult to find out the morphology of dislocation loops smaller than 3 nm in diameter using conventional TEM amplitude-contrast imaging techniques [10]. A new experimental technique has been developed for characterizing nanometer-sized defects in the electron microscope by collecting elastic diffuse scattering patterns in the vicinity of Bragg reflections [11]. This method shows great potential in characterizing individual nano-defects which cannot be visualized using other techniques. The diffuse scattering patterns in the immediate vicinity of Bragg reflections are dominated by Huang diffuse scattering. In this paper, we provide a theoretical framework of Huang diffuse scattering from dislocation loops of arbitrary shapes, and discuss the potential applications of

using the Huang diffuse scattering patterns to extract morphological information of small dislocation loops.

24.2 Theory

At a point q in the immediate vicinity of Bragg reflection g in reciprocal space, The Huang diffuse scattering amplitude $A(q)$ resulting from an individual or a cluster of point defects can be written as [12]:

$$A_H(q) = \sum_n iK \cdot u(r_n) e^{iq \cdot r_n} \quad (24.1)$$

where r_n is the ideal lattice position of atom n in the host lattice, and the position of atom n in the distorted crystal is given by $l_n + u(l_n)$; The scattering vector $k = k' - k = g + q$.

The Huang scattering amplitude may be approximated by an integral, as follows:

$$A_H(q) = \frac{1}{\Omega} \iiint_V iK \cdot u(r) e^{iq \cdot r} dV \quad (24.2)$$

where Ω is the atomic volume.

Huang diffuse scattering under the anisotropic elastic approximation Explicit expressions for the kinematical Huang diffuse scattering amplitude of circular dislocation loops in anisotropic elastic crystals have been given by Trinkaus, Dederichs and Larson & Schmatz. In this paper we consider a more general situation of planar dislocation loops of arbitrary shape. This can be done by the evaluation of Eq. 24.2 in conjunction with the displacement of planar dislocation loops based on anisotropic elastic theory. After tedious deviation, we can obtain the Huang diffuse scattering amplitude of an arbitrary planar dislocation loop in a very simple and physically appealing form as following [12]:

$$A_H(q) = A_H^{(\text{inf})}(q) S_L(q) \text{ and } A_H^{(\text{inf})}(q) = -\frac{1}{q^2 \Omega} K^T M^{-1}(q/q) B q \quad (24.3)$$

$S_L(q) = \iint_{S_0} e^{iq \cdot r} dS$ is determined by the shape of the planar loop, we denote it as shape factor here; $M^{-1}(z)$ is the inverse of the Christoffel stiffness matrix.

The Huang diffuse scattering patterns corresponding to the intensity of Huang diffuse scattering, i.e. the multiplication of Huang diffuse scattering amplitude and its complex conjugate is then given by:

$$I(q) = A_H(q) \times A_H^*(q) = I_H^{(\text{inf})}(q) |S_L(q)|^2 \quad (24.4)$$

According to Eq. (24.3), the Huang diffuse scattering of a loop of arbitrary shape can be obtained by multiplying the amplitude scattered per unit area of an infinitesimal loop by the shape factor of the loop. This allows us to calculate easily the Huang diffuse scattering intensities from any planar loops of arbitrary shape using Eq. (24.4). If we plot the Huang diffuse scattering pattern in the logarithmic scale, we have

$$\log(I(q)) = \log\left(I_H^{(\text{inf})}(q)\right) + 2 \log(|S_L(q)|) \quad (24.5)$$

For circular loops, $S_L(q) = 2AJ_1(QR)/(QR)$, where A is the loop area, R is the loop radius, J_1 is the first order Bessel function of the first kind, and Q is the projection of q on the loop plane. This leads to the same Huang diffuse scattering amplitude as that derived by Larson & Schmatz for circular loops.

24.3 Simulations

In the present section we apply Eq. 24.3 to calculate both the shape factor and the Huang diffuse scattering patterns from infinitesimal loops with $b = 1/3\langle 111 \rangle$ and loop habit plane $n = \langle 111 \rangle$. It can be seen from the simulated patterns that the characteristics of the Huang diffuse scattering are essentially determined by the nodal lines. The nodal lines can be originated from the shape factor of dislocation loops and Huang diffuse scattering intensity from corresponding infinitesimal loops.

24.3.1 Nodal Lines from the Shape Factor of Loops

The shape factor of loops can produce the nodal lines locating at the both sides of Bragg peaks and they are symmetric in the Huang diffuse scattering patterns. The loop habit planes can be determined from this kind of nodal lines. For example, the possible loops in *fcc* materials make only three types of diffuse scattering patterns in the $(0\bar{1}1)$ plane, according to the truncations of nodal lines of the shape factors as shown in Fig. 24.1. Such distinct natures of shape factors make it is very straightforward to find out the loop habit planes by the shapes of Huang diffuse scattering patterns. Also it might be possible to deduce the defect size by the separation of the nodal lines if they are distinguishable in experimental results. It is worth to note that the separation distance between the nodal lines is inversely proportional to the size of loops, which makes the Huang diffuse scattering technique having distinct advantages over other real-space methods in tackling the characterization of extremely small dislocation loops [11, 12].

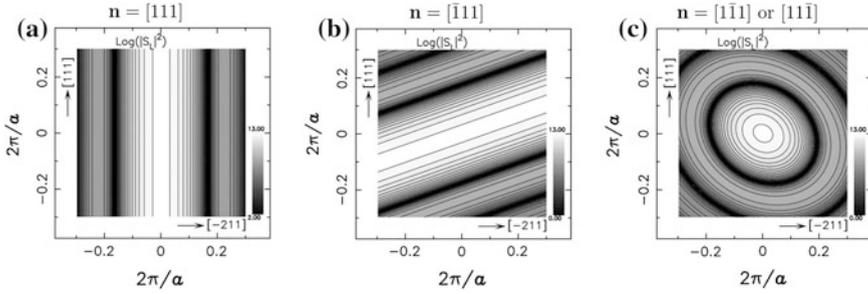


Fig. 24.1 The iso-value plots of the natural logarithmic scale of $|S_L|^2$ show the shape factors in the $(0\bar{1}1)$ plane

24.3.2 Nodal Lines in Huang Diffuse Scattering Patterns from Corresponding Infinitesimal Loops

In Fig. 24.2 we show Huang scattering patterns around three different Bragg spots calculated for infinitesimal Frank loops with differing Burgers vectors lying on the $\{111\}$ planes. It can be seen that this kind of nodal lines passing through the symmetry center of the Huang diffuse scattering patterns, are characteristics of Burgers vector and loop habit plane of dislocation loops. It is difficult to deduce directly the Burgers vector and habit plane from the nodal lines of a Huang diffuse scattering pattern. However, by referring to the database of simulated Huang diffuse scattering patterns for all possible combination of Burgers vector and loop habit plane of a given crystal, it is possible to characterize the Burgers vector and habit planes of individual loops based on Huang diffuse scattering intensity.

24.4 Summary and Discussion

A theoretical framework of Huang diffuse scattering from individual planar dislocation loops of arbitrary shape and size has been given out based on the anisotropic elasticity theory. It is suggested that the technique is powerful in characterization of very small dislocation loop (for example, loops small than 3 nm in diameter). We have discussed that, in principle the differences between Huang diffuse scattering patterns can be used to distinguish between the different loop types. The nodal lines passing through the symmetric center of Huang diffuse scattering patterns are determined by the combination of Burgers vector and habit plane of loops; The nodal lines located at both sides of the patterns are connected to the loop shape factor, these allow the habit plane, size and shape of loops to be deduced. With the advancement of microdiffuse X-ray scattering and electron scattering techniques, it is possible that the diffuse scattering intensities from individual or small population of dislocation loops to be collected in the immediate

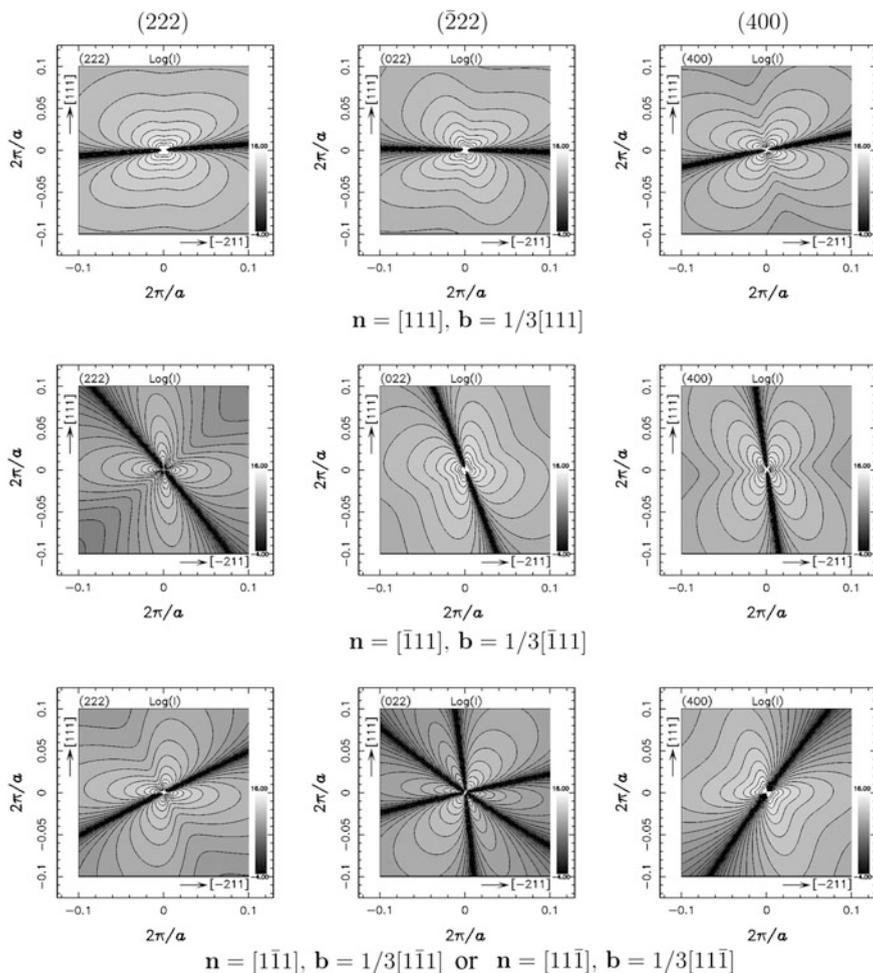


Fig. 24.2 Huang diffuse scattering patterns around the Bragg spots (222), (222), (222), (222) & (400) of all possible loops with habit plane (111) in gold

vicinity of Bragg reflection with high resolution, and then the morphology of such loops can be tackled by comparing the experimental and simulated Huang diffuse scattering patterns. However, in our preliminary practice the nodal lines may be too subtle to be seen in the experimental results especially if the geometry of real defects are more complicated than planar loops, further improvement in experimental facilities is still necessary to make this technique reach the stage of quantitative applications.

References

1. Singh BN, Horsewell A, Toft P, Edward DJ (1995) The numerical difference method of the second moment equation. *J Mater* 224:131–133
2. Sinno T, Dornberger E (2000) Light from Si via dislocation loops. *Mater Today* 28:149–152
3. Shen DY, Chen JA (1999) Study on the scintillation of optical study on the scintillation of optical wave propagation. *J Mater Res* 148(15):79–81
4. Fortuna F, Borodin VA (2011) Origin of dislocation loops. *Phys Rev* 84:144–148
5. Ng L, Lourenco MA (2001) Dislocation loops in pressureless-sintered undoped BaTiO₃ ceramics. *Nature* 410:192–194
6. Lourenco MA, Milosavljevic M (2005) Surprises in diffuse scattering. *J Am Ceram Soc* 87:106–109
7. Milosavljevic M, Lourenco MA (2011) Non-mean-field theories of short range order and diffuse scattering anomalies in disordered. *Economic Impact Study* 10:110–113
8. Arakawa K, Ono K, Isshiki M, Mimura K, Uchikosh M, Mori H (2007) Kinematical theory of spinning particles. *Science* 318:956–959
9. Jenkins ML, Kirk MA (2001) Characterisation of radiation damage by transmission electron microscopy. *Inst Phys* 13:155–160
10. Zhou Z, Jenkins ML, Dudarev SL, Sutton AP, Kirk MA (2006) Monte carlo study of short-range order and displacement effects in disordered CuAu. *AAPG Explor* 86:4882–4895
11. Kirk MA, Jenkins ML, Zhou Z, Twesten RD, Sutton AP, Dudarev SL, Davidson RS (2006) Kinematical theory of spinning particles. *AAPG Explor* 86:4797–4799
12. Zhou Z, Sutton AP, Dudarev SL, Jenkins ML, Kirk MA (2005) Surprises in diffuse scattering. *J Appl Phys* 461:3935–3940

Chapter 25

Vector Mathematical Morphology for Color Image Processing

Bo Tao and Lin Zhang

Abstract This paper presents a novel approach to the generalization of the concepts of grayscale morphology to color images. A new vector ordering scheme is proposed based on $L^*a^*b^*$ color space, and color erosion and dilation are defined, and the fundamental color morphological operations are proposed. The main advantages of the proposed vector ordering are that is compatible to the standard grayscale morphology when it is applied to grayscale images. In addition, it provides improved results in many morphological applications. Experimental results show that the proposed method is useful for color image processing, such as color image filtering.

Keywords Vector mathematical morphology · Color image processing · Vector ordering · Color morphological operators

25.1 Introduction

Mathematical morphology is a highly efficient tool in image processing; it has experienced a binary image, gray-scale images and color images of three stages. Binary and gray-scale morphology have been widely used in all areas of image processing, but the research and application of color morphology are not yet ripe [1]. Binary morphology based on set theory above, there are two basic operators: dilation and erosion. The structural elements are defined as a small set according to

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image the shape and application, and they are used to scan the image. As a result, dilation operation enlarges images while erosion operation contraction images. Dilation and erosion operation maintains the essential characteristics, and removes or suppresses irrelevant content of the images. Based on dilation and erosion operation, we can construct open and close operators. The four basic operators constitute a combination of the entire binary morphological algorithm; it is considered a subset of the infinite. Threshold method or the use of the umbra method can extend binary morphology to grayscale images processing, where the intersection and union operation can be replaced by the maximum and minimum operation in grayscale images processing. This shows that the core idea of theory of mathematical morphology is the ordering relation among the pixels. Because the grayscale images are scalar functions, they are easy to implement, the binary image is a special case of grayscale image so it is easy to promotion from the binary morphological Grayscale morphology [2, 3].

However, color images are vector-valued functions which are not comparable between vectors. Therefore, we can not directly extend gray-scale morphology to color images processing [4]. For the research works that extending grayscale morphology to color images processing, some research results have been reported. Especially Serra, Goutsias, who has made outstanding contributions. According Goutsias' research, when the ordering relationship among the pixel vectors is determined, we can define color morphological operators as well as grayscale erosion, dilation, opening and closing. The four basic operators can be combined to a number of algorithms, including the number of gray-scale morphology algorithm directly extended to color images processing [5].

The definition of Color morphological is described by Goutsias proposed the definition of Color morphological, but the definition is given only a theoretical approach, the specific implementation requires that the image color space based on color vector design of the sorting method. Most computer systems and image capture or display hardware devices use RGB color space [6]. However, RGB color space is not accord for the actual human eye perception; it is often the actual RGB color space is transformed LSH and $L^*a^*b^*$ color space [7]. Then the new vector ordering is defined in the new color space, and some new color morphological operators are defined. At present, the common color morphological operators are based on lexicography ordering and distance ordering. As the RGB color space does not require color space conversion, in order to facilitate the calculation, Yin proposed the morphological operators based on distance ordering in RGB color space. However, existing methods for color image processing are not satisfactory. In order to promote the grayscale morphology to color image processing theory, this paper proposed the novel color morphological operators in $L^*a^*b^*$ color space. The new color pixels' ordering is used through combining distance and the lexicographers. Based on the new vector ordering, the four basic color morphological operators is defined, furthermore, some morphological algorithms are used to achieve gradient extraction, edge enhancement, noise suppression for color images, experimental results show that the new color morphological operators have good performance for color image processing.

25.2 $L^*a^*b^*$ Color Space

The $L^*a^*b^*$ space is one of two device-independent color space developed by the CIE to be approximately perceptually uniform. This means that color which appear similar to an observer are located close to each other in the $L^*a^*b^*$ coordinate system.

In the $L^*a^*b^*$ space, L^* represents the lightness (luminance). a^* Encodes the red-green sensation, with positive a^* indicating a red color, and negative a^* a green color. b^* Encode the yellow-blue sensation, with positive b^* indicating yellow and negative b^* indication blue.

The grey-level or colorless points are located on the luminance axis ($a^* = 0$, $b^* = 0$), with black at $L^* = 0$, and white at $L^* = 100$. As is clear, it is possible to define a polar representation of the chrominance coordinates. The chromic $C^* = 0$ and hue $h^* = 0$ are defined as

$$C^* = \left[(a^*)^2 + (b^*)^2 \right]^{1/2} \quad (25.1)$$

And

$$h^* = \arctan \frac{b^*}{a^*} \quad (25.2)$$

The hue h^* is obviously an angular value, and has the property that $h^* = h^* + 2\pi n$, $n \in \mathbb{Z}$. Combining C^* and h^* coordinates with L^* leads to a cylindrical representation of the $L^*a^*b^*$ space.

The total color difference ΔE_{ab}^* between two color, each expressed in terms of L^* , a^* and b^* is given by the Euclidean metric

$$\Delta E_{ab}^* = \left[(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2 \right]^{1/2} \quad (25.3)$$

In the cylindrical representation, the Euclidean distance between two color (L_1^*, h_1^*, C_1^*) and (L_2^*, h_2^*, C_2^*) , is

$$\Delta E_{ab}^* = \left[(\Delta L^*)^2 + (C_1^*)^2 + (C_2^*)^2 - 2C_1^*C_2^* \cos(\Delta h^*) \right]^{1/2} \quad (25.4)$$

25.3 Color Morphological Operators

The $L^*a^*b^*$ color transforms projects RGB tristimulus vector into a space with a luminance axis and a chrominance plane a^*b^* . The space was devised so that a translation of a fixed distance within the space corresponds to a perceptually similar difference in color, independent of the location in the space. That is, translations in the space are isomorphic to perceived differences in color. If the chrominance plane is indexed by polar coordinates, then the angle of the a^*b^* value corresponds to perceived hue whereas the magnitude corresponds to perceived color saturation. This space is ideal for the perceptually significant ordering of color vectors, with one exception: the hue.

The morphological processing of hue is problematic. One cannot order color from largest to smallest in that the ordering of hue is circle. Therefore, we can define the color ordering as below.

25.3.1 Hue Ordering

The morphological processing of hue is problematic. One cannot order colors from largest to smallest. As the hue is defined on the unit circle, the values wrap around, and we cannot directly build a lattice for the hue values. A method for ordering the hue values which requires the choice of an origin has been proposed by Aptoula [8]. Consider some arbitrary points h_i distributed on the unit circle with centre o . After choosing an origin h_0 , the distance from each point h_i to the origin is defined as the acute angle $D_i(h_i, h_0)$.

$$D_i(h_i, h_0) = h_i \div h_0 = \begin{cases} h_i - h_0 & \text{if } |h_i - h_0| \leq \pi \\ 2\pi - |h_i - h_0| & \text{if } |h_i - h_0| \geq \pi \end{cases} \quad (25.5)$$

For a hue image, we choose a global hue origin h_0 , and to calculate the distance D_i for all the points in the structuring element. According to the principle of grayscale morphology, the point with smallest D_i is considered to be the erosion result of the structuring elements, and the point with the largest D_i to be the dilation result. However, nothing could be further from the truth. Because the object and background in color images is a relative, the interested areas are called object and the other areas are background. Therefore, the ordering of hue is defined as follows:

$$h_i \leq h_j \Leftrightarrow D_i(h_i, h_0) \geq D_j(h_j, h_0) \quad (25.6)$$

25.3.2 Color Ordering

Based on the previous discussion, we define color ordering $<$ and $=$, for two colors $c_i(L_i, a_i, b_i)$ and $c_j(L_j, a_j, b_j)$, as follows:

$$c_i < c_j \Leftrightarrow \begin{cases} (L_i^2 + C_i^2)^{1/2} < (L_j^2 + C_j^2)^{1/2} & \text{or} \\ (L_i^2 + C_i^2)^{1/2} = (L_j^2 + C_j^2)^{1/2} \text{ and } L_i < L_j & \text{or} \\ (L_i^2 + C_i^2)^{1/2} = (L_j^2 + C_j^2)^{1/2} \text{ and } L_i = L_j \text{ and } (h_i \div h_0) > (h_j \div h_0) \end{cases} \quad (25.7)$$

$$c_i = c_j \Leftrightarrow (L_i^2 + C_i^2)^{1/2} = (L_j^2 + C_j^2)^{1/2} \text{ and } L_i = L_j \text{ and } h_i = h_j \quad (25.8)$$

25.3.3 Color Morphological Operators

Let us consider the set f to be a color image with pixel values in the $L^*a^*b^*$ color space and the set B to be the structuring element for the color morphological operations that will be described here.

$$\varepsilon_B(f)(\mathbf{x}) = \{f(\mathbf{y}) : f(\mathbf{y}) = \inf[f(\mathbf{z})], \mathbf{z} \in B_{\mathbf{x}}\} \quad (25.9)$$

We define color dilation of f by g at a point x as follows:

$$\delta_B(f)(\mathbf{x}) = \{f(\mathbf{y}) : f(\mathbf{y}) = \sup[f(\mathbf{z})], \mathbf{z} \in B_{\mathbf{x}}\} \quad (25.10)$$

As the new color ordering is based on lexicography ordering, the color morphological erosion and dilation meet the conditions of the basic properties of the grayscale morphology.

Color opening and closing are defined analogously to grayscale opening and closing, respectively. Specifically, vector opening of f by B is denoted by $\gamma_B(f)$, and it is defined as follows:

$$\gamma_B(f) = \delta_B(\varepsilon_B(f)) \quad (25.11)$$

Color closing f by B is denoted by $\phi_B(f)$, and is defined as follow:

$$\phi_B(f) = \varepsilon_B(\delta_B(f)) \quad (25.12)$$

An application of great importance in the field of image enhancement is filtering. The aim of filtering is to eliminate noise and its effects on the original image, while distorting the image as little as possible. Opening and closing operations can be used to construct morphological filters. The extension of morphological filtering to color images using the component-wise morphology alters to the color composition and object boundaries of the image. There is a possibility that an object could be removed in one or two of the R, G, B components, but not in all of them. This effect is unacceptable, since the filtering produces new colors which not present in the input image. Here, a type of morphological operators is introduced in this paper aim to solve the problem. From the definitions of the new operators it is clear that the output vectors and therefore no new colors are introduced.

Morphological opening filter can suppress the signal of the positive impulse noise; the closing filter can suppress the negative impulse noise. In order to suppress the positive and negative impulse noise, the color opening-closing (closing-opening) sequence filters are denoted by ASF , and the represent form as follows:

$$ASF_{\phi\gamma}^i = \phi_{B_i}\gamma_{B_i}\phi_{B_{i-1}}\gamma_{B_{i-1}} \ominus \phi_{B_2}\gamma_{B_2}\phi_{B_1}\gamma_{B_1} \quad (25.13)$$

$$ASF_{\gamma\phi}^i = \gamma_{B_i}\phi_{B_i}\gamma_{B_{i-1}}\phi_{B_{i-1}} \ominus \gamma_{B_2}\phi_{B_2}\gamma_{B_1}\phi_{B_1} \quad (25.14)$$

25.4 Experimental Results

In order to test the proposed color mathematical morphology operators, the standard images “Monkey” (512*512*3 bit) and “Kid” (708*437*3 bit) is chosen as the tested image (see Fig. 25.1). Figures 25.2 and 25.3 shows that the filtering results of noise images (see Fig. 25.1) which is corrupted by salt & pepper noise (10 and 20 %) using various color morphological filtering operators. They are DRGB [6], HLS [7] and the proposed method. Where filtering operators choose opening-closing operation, the structure element is a square with size of 3×3 .

In Figs. 25.2 and 25.3, we can see that DRGB is better than HLS, and the proposed method is better than DRGB. The proposed color morphological operators can suppress strong noise while preserving image details.

25.5 Conclusions

With the development of color sensors and other hardware devices, the acquirement of color images is more and more easy. To convert color images to grayscale images will inevitably lose a lot of information, therefore, the mathematical

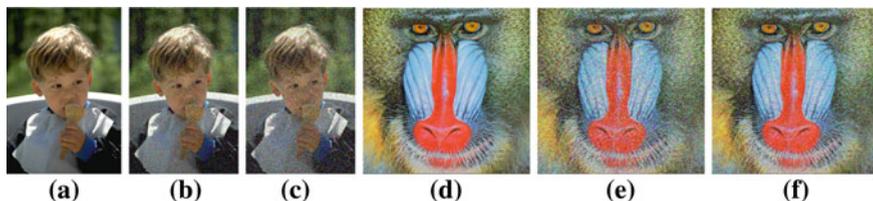


Fig. 25.1 Original image and noise image. **a** “Kid”, **b** salt & pepper noise 10 %, **c** salt & pepper noise 20 %, **d** “Monkey”, **e** salt & pepper noise 10 %, **f** salt & pepper noise 20 %

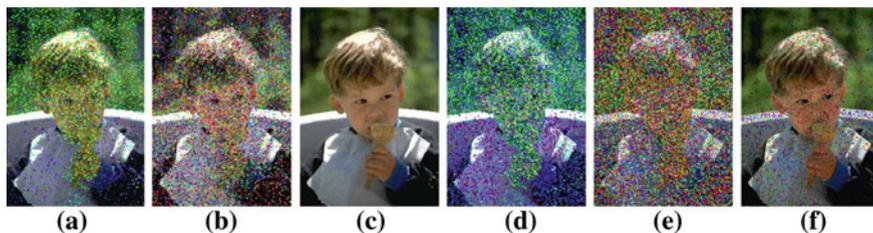


Fig. 25.2 The filtering results of noise images using different color morphological closing-opening operators for “Kid”. **a** HLS in noise level 10 %, **b** DRGB in noise level 10 %, **c** the proposed method in noise level 10 %, **d** HLS in noise level 20 %, **e** DRGB in noise level 20 %, **f** the proposed method in noise level 20 %

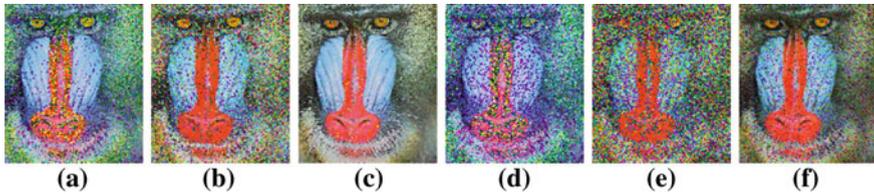


Fig. 25.3 The filtering results of noise images using different color morphological closing-opening operators for “Monkey”. **a** HLS in noise level 10 %, **b** DRGB in noise level 10 %, **c** the proposed method in noise level 10 %, **d** HLS in noise level 20 %, **e** DRGB in noise level 20 %, **f** the proposed method in noise level 20 %

morphology from the binary image and grayscale image promotion to color images is very important. This paper studies the basic principles of mathematical morphology, in the $L^*a^*b^*$ color space, based on the existing color morphological operators, gives a new vector ordering, define some new color morphological operators and the new operators are applied to color image filtering, contrast enhancement, the experimental results show that the new color morphological operators are useful in color image processing.

References

1. Lei T, Fan YY (2011) Noise gradient reduction using dual morphological operators. *IET Image Process* 5(1):1–17
2. Angulo J (2010) Geometric algebra colour image representations and derived total orderings for morphological operators—part I: colour quaternions. *J Vis Commun Image Represent* 21(1):33–48
3. Luengo-Oraz MA, Angulo J (2009) Cyclic mathematical morphology in polar-logarithmic representation. *IEEE Trans Image Process* 18(5):1090–1096
4. Witte VD, Schulte S, Nachtegaal M, Weken DV, Kerre EE (2005) Vector morphological operators for colour images. *Lect Note Comput Sci* 3656:667–675
5. Goutsias J, Heijmans HJAM, Sivakumar K (1995) Morphological operators for image sequences. *Comput Vis Image Underst* 62(3):326–346
6. Yin XY, Ma J (2008) Research on color image morphology and its application. *Comput Eng* 34(17):667–675
7. Hanbury A, Serra J (2001) Mathematical morphology in the hls colour space. In: *Proceedings of the 12th British machine vision conference*, vol 123. pp 451–460
8. Aptoula E, Lefèvre S (2009) On the morphological processing of hue. *Image Vis Comput* 27(9):1394–1401

Chapter 26

Study of Cost Reduce Scheme of Enterprise Logistics Purchasing

Meili Tian

Abstract Our enterprise especially logistics enterprise purchase cost to the profit level has important influence, discussed the composition of the purchase cost, and analyzes our country enterprise cost management of the existing problems and obstacles, to reduce the purchase cost way: well needs analysis, sure good suppliers, choose the appropriate purchase.

Keywords Logistics · Purchasing · Cost · Suppliers

26.1 Introduction

The purchase cost for many manufacturing and distribution class of the profits of the business, has an important influence on the level. How to reduce the cost pressure, effectively control the purchase cost, promote the enterprise management benefit, and purchase cost management is the main goal.

26.2 The Composition of the Purchasing Cost

26.2.1 Order Cost

Order cost is pointing to a supplier purchase contracts order cost. Also is in order to realize a purchasing enterprise of the various activities expenses [1]. Order a portion of the cost and the order number, not a permanent buying institutions such

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as the basic expenses, called to order the fixed costs [2, 3]; The other part of the number of times and order about, such as traveling expenses, such as postage, called order variable costs.

26.2.2 Maintain Cost

Maintain cost is to point to to keep the material in a certain number of cost and happen. Maintain cost can be divided into the variable cost and fixed cost. Variable costs and hold number of related to how much, such as material capital accrued interest, material damage and loss, material of metamorphic insurance expenses, etc. [4, 5]; Fixed costs and inventory quantity has nothing to do, such as warehouse depreciation of the fixed monthly wages, warehouse staff, etc. In many enterprises, maintain cost often occupy most of the purchasing cost. Therefore, it is necessary to introduce the composition of the variable cost and its proportion.

26.2.3 Lack of Material Cost

Lack of material cost is because the material supply disruptions and create the loss, including stock outs loss, delay delivery loss and lost sale loss, also include goodwill loss, if loss customers, may also cause long-term damage to the enterprise.

26.2.4 The Cost of Losing Customers

Because out of stock lose customers, clients always turn to another enterprise, and the loss is difficult to estimate, need to use the management science technology and marketing research methods to analysis and calculation. Credit in the purchase cost control often neglected, but it for future sales and customer business activities is very important.

26.3 The Present Situation of Our Country Enterprise Purchasing Cost

26.3.1 Cost Management Study of the Theory of the Lag

The application of cost management methods lack of contact, introducing new methods to cost management often leads to the original method greatly give up,

so that the cost management lack of consistency, and increase the cost of management [6]. Traditional cost research, limited to internal, lack of strategic management thinking. Only pay attention to the process of production cost management, ignore the cost management of supply process. Only after the production cost management attention, ignore before production product design and production factors of reasonable cost management organization. Just pay attention to product cost itself level, neglecting cost benefit of level. Just pay attention to enterprise cost management, ignore the macro cost management.

26.3.2 Cost Management Concepts Backward

The purpose of the cost management limited to reduce cost, less benefit from the perspective of utility cost, lower the cost of means also relies mainly on the way to save, cannot be applied cost benefit principle, happened to achieve cost by a bigger profit. The idea behind these already cannot adapt to the increasingly competitive economic environment. Traditional enterprise management mainly through the two ways to reduce the cost of product, is a scale; 2 it is enhanced with suppliers and distributors negotiation skills, in order to achieve the purpose of transfer cost. But the size of the demand of the restriction by the size, and what's more, now the consumption demand of consumers difference is increasing, the production scale of similar products have narrow trend. The cost of the core enterprise transfer from simple to suppliers or distributors, can't reduce product final sales price, even can cause the increase in costs, reduce from raw material to finished consumer goods value. Especially in today's increasingly open market environment, shifting the cost of too much will make enterprise lose good partners.

26.3.3 Cost Management Method is Dated

China's production organization also comparatively extensive, and not enough attention to consumer individual character, bring the corresponding cost accounting method choice simplification. The standard cost and plan cost and target cost is the cost and cost management of relatively popular in modern cost management methods. From the circumstance of the enterprise see survey, 51.4 % of the enterprise USES the target cost method, 38.9 % of the enterprise USES the plan cost method, 18.1 % of the enterprise USES the standard cost method. But, advanced operation cost method, cost planning method in the enterprise fails to get promotion.

26.3.4 The Enterprise Internal Cost Management of the Main Body of the Established Mistakes

For a long time, people there is a deviation: cost management as a financial personnel, a few management personnel's patent, think that cost, benefit shall be made by the leadership and the financial department responsible for enterprise, and put the workshop, department, team worker only as producers, lead to the cost of the technology, don't understand technical don't understand finance, broad worker to what cost should control, how to control not is weak to ask, cost consciousness indifference. The worker thinks to do bad dry the same, not feeling market pressure and control the cost of the enthusiasm can't aroused, waste is serious, the enterprise cost management lose connaught large management group of course difficult to really achievements have been made.

26.4 Reduce Procurement Cost Way

26.4.1 Do Demand Analysis

Any purchase is a department of the enterprise exactly demand and output, the determination of purchasing process is the demand of the initial link. To the needs of the enterprises to make accurate predictions, it is instructive to make good purchasing work of significance. Correctly determine the enterprise need what, how much demand, when demand, can have a variety of methods. In general can be summarized by the following several kinds.

26.4.1.1 Commonly Used Qualitative Analysis Method

Expert advice method

Expert advice method is to through the asking for some familiar with the relevant problems, experienced professional advice to predict the method of demand.

Experts generally have the following method of two forms:

- A. scene analysis: refers to the assumption of the expert group members according to condition, points out that the demand of the most likely scenario. The results of the best and worst including and most likely to appear in between.
- B. the Delphi method: it is to point to a panel of experts in an independent each other members, on condition of anonymity because the demand forecast respectively, and then all the opinions of the members, compared with different points of discussion, eventually agreed the results.

Market test method

Market test method refers to that the company product or service target market pulled out of a test sample, according to the same period of the sales of the trial of demand forecasting a method. When facing a lot of uncertain factor, can use the method of demand forecasting.

26.4.1.2 Method of Quantitative Analysis

Quantitative ordering method

It is to show when stocks down to a minimum inventory (order point), according to the prescribed quantity (generally in economic batch EOQ for standard) to order a supplement inventory control method (Fig. 26.1).

26.4.1.3 Order on a Regular Basis Method

Regular orders according to law is the predetermined time intervals for the order on order, to supplement the stock of a kind of inventory control methods. Its decision thinking is: every a fixed period of time check inventory project reserves. According to the results and inventory scheduled target inventory level to determine the difference between each batch purchase.

26.4.1.4 Based on Computer Pruning the Material Requirements Planning System

Material requirements planning is a kind of computer-based production plan and control system, it according to the general production schedule specified in the plan of the final product delivery date, the final product of form of the assembly parts, components and parts production schedule, foreign purchase plan of the production plan, internally. It can be used to calculate the material demand and demand time, so as to reduce inventory (Fig. 26.2).

Fig. 26.1 Quantitative ordering figure

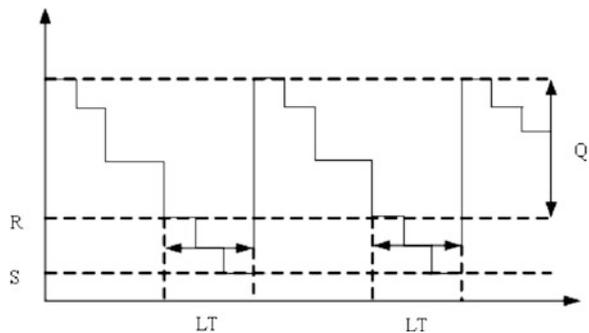
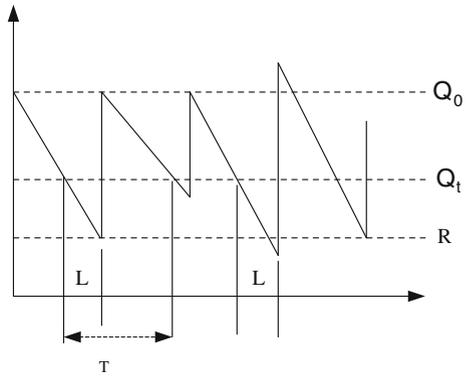


Fig. 26.2 Order on a regular basis



26.4.2 Sure Excellent Supplier

The purpose of the preliminary supplier survey, is to understand the general situation suppliers. And understand the purpose of general suppliers, one is to choose the best suppliers to prepare, 2 it is to understand the whole resources market, because many of the basic conditions of supplier summary is the whole resources the basic situation of the market.

26.4.2.1 Supplier Selection Method

Intuitive judgment method

Intuitive judgment method is to through the investigation and consultation, the comprehensive analysis and judgment to select suppliers of a kind of method, is a kind of subjective the strong judgment method, main is to listen to and adopt experienced purchasing personnel's opinion, or by purchasing personnel directly with experience to make judgments.

26.4.2.2 Linear Weighting Method

The basic principle is to give each criterion assigned a weight, each supplier selection for the results of quantitative criterion and the scores of the suppliers corresponding standards of the product of the weight of add and. Through the of each candidate supplier selection of quantitative results comparison, realizes to the supplier of choice.

26.4.2.3 Analytic Hierarchy Process (Ahp)

It is the basic principle of the hierarchical structure according to have goals, objectives (rule), constraint condition, departments and to evaluation plan, the two two comparison method to determine judgment matrix, and then the biggest characteristic vector matrix of the coefficient of weight as the corresponding, finally given the weight of the comprehensive plan (first degree)

26.4.2.4 The Tender Choice

It is by the enterprise bidding conditions, the bidding suppliers to bid, and then made by the enterprise standard, and puts forward the most favorable conditions suppliers to sign the contract or agreement.

26.4.2.5 Consultation Choice

Purchasing units chose supply conditions of relatively advantageous few suppliers, negotiate with them respectively, to identify appropriate suppliers

26.4.3 Choose Appropriate Purchase

26.4.3.1 Centralized Purchasing

Centralized purchasing is to show enterprise in the core management establish special purchasing agency, unified organization of the business enterprise required purchasing items. Established in the procurement department of internal united by the way the distribution of branches all over the world the purchasing business, reduce purchasing channels, and through the batch purchase price gain. Group headquarters or purchase the company responsible for the management of the suppliers and develop sourcing price procurement policy, and is responsible for purchasing order work. Branch raise the purchasing application, the former location, adjustment, and according to adjust the results give the purchase order, hair receiving the notice to branch; Branch according to receiving the notice or purchase order for receiving and warehousing; The former collection of the latter GRN and external suppliers for payment and settlement, and according to each branch of the warehouse receipts and branch internal settlement respectively.

26.4.3.2 Decentralized Procurement

Decentralized procurement is centralized purchasing perfect and added, be helpful for procurement procedures and inventory, for materials, and other areas of coordination, to strengthen the job responsibility, make grass-roots work flexible and effective. Decentralized procurement is suitable for single piece and small batch, low value, total spending in product management expenses in the proportion of small items (GeChang situation is different, the established himself); Decentralized procurement is better than the centralized purchasing items, including cost, time, efficiency, quality and other factors are lacking, and shall not affect the normal production and business; The market resources assurance, easy to delivery, less logistics cost; After scattered, each basic have the purchasing and testing ability; The product development research, experiment needed items.

26.4.3.3 The Third Party Purchasing

The third party procurement is enterprise will purchase a product or service outsourcing company to a third party. The overseas experience shows that, compared with the enterprise to purchase, the third party purchasing often can provide more value and purchasing experience, can help enterprises to be more concentrate on core competitiveness.

26.4.3.4 JIT Purchasing

Also called just-in-time purchasing, it is by the just-in-time production (Just in Time) management thoughts of evolved. The basic idea is: put the right quantity, appropriate quality item, in the right time supply to the right place to maximize the user needs to meet. The basic idea is JIT purchase with suppliers in need to sign provides the required number of spare parts, raw materials of the agreement. This means that a day once, twice a day, and even every hour several times to supply.

JIT purchasing final objective is to each resource, and several kinds of materials of the establishment of a single reliable supply channels.

26.4.3.5 Electronic Procurement

Electronic procurement is to use the computer system in place of the traditional clerical system, through the network support the completion of the purchase of a business work process method, such as Internet bidding, online bidding, online negotiation.

References

1. Jing SX, Kui TG, Hong TC (2003) Purchasing management. Beijing: China Supplies Press 94:193–196
2. Xiang LS (2005) Procurement practices. Beijing: Beijing People's Traffic press 4:24–29
3. Qiao G Q (2008) Cr-sludge sedimentation, a kind of improved ABC classification 11:82–85
4. Yuan T (2007) na: how to control the purchase cost. Beijing: Press of China Economy 91:291–292
5. Si S, falleen's JuLei (2007) Purchasing and supply chain management. Beijing: Electronic Industry Press 06:79–84
6. Hu SZ, Li CS (2007) Purchasing and supply management process design and working standard. Beijing: People's Post and Press 10:79–83

Chapter 27

Research on Zombie Network

Hongling Gou

Abstract In order to restrain botnet security issues arising from operation of the network, in the dissect of botnets based on the principle of a real botnet tracking, detection methods; effectively restrain botnet network security threats. Through the understanding of the concept of botnets and botnet generated on the principle of the internal working mechanism of development, type and risk of such a comprehensive study, gives the tracking, detection and prevention of specific methods of different botnets. Experiments show that this method is effective to inhibit the breeding of botnets in the slow extension of the network, defense and control of active botnets, strengthen the operation of the network user data safety and security has a very important significance.

Keywords Botnet · Bot · Defense · Control

27.1 Botnet

Botnet (botnets) is “Robotnetwork” portfolio which is made up of Bot can communication, can be the attacker control network. The zombie network and is not a physical meaning is the network topology structure, it has a certain distribution sex, with the spread and constantly Bot program there have been new position zombie computer added to the network. The zombie network is adopted certain spreads the means of the formation, such as holes attack, email virus and

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other viruses and worms spread, tell from this meaning malicious program Bot is also a kind of viruses or worms [1]. Botnet most main characteristic is a more can carry out the same malicious behavior, such as can also to one target site DDos attack, at the same time send a lot of junk mail and so on, it is this a couple more control relation, cause the attacker with extremely low price can efficiently control a lot of resources for its service, this also is Botnet attack mode in recent years by hackers favour basic reason [2]. In the execution of the malicious behavior, as a Botnet attacks the role of platform, which also makes the Botnet is different from simple viruses and worms, and with the different meaning usually Trojan horse. One English abbreviations, can automatically perform predefined programs, you can be the predefined instructions manipulation, Bot program is a by an attacker modified network client program, it will take initiative to connect to the server read control instruction, according to the instruction executes code.

27.1.1 The Botnet Produce, Internal Work Mechanism and Development, Types, and Risk

27.1.1.1 The Botnet Product

The zombie network from Internet relay chat to management (IRC) network and development of beneficial harmless tools. The purpose of the IRC for all over the world of Internet users to provide a text based on informal discussions of the mutual communication channel. Channel can shield or eliminate by misbehave user channel the pilot management. In order to expand the function of the IRC, some channels using automatic pilot script execution such as log channel statistics, running the game, file transfer and coordination, and other functions [3]. With the popularity of the IRC community growth and the increase in the number of servers, users of conflict between times also will increase, which led to the passage of the control of popular race. IRC is structured, when all specified channel the pilot and a channel after disconnected, another channel members automatically become a new pilot role. In order to try to control a channel, some malicious users can create to carry out a server on IRS denial of service (DoS) and distributed denial of service (DDoS) attack script. Through the aimed at specific channel the pilot of the server, these scripts can force channel the pilot offline, so that the attacker or others to get the pilot position.

27.1.1.2 The Botnet Working Mechanism

Botnet work mechanism including communication, to join and control three stages. Botnet need a certain scale which was charged with computer, the scale the formation of the following several means.

- (1) The initiative against bugs, and its principle is to attack the system through the existence of the loophole gain access to power, to attack the system infection become bots.
- (2) The email virus, Bot also the application sent through a lot of email virus spread itself, thus make the receiver to host infected become bots.
- (3) Instant communication software, the use of instant communication software to send a friends list of links zombies program execution, and through the social engineering skills lure its click, and thus for infection.
- (4) The malicious website script, the attacker WEB site in providing in HTML page binding malicious script, when the visitor to the site will perform malicious script, makes the Bot program downloaded to host, and was carried out automatically.
- (5) Trojan horse, disguised as a useful software at the site, server, FTP, P2P network users to download and execute provide lure.

Join stage, each infected host will be hidden in on itself as Bot program to join Botnet attacks to join way according to the control mode and the communication protocol and differ somewhat different [4, 5].

Control stage, the attacker through the center server to send forecast definition good control instruction, let the infected host executive malicious behavior, such as launched against DDOS, steal host sensitive information, upgraded the malicious programs, etc.

27.1.1.3 The Development of Zombie Network

The zombie network development trend is the mainstream of the command and control mechanism from based on IRC protocol gradually transferred to based on the HTTP protocol and P2P agreement. In the network dissemination of reference and the integration of traditional mode of transmission malicious code, including the latest through instant communication software and P2P file sharing software to spread. By enhancing the authentication and channel encryption mechanism to the zombie procedures polymorphism and deformation of confusion, introducing the Rootkit hidden mechanism which makes the botnet detection and tracking and analysis more difficult.

27.1.1.4 The Type of Botnet

The zombie network according to the size of its dimensions, tested and damage to the difficulty of the control mode and instructions can be divided into three kinds of structure.

- (1) Suppressive botnet. This architecture botnet depends on a central server, the attacker and the bots through the center server communication, configuration is simple, but easy to testing and close, such as IRC botnet.

- (2) Distributed botnet. P2P botnet is embedded in particular P2P agreement zombie program and use that agreement to establish their command and control of the channel botnet. P2P network in each node is not only a client can also is the server, which does not exist close a node can shut down the entire botnet risk.
- (3) Mixed botnet. In the comprehensive front is two kinds of zombie network structure advantages of improving new botnets, the structure of the P2P botnet is to avoid the single point failure and simplified the zombie network communication mechanism.

The current P2P botnet is used mostly which is distributed and mixed zombie network structure, including mixed botnet due to strong control are more the favour of the attacker.

27.1.1.5 The Risk of Botnet

The zombie network is to attack the hands of an attack platform. Use of this attack platform, and attacker can implement various destructive behaviors, the destruction than the implementation methods of traditional behavior more harmful, more difficult to guard. In many ways, a botnet is the best computer crime action base. Zombie robots are designed to run in the background, no visible signs of their existence. Users often don't know their computer is used for malicious purposes. According to the different nature of zombie robots, the attacker may have with victims can be completely control computer and even have more control privileges. By keeping a low profile, zombie robots can sometimes keep several years of activity and operability. Through the botnet implementation aggression, simplified the attack step improve the efficiency of the attack, and more easy to conceal the identity. The zombie network controller can gain from attack economic interests; it is significant to the development of botnet increasingly driving force.

27.2 The Botnet Tracking, Testing and Defense

27.2.1 The Tracking of Botnet

The zombie network tracking for the defender who provides a feasible plan, the basic idea is through various channels for the Internet real botnet command and control channel of relevant information, and then into a zombie process simulation controlled to join a botnet, and thus to the botnet activities within the observing and tracking. In the earliest botnet tracking research work team is Germany's honey nets project team, such as Holz Bacher and through the Windows honeypot deploy contains host the second generation of the honeynet captured the Internet a lot of actual spread zombie program, and then use snort_inline analysis program is

a zombie connected command and control IRC channel information, including the IRC server domain name IP and port, connect the IRC server password, zombie program user identity and the structure of the nickname, join channel name and optional channel password, and use the IRC client tracking tools drone according to the control information to join the zombie network to carry on the track. In the 4 months of time, they of more than 100 a zombie network for the continuous tracking, and to the security industry first system introduction to the zombie network of internal mechanisms.

27.2.2 The Testing of Botnet

In the use of tracking method know botnet internal work the basis of the mechanism, the researchers also explores network recognition and security threat botnet test methods. Binkley and others propose a heuristic based on TCP scanning weight to detect anomaly detection algorithm IRC zombie network control communication. Strayer also puts forward through the check bandwidth use, duration and packet timing and other network flow to identify botnet command and control methods of communication. Goebel, puts forward a simple and efficient IRC botnet detection method Rishi method, through the open source ngrep tool for network flow, including the IRC protocol connection information. AT and T laboratory Karasaridis also proposes a new level detection and ISP backbone depicts the behavior of the botnet method. Gu, driven by session IDS connection method realizes the zombie program that can detect infected Bot Hunte system, this system is put forward for the first time the advantages of a relationship and depicts the whole process of infection of zombie process real-time analysis system, and through the actual test 35 recent zombie program to verify its validity [6].

At present IRC protocol is still the botnet mainstream control protocol, almost all the related research work is the focus of the IRC botnet control channel detection and portrayal based on HTTP and P2P botnet agreement because of the strong individual differences, at present not provide universal test methods.

27.3 The Defense of Botnet

Attacking the weak or use which there is no security or strategy, the use of security holes, use of social engineering strategy to entice people to install malicious software. Most of the attackers were largely at relying on social engineering to mislead the victims inadvertently for the attacker provide information and access. Although media for social engineering against such as fishing concern has increased the public to this type of threat of consciousness, but the attacker can still through some of the different technical means succeeded in using the user for more information. Whether at the early stage of the various client, or the use of

various hang Trojan, and manner of the new type of zombie network, to be for their comprehensive thorough defense, you must know the formation mechanism of the botnet, combining network and host of various protection means of all levels of defense; to realize the botnet dynamic targeted against zombie program.

27.4 Network Level

No matter old or the latest program of the botnet communication must pass through each port to realize, such as the use of port 6667 and other numerical larger port. More than 1024, all of the port should be banned in program, unless there is a special application should use a particular port, and even this will use only in certain time open the control policy.

27.4.1 Host Level

Host level to understand safety knowledge enhance safety consciousness, is clear about the firewall to block attacks and illegal saturated type links, antivirus software used to destroy the back door, trojans, and other virus program, rational choice really suitable for their own network supporting protection scheme. A good security practice, installation software patches to regularly that the attacker can't using the known problems and vulnerabilities. The system timely update, use the original software. Try not to click E-mail, instant messaging and social networking site in links, don't receive the network at the documents, don't open sharing function at will.

27.4.2 Centralized Botnet

For centralized botnet is concerned, found that the control points in the foundation, the most direct counter method is through the CERT department deal with close coordination control points, and also through the contact domain name service providers to remove the zombie program used by the dynamic domain name, to thoroughly remove zombie network control server. In addition, the acquisition of domain name service provider of licensing conditions, the defender also can use technology to get be DNS hijacking botnet infection of bots IP list, and inform the infected host user of the program for zombie removed.

27.4.3 Are not Afraid of Botnet New Operating System

Illinois university computer security and cryptography expert are designing a new, more secure operating system. Jon Solworth and Daniel Bernstein professor says the system (Ethos) will become a new generation can resist loophole, viruses and all kinds of malicious software of the operating system. They hope to through the Ethos operating system solve through the application of the operating system against traditional problems.

27.5 Last Word

As a traditional form from malicious code evolved complex attack mode, the zombie network provides occult, flexibility, and has more than a pair of command and control mechanism. The future within a period of time is developed certain automation program botnet detection and tracking and strategies of defense mechanism is imminent, especially in based on the HTTP protocol and P2P botnet agreement to carry out effective detection and tracking, is an important research topic.

References

1. Han X (2009) The botnet-network program killer, vol 46. Science Press, Beijing, pp 6–15
2. Zhang C, Wang L, Xiong W (2010) P2P botnet detection technology. *Comput Appl* 30(1):118–120
3. Wei J, Ge Z, Han X, Ye Z, Zou W (2008) The zombie network. *J Softw* 19(3):702–715
4. Lanellin N, Hackworth A (2008) Botnets as a vehicle for online crime. *Cyber Security* 21(02):35–38
5. Cai H (2008) The botnet research and found. *Comput Secur* 432:28–31
6. Zou W, Tang X (2008) The honeypot net and technology research and analysis. *Netw Commun Saf* 93:36–39

Chapter 28

Study of Initiation Network Monitoring System Based on LabVIEW Platform

Jie Liu, Yujie Wang, Genzhao Chang, Xiaohu Li, Shaofeng Ren and Zhigang Liu

Abstract This article has submitted that we can detect whether detonation points can explode accurately by using graphical programming language LabVIEW to collect and analysis status information of initiation network. Moreover, we can strengthen the control of initiation network, augment the safety of blasting engineering, lower the incidence of misfire and lessen accidents caused by connection error of initiation network by this monitoring analytical system.

Keywords Initiation network · Monitoring · LabVIEW · Data acquisition

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28.1 Introduction

Initiation network is a system of blasting engineering in which detonation combination of single initiation cartridge transmits information and energy of detonation to that several blasting cartridges. At present, on terms of the different method of ignition, initiation network can be divided into 3 categories: Electric firing, detonating cord initiation method and fuse initiation method, the latter two of which are also named non-electric initiation method [1].

Owing to the distinctive strong point of non-electric initiation network, its initiation ability is not limited by the quantities of detonator and hence the non-electric network gains it popularity in the demolition of constructions and other blasting projects. However, for the moment, because of non-electric initiation method's lacking of feasible instrumental monitoring means, in its application, misfire accidents take place now and then. Blind shot caused by misfire accidents poses a severe threat to the security of our lives and property, influencing the process of our work. As a result, to reduce and avoid misfire accidents to the utmost extent, it is of great significance to detect and control non-electric initiation network in its design and construction [2, 3].

28.2 Main Design of the Initiation Network Monitoring System

The initiation network monitoring system is built to strengthen the initiation network test and improve the safety of the blasting. At the same time, detecting whether initiation material could explode, providing strong evidence to deal with misfire after blasting and enhancing the supervision of the blasting equipment can bring remarkable economic and social security benefits.

The design of this monitoring system is made up of signal generator, wireless signal transceiver, real-time data acquisition and processing, software and other components, shown as system flow chart in Fig. 28.1.

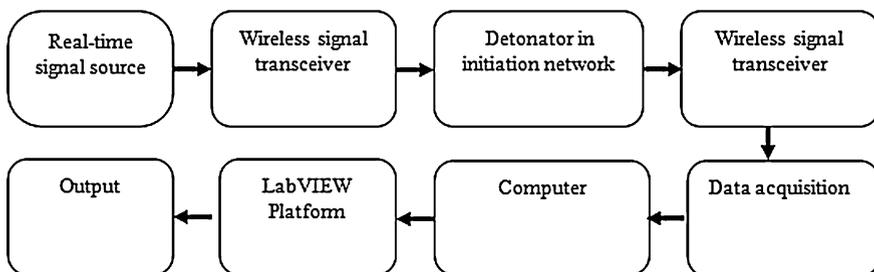


Fig. 28.1 Monitoring system flow chart

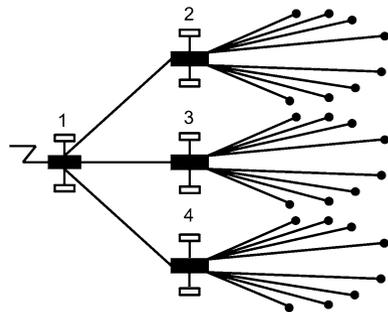
According to the way of initiation network, installing a trigger system at every joint. Connecting a full set of wireless signal transceiver which beyond the explosive scope with the trigger system. Setting codes of the wireless signal transceiver according to initiation network as shown in Fig. 28.2. When the system starts, signal from real-time signal source goes through the wireless signal transceiver, and arrives at a joint of network. The signal continues transmits to the other sets of wireless signal transceiver by wire which is tied up with the detonator or initiation cartridge. The wireless signal transceivers send the signal to LabVIEW data acquisition card. After data processing, LabVIEW would output waveform figure, contrast the figure before the blasting and the other picture after the blasting. We will not only get location of the detonator which didn't explode, but the accurate explode rate of the whole network.

28.3 The Software Design of the Initiation Network Monitoring System

LabVIEW, with the whole name of Laboratory Virtual Instrument Engineering Workbench, based on G language which is compiled graphically, is exploited by the National Instruments of the USA. It is of powerful function, including numerical computation, data acquisition, data analysis, signal generation, signal processing, input/output control, and image acquisition and processing and transmission, etc [4]. Compared with text language adopted in traditional programming, LabVIEW uses graphical language including various kinds of icons, graphical symbol, attachment, etc. G language, which is a programming language with intuitive graphs, its interface is very friendly and audio-visual with people's familiar switches, knobs, waveforms, etc.

All exploited produce in LabVIEW is called VI, which contains 3 parts: front panel, block diagram and connector. To be brief, front panel is a window by which users interact with procedure. When VI operates, the front panel must be opened so that data can be input to the executive program [5]. Procedure is divided into three parts: acquisition of signal, signal analysis and processing and signal display.

Fig. 28.2 Initiation network coding figure



Data collection panel is the main interface of the system, displaying when the procedure starts, including channel selection, signal trigger mode, real-time data displaying and stopping the switch of the data acquisition. System design can collect eight channels simultaneously and continuously.

Data Acquisition, DAQ is the process of sampling signals that measures the real world physical conditions and converts the resulting samples into digital numeric values that can be manipulated by a computer. [6].

The whole program controls the bus directly with the help of test PXI bus, controller PXI-8106 (dual-core processor), and exchanges real-time data. NI PXI data acquisition system [7, 8] serves as signal pickup assembly and the specific type is high-speed parallel data acquisition module PXI-6123.

The software design of signal acquisition and real-time display is divided into a few parts, as shown in Fig. 28.3.

When data collection starts, signal transmits from the data acquisition card into the channel which had created before, according to the user's setting system of collecting signal. At the same time, the sampling clock judges the edge of the signal and returns 1 or 0 according to user's settings of the timings parameters (the rising edge or the falling edge triggering). Then, the system reads samples of each channel, and the digital waveform would be output as a result. The program can run continuously if you don't touch the STOP button.

We can easily know whether initiation joints exploded successfully by output waveforms which are created by LabVIEW. If the numerical value is 1 in waveform, it tells us that detonators in the network don't fire; but, if the value is 0, the message is that the detonators exploded. In theory, all the value returned should be 1 before the initiation and all the value returned should be 0 after blasting. Practically, engineering environment is more complex than in theory as not all the detonators will explode. The codes of the detonators didn't explode could show in the figures and we could find them without lots of efforts. Then the misfires should be disposed of in a safe way.

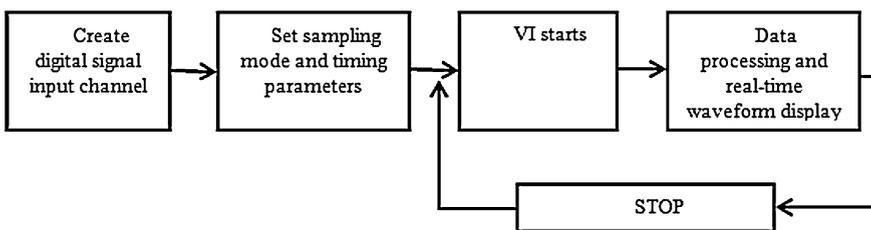


Fig. 28.3 Data acquisition module chart

28.4 Conclusion

Based on LabVIEW software platform, combined with signal transmission techniques, this system provides an easy and reliable monitoring method of blasting engineering. By detecting, it can accurately orientate the misfire, thereby enhancing detonation safety performance of blasting network, strengthening the basic criteria of blasting safety assessment and improving safe guard system of blasting projects on the equal footing.

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References

1. Wang YJ (2007) Blasting engineering. Wuhan University of Technology Press, Wuhan, vol 12(3), pp 71–73
2. Zheng Shaosheng, Xing Guangwu, Zhou Minghui (2011) Safety monitoring and measurement of adit construction on Xuanhan side of Houhe tunnel. *Blasting* 28(2):109–111
3. Biao Yongyi, Xiao Kunming, Wen Chengli (2010) Experience of site safety management of blasting engineering. *Blasting* 27(2):109–111
4. National Instruments Corporation (2006) Labview™ help. 371361B-01 8:23–68
5. Jeffrey T, Jim K (2008) LabVIEW for everyone, pp 24–32
6. Rick B, Taqi M, Matt N (2001) LabVIEW advanced programming techniques. CRC Press LLC, Boca Raton, vol 1(2), pp 56–70
7. Kang Tianwen (2009) Design of strain test system based on LabVIEW. *Electron Instrum Cust* 116(5):54–56
8. Chen X, Zhang Y (2007) LabVIEW8.20 program design from approaches to master. Tsinghua University Press, Beijing, vol 1(12), pp 1–3

Chapter 29

Zero Digital Images Watermarking Method Based on Cellular Neural Network and Contourlet Transform

Jie Zhao and Yawen Li

Abstract Watermark embedding introduces inevitably some perceptible quality degradation of the host image. Another problem is the inherent conflict between imperceptibility and robustness. However, zero-watermarking technique can extract some essential characteristics from the host image and use them for watermark registration and detection. The original image was decomposed into series of multiscale and directional subimages after contourlet transform. The low-frequency subimage and watermark image are inputs of the cellular neural network (CNN), and the zero-watermarking registration image is the output. The geometric moments and log-polar mapping are employed to against scaling and rotation attacks. To investigate and improve the security and robustness, the original watermark and registration image are scrambled or encrypted. The proposed method is simple for hardware realization. Experimental results show that it is robust to many common image operations.

Keywords Zero watermarking · Cellular neural networks · Contourlet transform

29.1 Introduction

With the rapid development of multimedia and network technology, it is more important that how to effectively protect the copyright of digital multimedia [1]. In most traditional digital watermarking algorithms, watermark information is

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embedded in the spatial or transform domain of the image [2]. The LSB algorithm and Patchwork algorithm are typical watermarking methods of spatial domain. Transform domain algorithms are most based on DCT, DFT, DWT [3, 4], Fourier–Mellin transform, Radon transform and so on [5, 6]. A good digital watermarking algorithm should have some basic characteristics, such as: invisibility, robustness, larger embedding capacity, lower computational complexity and so on. However, it is also a challenging problem to completely meet these requirements of algorithms in watermarking [7]. Literature proposed without modifying the original image of zero-watermarking technique including registration and authentication [8, 9]. In the registration process, the algorithm constructed watermark with being protected of image characteristics, and stored in a centralized authentication center. In the authentication process, watermark information is recovered with recognition images and the data of authentication center. In the literature, it has the high computational complexity in calculating Higher-Order Statistics. The zero-watermarking can be implemented by DWT in the literature. DWT offers multi-stage and time–frequency localization of the image. However, it fails to represent the image characteristics and get the sufficient exploitation geometric regularity when the image contains smooth contours in different directions. M. N. Do and Martin Vetterli proposed a new method of multiresolution image representation: Contourlet transform, which is a method of multiresolution, location and multi-directional to represent the image and a lot performance better than wavelet transform [10].

Based on the parallelism and real-time characteristics of cellular neural network (CNN) image processing, the paper proposes a zero-watermarking algorithm in Contourlet transform domain with CNN. The algorithm first gains the low frequency sub band by Contourlet transform. Then low frequency sub band and the scrambled watermark image are inputted into CNN network, and the encrypted image is produced. Experiments show that the method can get a good visual effect and is robust to plus-noise, filtering, JPEG compression, and cropping attack.

29.2 Cellular Neural Networks and Contourlet Transform

In 1988, L. O. Chua et al. putted forward the CNN that simulated the non-linear and real-time speed array processor of VSLI [11]. The model of a two-dimensional CNN is described which compose of basic processing units called cells. Each cell is connected to its neighboring ones, therefore only the adjacent cells can interact directly with each other. For a CNN array with $M \times N$, the dynamics of each cell can be described as:

$$\begin{cases} \dot{x}_{ij} = -x_{ij} + \sum_{C(k,l) \in N_r(i,j)} A(i,j;k,l)y_{kl} + \sum_{k,l \in N_r(i,j)} B(i,j;k,l)u_{kl} + I_{ij}, \\ y_{ij} = f(x_{ij}) = \frac{1}{2}(|x_{ij} + 1| - |x_{ij} - 1|) \end{cases} \quad (29.1)$$

where $i = 1, \dots, M, j = 1, \dots, N$. x_{ij}, u_{kl} and y_{ij} are the state. The input and the output of the (i,j) -th cell in the grid. The initial condition x_{ij} is zero and static input. $A(i,j;k,l), B(i,j;k,l)$ denote the connection templates from cell $C(k,l)$ to cell $C(i,j)$. I_{ij} represents the bias of (i,j) -th cell in the grid. CNN parallel processor can implement difference function of image processing when setting kings of feedback template A and control module B.

Contourlet transform gives a multiresolution, local and directional expansion of images. It can efficiently represent contours and textures of an image. It consists of two steps: the sub bands decomposition and the directional transform. A Laplacian pyramid (LP) is first used to capture point discontinuities, then followed by a directional filter bank (DFB) to link point discontinuity into linear structure.

29.3 Zero-Watermarking System

Zero-watermarking technique includes registration and authentication. In the registration process, the constructed watermark is generated with being protected of image characteristics and stored in a centralized authentication center. In the authentication process, it can recover watermark information with recognition images and the data of authentication center.

If the watermarking image is a binary image $w(x,y)$ and the original image $f(x,y)$ is gray image of $N \times M$ size, the procedure is as follows:

Embed process of zero-watermarking:

- (1) The algorithm first implements log-polar mapping (LPM) on the original image $f(x,y)$. To ensure the unchanged image size after LPM and the sample number of polar axis and polar angle is N and M .
- (2) Using the two level LP transformation and the finest sub-band decomposition at 8 directions, the low frequency approximation $f'(x,y)$ can be obtained by the results of step(1).
- (3) The scrambled watermark image $w'(x,y)$ is produced by scrambling key.
- (4) The low frequency approximation $f'(x,y)$ and scrambling image $w'(x,y)$ will be inputted into CNN network, and then the output is marked as $I(x,y)$. To improve the security of system, $I(x,y)$ can be encrypted or scrambled. Then the zero-watermarking registration information $I'(x,y)$ is generated.

Detection process of zero-watermarking:

For the test image $m(x,y)$, the zero-watermarking detection procedure $m(x,y)$ is as follows:

- (1) By scaling normalization on $m(x,y)$, the results is $m_S(x,y)$. Then after the LPM on $m_S(x,y)$, $m_{SL}(x,y)$ is produced.
- (2) The low frequency approximation $m'(x,y)$ is obtained from $m_{SL}(x,y)$ by Contourlet transformation.

- (3) After decrypting the zero-watermarking registration information, $I(x, y)$ is obtained.
- (4) As the low frequency approximation $m'(x, y)$ and the decrypted image $I(x, y)$ are inputted into CNN network, the output is marked as $w''(x, y)$.
- (5) After image reconstruction on $w''(x, y)$ by scrambling key, the abstracted watermark image is $w'(x, y)$. By means of correlation analysis, the correlation degree of watermark image $w(x, y)$ and abstracted watermark image $w'(x, y)$ can be computed. The formula is as follows:

$$SIM = \frac{\sum_i \sum_j w(x, y)w'(x, y)}{\sum_i \sum_j w^2(x, y)} \tag{29.2}$$

According to the following expression, the detection result can be calculated:

$$FR = \begin{cases} 1 & SIM \geq T \\ 0 & SIM < T \end{cases} \tag{29.3}$$

In the expression, T is the empirical threshold value? If FR is 1, the appraised work includes watermarking information; if not, $m_{SL}(x, y)$ is first done by cycle-spinning at the polar angle direction by each translation unit k ($k = 1, 2, 3, \dots, \theta$). Then to repeat the detection process from step abstracted (2), the largest correlation degree value is obtained. If the value is bigger than the empirical threshold value, the watermarking information exists. If not, the watermarking information does not exist.

29.4 Scaling and Rotation Invariant Analysis

The geometric moments of two-dimensional image $f(x, y)$ in (x, y) coordinates can be expressed as:

$$m_{pq} = \iint_{x,y} x^p y^q f(x, y) dx dy \tag{29.4}$$

After the λ times scaling on the original image, the results is expressed as $f(x/\lambda, y/\lambda)$. The geometric moments of the original image $f(x, y)$ is m_{pq} , and that of $f(x/\lambda, y/\lambda)$ is m'_{pq} . The formula is as follow:

$$m'_{pq} = \iint_{x,y} x^p y^q f(x/\lambda, y/\lambda) dx dy \tag{29.5}$$

Let $x_1 = x/\lambda, y_1 = y/\lambda$ then $x = \lambda x_1, y = \lambda y_1$ we can get:

$$m'_{pq} = \lambda^{p+q+2} m_{pq} \quad (29.6)$$

To solve the scaling problem, all images are normalized as a magnitude β , and that is $m'_{00} = \beta$. The image can be transformed by scaling factor $\lambda = \sqrt{\beta/m_{00}}$. The results as follows:

$$f'(x, y) = f(x/\lambda, y/\lambda) \quad (29.7)$$

The image $f'(x, y)$ has the scaling invariability.

After the image $f(x, y)$ is rotated as ϕ angle on clockwise direction, the result is expressed as $f^r(x, y)$:

$$f^r(x, y) = f(x \cos \phi + y \sin \phi, y \cos \phi - x \sin \phi) \quad (29.8)$$

The LPM is as follows:

$$\text{Where } x = e^\rho \cos \theta, y = e^\rho \sin \theta \text{ and } 0 \leq \theta < 2\pi, \rho \in \mathbb{R}^2 \quad (29.9)$$

The formula (29.9) is inserted in formula (29.8), as below described:

$$\begin{aligned} f^r(e^\rho \cos \theta, e^\rho \sin \theta) \\ = f(e^\rho \cos \theta \cos \phi + e^\rho \sin \theta \sin \phi, e^\rho \sin \theta \cos \phi - e^\rho \cos \theta \sin \phi) \\ = f(e^\rho \cos(\theta - \phi), e^\rho \sin(\theta - \phi)) \end{aligned} \quad (29.10)$$

The formula (29.9) is described simply as:

$$f^r(\rho, \theta) = f(\rho, \theta - \phi) \quad (29.11)$$

where ρ and θ are the sample number of the polar axis and angle. The formula (29.11) shows that if the original image is rotated as ϕ angle in Cartesian coordinates, the image will shifted as ϕ unit at polar angle θ direction in log-polar coordinates. When the image is rotated, the data can be detected after cycle-spinning. As above mentioned, the algorithm can realize the rotation invariability.

29.5 Experimental Results

The simulation is implemented by Matlab. A 128×128 binary image is used as watermark image, and gray image of Lena is used as original image (Fig. 29.1).

Lena image is rotated from 10 to 180° in 20° intervals, and this operation produced 9 images, in further, zero-watermark testing to every image and the detection results just as Table 29.1.

In addition, Lena image is scaled from 0.2 to 2 in 0.2 intervals, and this operation produced 10 images. The tested results are shown as Table 29.2.



Fig. 29.1 The original image and watermark image

Table 29.1 The result of rotation attack

Angle [°]	10	30	50	70	90	110	130	150	170
SIM	0.97	0.97	0.98	0.97	0.98	0.97	0.97	0.98	0.98

Table 29.2 The result of scaling attack

Scaling factor	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2
SIM	0.78	0.81	0.87	0.93	1.00	0.94	0.91	0.90	0.89	0.88

Table 29.3 Result with different compression of JPEG

Compression quality	10	9	8	7
SIM	1.00	0.99	0.98	0.96

Table 29.4 Result of other operations

Attacks	SIM
Slat and pepper noise (0.01)	0.94
Gaussian noise (mean 0 and variance of 0.005)	0.94
Median filtering (3×3)	0.98
Mean filtering (3×3)	0.97
Cropping 1/4	0.97

Tables 29.1 and 29.2 show that this algorithm is robust to rotation and scaling attack.

Simulation results for common image processing operations are shown in Tables 29.3 and 29.4. The two tables indicated that the values of similarity distribute between 0.9 and 1, which means this algorithm is robust to JPEG compression and other common image processing attacks.

29.6 Conclusion

This paper proposes a zero-watermarking algorithm base on CNN and Contourlet transform, which enjoys both the invisibility and the robustness. The results of experiment show that this algorithm can obtain better visual effect, it also has a good robustness to geometric attack of the rotation, scaling, filtering, noise, cropping, and JPEG compression and so on. In addition, the image processing by CNN is parallel and can be implemented by hardware easily. So this algorithm is suitable for requiring higher real-time situation.

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References

1. Schyndel RG, Tirkel AZ (1994) In: Proceedings of the international conference on image processing, vol 12. Texas, pp 13–16
2. Bender W, Gruhl D, Morimoto N, Lu A (1996) IBM Syst J 35(3&4):313–319
3. Luo T, Yu M, Jiang G, Wu A, Shao F, Peng Z (2012) Future wireless networks and information systems, LNEE 143:297–307
4. Lan Meng, Hongying Yang, Xiangyang Wang (2008) J Chin Comput Syst 29(11):2153–2163
5. Zhang D, Wu B, Sun J, Huang H (2009) In: Proceedings of the international congress on image and signal processing, vol 9. Tianjin, China, pp 17–19
6. Joseph JK, Ruanaidh O, Pun T (1998) Signal Process 66(3):303–309
7. Cai Lian, Sidan Du, Duntang Gao (2005) J Electron 22(5):300
8. Quan Wen, Tanfeng Sun, Shuxun Wang (2003) Acta Electron Sin 31(2):214–220
9. Jianhu Ma, Jiaying He (2007) J Image Graph 12(4):582–587
10. Do MN, Vetterli M (2002) In: Proceedings of the IEEE international conference on image processing, vol 1. New York, pp 22–25
11. Chua LO, Yang L (1988) IEEE Trans Circ Syst 35(10):1257–1264

Chapter 30

Research on Teaching Reform on Tourism Specialty Under the Network Environment

Jing Chen

Abstract The network is an important feature of an information society, the classroom teaching under the environment of network is different from the traditional one. Based on the analysis of influence of network environment on tourism specialty teaching, the paper proposes some ideas for teaching reform under network environment in order to construct tourism professional courses teaching model with a view to better improve the affection of teaching and train higher qualified talents.

Keywords Network environment · Teaching reform · Tourism specialty

30.1 Introduction

Since 1980s, the internet information network technology represented by the internet develops rapidly provides an excellent opportunity for rapid development of Chinese education and changes the traditional model of personnel training and method for it. Now different kinds of education based on internet have been used by more and more institutions of education in the world [1].

Environment is related with the certain space. From the narrow point of view, the network environment can be understood as “the place for learners to use a variety of tools and information resources and put them together for pursuing the objectives of learning and solving problems”. From the wide point of view, the environment of network includes the virtual reality world, namely, Cyberspace.

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That is to say, the network environment not only refers to the place of operation for network resources and network tools, but also includes learning environment, learners' motivation, interpersonal relationship, and the teaching strategies of non-physical form. Although people more and more ignore its physical characteristics of the network environment, more attentions are paid to meaningful communication between teachers and learners, students and students, students and the teaching materials, students and the supported system. The meaningful communication in the practical teaching is mainly embodied as a teaching concept on supporting the background. Based on the information, the network environment refers to the combination between network resources and network tools from the point of teaching design [2, 3].

30.2 Effect of Network Environment on Teaching of Tourism Professional Courses

30.2.1 Effect on the Teaching Environment of Traditional Tourism Specialty

The relatively closed teaching environment of tourism specialty has been greatly changed along with the network interconnection. Almost all universities have built at least one website. Under the traditional conditions, the teaching contents for tourism specialty courses are easy with lacking of flexibility for the construction of courses system, single teaching way and non-positive learning interesting. Under the traditional teaching mode, teachers adopt Giving-Demonstrative teaching method without using necessary diversified teaching means, lacking of flexibility [4]. Teachers pay attentions to giving the simple knowledge and skills and tests but ignore the training for their social practical ability with comprehensive qualities form tourism specialty. The traditional teaching method has a great bad effect on learners' learning initiative, creativity and the teaching effects are weakened [5].

The present network environment has played a role in promoting the effect of teaching for tourism professional courses. The rapid development of provide protection for the co-construction of teaching resources and sharing them which lay the foundation for learners' extensive and lasting learning the tourism professional courses [6].

30.2.2 Effect on Teaching and Learning

The formation of the network environment brings great influence for the tourism course teachers. In the traditional teaching environment, teachers can carry out classroom teaching with a textbook, a piece of chalk, and PPT. Teachers in the

theoretical classroom use unidirectional output or interactive communication to finish their teaching. The classroom of practical training teachers, give the demonstration and let students give simple imitation and practice. This kind of education content and methods has their limitation which has a long distance to the requirements of learners to learning based on network. Its' teaching effect is not obvious.

With the continuous development of computer network, computer network will become the main way for college students to learn knowledge. The teaching of tourism professional courses should be adapted to the situation to make full use of computer network to construct the teaching mechanism between classroom teaching and network teaching in order to realize the reform of teaching methods for tourism professional curriculum. Integrated teaching resources for tourism specialty by using the advantages of network based on the requirements, new development and new needs from tourism industry and learners meet the need of learners' practical network tourism professional education curriculum and constructing the new teaching and learning mode.

The characteristics for network including ritual, interactive, multidimensional points give teachers and learners deep influences. Teachers can use the virtual and interactive features for network to design virtual tourism industry situation, and they can give full play to their leading roles to actively lead learners into the virtual tourism industry situation by using multimedia and diverse and abundant tourism information on internet.

30.2.3 Effect on the Teaching Content, Teaching Means and Teaching Methods

The traditional tourism reform was restricted into a certain time and space including teaching contents, the exchanges among learners learning experiences, teaching place, teachers' teaching habits, the size for class and so on. Under traditional situation, teachers for tourism professional courses have to use simple teaching methods due to the fixed teaching place and teaching time. The teaching result is not very good with insufficient activity. Teachers always use explanation for teaching difficult points and main points to learners by themselves, then classifies them into several groups. After their practices, learners discuss with each other to find the excellent trainers. Although the way could let some learners take part in the training with passive acceptance, teaching effect and learning effect are not significant. And the three-dimensional network communication mode can realize the optimization transfer of information to form tourism courses mode from the three-dimensional network with combination between the virtual point and reality, the individual and the popular. A good new teaching situation will be appeared with forming a bidirectional interaction of Online and Class.

30.3 Construction for Teaching Mode for Tourism Professional Courses Under the Network Environment

30.3.1 Creating Virtual Teaching Situation

Tourism is travel sightseeing, is a complicated social phenomenon, involving politics, economy, culture, history, geography, law and other social fields. Tourism is also a kind of recreational activity, with remote and transient characteristics. Tourism is related to living, eating, entertaining and shopping during the process of traveling. Knowledge for tourism cover very broad which make teachers of tourism professional courses only rely on indirect tourism information such as indirect photographs, publicity pictures, video clips and so on to help learners know what is tourism, skills for tourism and knowledge for it. In the traditional teaching method, teachers often use charts, illustrations and other materials make intuitive presentation, but it is lack of dynamic result, and the visual and auditory effect is poor, affecting the teaching tasks.

The Internet has very rich resources. It put the text graphics, image, sound, animation, video and other multimedia teaching software and advanced technology together organically which creates a simulation environment with vivid image and knowledge. It also creates the virtual tourism scene and changes the abstract image to enable learners to see the virtual scene and nature. Through the inner emotional experience, learners' learning interesting in travel is stimulated greatly.

30.3.2 Boarding Learning Space

Tourism knowledge covers development of human society and people's daily life in all aspects and fields including political, economic, cultural, military, etc. Every tourist behavior is not independent related to living, entertaining, purchasing and shopping, and also related to knowledge of different fields such as tourism psychology, consumer psychology and other aspects.

The comprehensive and systemic features for tourism knowledge become the difficult points in the teaching of tourism professional courses.

The application of network multimedia CAI courseware as well as the close communication between teachers and learners could construct a complete travel knowledge structure with a closer relationship among tourism knowledge and travel activities. Internet tourism teaching activities give learners much more learning chances to learn according their free-time at any place which provides a convenient learning opportunity for them. Multimedia CAI courseware helps teachers finish their teaching task well and effectively. Teacher could form the network multimedia CAI courseware with organic ground arranged for tourism attractions, scene picture for tourism enterprises and video with lots of tourism knowledge which can change the numerous information brief one and clearly

complete knowledge system in front of learners. At the same time, teachers can adjust the progress of teaching according to learners' cognitive level to make CAI courseware, which is result based on judgment for learners' differences, learners' learning level about tourism professional courses, their interesting for these courses and so on. If learners have some problems about the courses, they could send e-mails to teachers, and they will give the suggested answers for the questions to learners. So, this way realizes dividable teaching based on learners' different characteristics.

30.3.3 Creation of Collaborative Learning by Using Network Interaction

Interactive feature is the main and important characteristics for Network education. Teachers and students can exchange and discuss with each other. Based on students' acquired knowledge, teachers can divide students into several groups according to their leaning style and different personality to deal with the same question. All the exercise can be finished by BBS, online chatting and e-mail and so on which are convenient for students to freely show their creative ideas and build their interesting in communicating with other learners to listen to the views of others, to absorb other people's ideas, frankly putting forward their own views. Through the use of competitive, cooperative, and co-splay and other forms of interactive cooperation and communication, students can benefit by mutual discussion and have more comprehensive and scientific understanding about that.

30.3.4 Improvement of Thinking Ability by Guiding Inquired Learning

The basic starting point for exploratory study is that students' learning is more effective than teachers' explanation for teaching contents with much more profound thinking training. Exploratory learning includes problem analysis, information collection, and combination among knowledge, refinement, and reflection. Tutor gives students the solved problem without teaching. Students can explore new fields independently, and can also cooperate with other students to solve them. At the same time, they can learn some knowledge about internet or technology about network teaching including the way of information gathering tools, way of computer modeling, data processing etc.

Teachers should provide technical support and guidance for students, rather than a direct answer, and gradually cultivate the students to become more skilled in information processing. Teachers should pay attention to in a specific research project to avoid too much new technology, otherwise it will lead to students'

limited mental resources from the research subject dispersion. After a period of collection of information on the autonomous learning phase, students use their new knowledge to make assessment. Through learners' application of new knowledge, new knowledge on the existing knowledge foundation is consolidated with the application, producing extensive connection, thereby firmly establishing their own knowledge system. Their problems are being solved and they will discuss about the related or similar questions among in order to refining and they will conclude and give their self-evaluation. And teachers will help students to make summary.

30.4 Teaching Reform and Thinking Under the Environment of Internet for Tourism Specialty

30.4.1 Changing for Roles of Teachers

Teachers under the network environment, play roles including not only being provider for information and problems-solver, but also being designer for learning activity of learners, developer for the resources of the course and cooperater during learners' learning process.

Firstly, teachers should be the planner for students' learning activity. Each class for teachers is just like a project. And efficient design for it will improve their learning efficiency. Preparation for their teachings, teaching design, the practice for their teaching in classroom is based on cultivating students' ability and developing their intelligence activities. Therefore, teachers should have a certain organizational capacity for planning. Secondly, it is very hard for students to find the suggested answers required by their teachers online by their selves. Students find the information with exact purpose. Teachers should arrange some tasks to students and they could complete the learning task through the network independently. So, teachers should collect related information before giving the arrangements to students and recommend some related websites to them or download resources and reorganize them to design some WebPages to students in order to save their time.

Secondly, teachers should be consultants during students' learning activities and they should be the final recourse for difficulties encountered by students. Therefore, teachers should have extensive knowledge. Then, teachers should be partners for students' learning and they should be one of member for their learning activities with equal status to participate in it so as to find their problems during their learning and help to solve them as soon as possible.

Teachers should go down the pulpit and become partners for students' learning to understand their thinking's. Teachers could do their educating and teaching work based on these teaching reforms.

30.4.2 Avoiding Blind Searching Information to Constructing Teaching Resources Information

It is open for education information resources and they exist in various forms. While students explore their needed information according to their learning objectives and want to save time on online to improve their learning efficiency. Therefore, we need to collect, organize, process, integrate the educational information to construct an ordered structure.

Information theories point out: according to the requirement for information in our actual activity, the collection of information by selecting some relevant parts among all information is called information index set. From the information perspective, the collection, organization and integration of information should identify the information index system based on the need of understanding and the index set is base for screening and integrating information.

The information collection, collation, organization, first according to the understanding of things need, identify the information index system; the index set is screening, integration of information based on. We establish the education information data base based on network environment which screens, organizes, integrates the information to offer students a convenient query information platform.

References

1. Qiao Weide (2009) Study of teaching reform and experiment based on network environment. Shanxi Coll Commun Technol Coll Newsp 21:429–431
2. Lai Weiwei (2009) Research and practice of Chinese education information for PBL teaching mode under the network environment. High Vocat Educ 8:348–352
3. Chen Xin (2010) Multimedia environment for PBL teaching reform. Chin Med Inf 36:239–341
4. Zhou Xuemei (2010) Research for teachers' role transformation. China Educ Innov Herald 13:82–87
5. Zhang Meilin (2011) Discussion of advantages on multimedia teaching method for teaching of tourism. Occup Technol Educ 10:421–423
6. Wang Weihong (2011) Make full use of network information technology, improve tourism specialty teaching quality. China Educ Innov Herald 11:281–289

Chapter 31

Unity Retrieval Technology of Universities Heterogeneous Data

Xiaoxiao Liang, Shiwen Li, Chong Gang Wei, Jiang Ma and Yi Luo

Abstract This paper introduces the present universities' commonly used heterogeneous data retrieval technology, analyzes the data retrieval technology which can be chosen by the digital construction of university, and deeply researches the unity retrieval technology realization method. Based on XML universities heterogeneous data by Microsoft.net framework, JDBC database technology, XQuery language editing inquires the metadata. This method has low cost, practical and high efficiency use and so on.

Keywords Heterogeneous data · Unified retrieval · XML · Xquery · XML schema

31.1 Introduction

Colleges and Universities need to construct a lot of information management systems in the information construction process. Because the application systems are lack of unified planning and organization, and the methods of using operating system, database technology, data organization are greatly different and it makes

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the between data independent and difficult to share. We formed an “Information Island” and it makes the various data of application and decision-making difficulties urgently need the computer and network technology to solve this problem. This scheme has low cost, practical and efficient characteristics.

31.2 The Status of University Unity Retrieval Heterogeneous Data

The basic principle of university heterogeneous data unified retrieval technology is that all kinds of distributed heterogeneous data undertake unity query, it provides users with a unified retrieval platform on the university existence heterogeneous data sources, first decompose the user of the retrieval requirements, put forward into different data source query expressions, and then issue queries instructions to different data sources and conversion, integration, integrate the results of inquires, finally the system will query results returned to the user by a unified format [1].

There are many software companies, universities and research institutions doing the heterogeneous data integration research and exploration worldwide, for example, MIND of the Middle East University of Technology in Turkey, Web Feat of Web Feat Company, and Galaxy of China southeast university. Due to the library information resources’ rapid growth and the digital resources increase in university, the integration of heterogeneous database and retrieval technology are more extensively used. For example, the CDL research result Searchlight of California university library, it can support the Web and Z39.50 retrieval and is able to support the unified query of 55 data sources, Flashpoint of US Los Alamos national laboratory research library can conduct unified query in 11 data sources including electronic magazine, the library catalog and network database from 2002 [2].

The university heterogeneous data retrieval technology research started relatively late, but developed rapidly in our country. In 2002, China’s higher education literature guarantee system projected USES unit data retrieval technology, launched CALIS retrieval technology research to realize a unified retrieval language and interface of distributed heterogeneous data sources. Many colleges and universities also implemented unified retrieval technology research and made some staged achievement, such as the central China University of science and technology, Tsinghua University and Nanjing University put the retrieval platform in use.

31.3 The Unified Retrieval Technology of Heterogeneous Data

The unified retrieval technology of university heterogeneous data basic principle refers to various digital resources, it provides an integrated retrieval service, and

will have different formats and different types of digital resources together, realizes seamless connection, unified retrieval, improves the utilization of the resources. This integration embodied in the resources of the unified retrieval selection modes, unified retrieval methods and unified results shows that the method, which all digital resources and the retrieval network search engines like search a database conveniently.

31.4 The Whole Structure of University Heterogeneous Data Unity Retrieval

In university information construction process, the business departments constructed a lot of information management systems according to their needs. Educational information management system, students' information management system, the information management system, financial information management system, one card information management system, the scientific research information management system are pretty common. Based on the analysis of the unified retrieval technology and the present situation of university heterogeneous data sources, university heterogeneous data retrieval system framework used middleware data retrieval system model. For this each model, we do not need to use complex queries mechanism, nor to establish and maintain the huge retrieval in the database. Instead we need to make system in the upper interface and the underlying design on the foundation that can easily add new query service. This model for the user, provides a more transparent inquires interface of heterogeneous data sources, shielding the interface, heterogeneous data position details, greatly improves the accuracy of the inquiry, the efficiency of the time and space. The system frame work as shown in Fig. 31.1.

31.5 The Key Technology Design and Implementation

Apply the above retrieval structure, and realize the heterogeneous data retrieval platform. Platform of university management information system based on Oracle students information database, based on SQL Service of educational administration information database, based on the financial information database etc. MySQL relational database system as the research object, the Microsoft.net Framework technology, says layer use asp.net embedded in Web achieve, logic layer use asp.net built-in Page Controller mechanism to realize, data layer use.net Framework of ado.net class to realize the database access, and finally achieve the college of heterogeneous data retrieval Service.

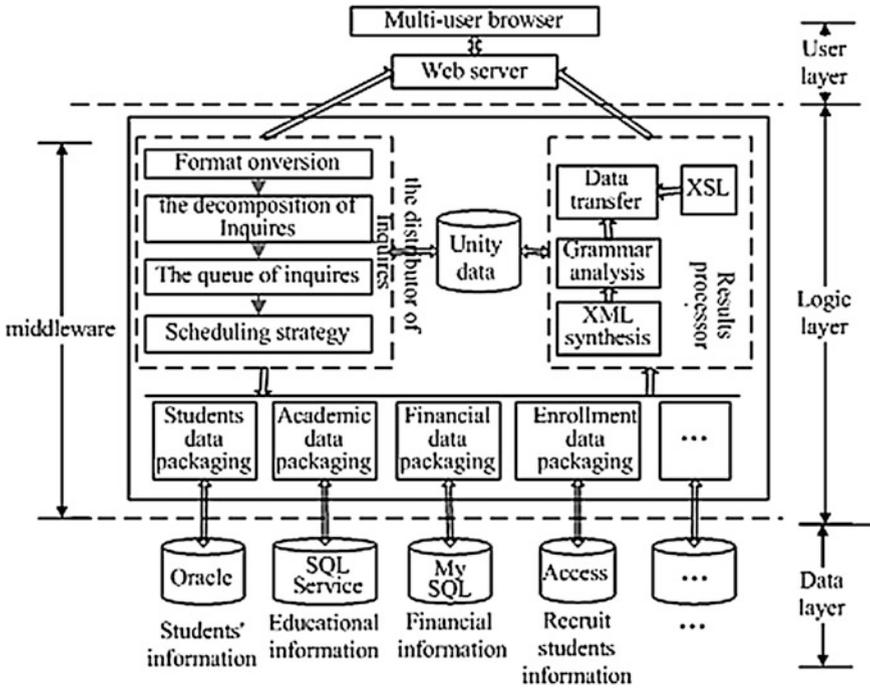


Fig. 31.1 The heterogeneous data of university retrieval platform structure

31.5.1 Unit Data Acquisition

From the user receiving the global inquires request, to seeking the corresponding unit database of data dictionary, global database and the corresponding relation of local database, then they decomposition. It is needed to establish a database to store the RMB global data dictionary, local data dictionary and relationship dictionary, such as: global data table university info, local data table part info, global and local mapping table Conn, etc. In order to realize the global view and global inquires son inquires of decomposition. Unit data, simply say to be data that describes data, it has different representation. Because college of heterogeneous data in XML data for unified inquires middle data exchange format, so the XQuery language to edit inquires the unit data, using the XML Schema to describe the unit more data sources data.

In this scheme, the universities has five specific heterogeneous database: students' information management system USES is Oracle database, and it contains the student information in the school during the period of ideology, study, life and work, such as the scholarship, and student loans, and as a student cadres, to participate in social work, and other information, Educational information management system USES is the SQL Server database, it contains student status and

academic achievements information, such as professional, class, learning courses and results and information, Financial information management system USES is My SQL database, contains the school's financial information, such as student tuition, accommodation and information, students recruiting information management system USES is the Access database, contains school enrolment information, such as the university entrance exam scores, the students' hometown information, Book information management system USES is the SQL Server database, contains school books borrowed inventory information, such as the collected books, student borrowing, etc. These are all relational database, we need to get their metadata, and put them in a server machine of the database which has middleware. So, on the yuan it can be realized in the data dictionary visit just visit related machine is database. Below SQL Server and Oracle database access relationship of metadata method is introduced:

Get SQL Server and Oracle in relational data Yuan data, use the API can relate JDBC, key class is ResultSetMetaData. execution select * from table Name, get Result Set, again from the Result Set get ResultSetMetaData, then use class ResultSetMetaData function getColumnCount (), getColumnTypeName (I), getColumnName (I), get the table column number respectively, and the type of column name [3]. The last of the Yuan will get data written to a schema temporary file (*. XSD), with graphical forms submitted to the development platform for developers inquires and editor. XML data metadata, and XML files and text files metadata here don't introduction.

31.5.2 The Distributor of Inquires

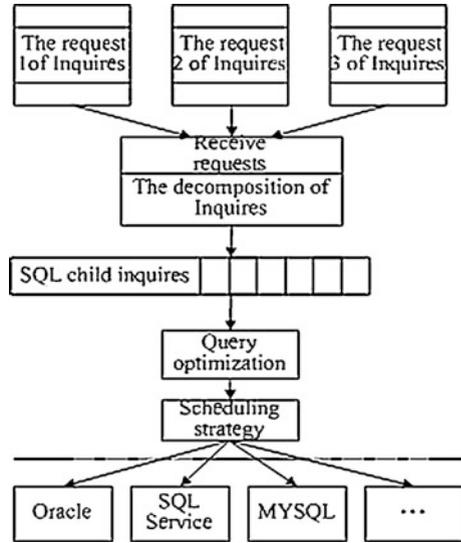
XML information decomposition is the user system transmission of full XML document information for several can be in specific split heterogeneous system performs XML information and send them to the corresponding heterogeneous information system to implement, When heterogeneous system execute the tasks assigned to finished, the results will come back to the heterogeneous data processing system, collected by all the heterogeneous system XML response information, integration as a complete XML document information, returned to the user system, as shown in Fig. 31.2.

For example, students and borrowing to inquire status as book information, the request of user to inquires:

Select * form university info According to the global table name in the dictionary, search for the global table name's correspondence in the connection dictionary. So the inquiry SQL statements are:

Select SubTbl form Conn where HoleTbl = "university info" Because the information is related to the students' educational information management system and financial information management system, so the above query is decomposed into two sub-inquires:

Fig. 31.2 The distributor business process of inquires



Select * from Student Info,
 Select * from Book Info,
 Respectively undertake corresponding database queries.

31.5.3 The Result Processor Realization

The conversion function of the results approach is: First of all, for every connection database of global inquiry request establish XML documents defined as XmlResult according to the definition of elements, Secondly, according to the database query results returned objects start ResultSet processing, for each of the result set every line of data set up TmpRow sub-elements, take out each column value to establish Tim Row sub-element of the column name, the name of the element for listing, the element value is listed value [4].

Conversion method: Document convertToXML (ResultSet result)

Parameters: the result is a relationship of inquires database returns to the results.
 Return type: Document, according to the results of a query XML data structure.
 The result with function approach is: according to the connection key conditions inquires “and” and “or” integration, again according to two local data sources keyword connected search results. For “or”, to the local data sources result of the inquiry combined operation, For “and” key words, two data sources result of the inquiry based on the decomposition of the inquires connection the key word operation.

How to construct the XML format of global results depends on the data field involved in global queries written by the user. XML format results are further

converted into the form of XMLSet, so it facilitates developers handle the results in a way similar to Result set.

31.5.4 Packaging

Rewrite XQuery sub-inquires into XML document: when wrappers receive an XQuery inquiry related to connection database. First rewrite inquires. Rewrite the XQuery format sub-inquire into XML document. Next, the system will convert the query XML document into SQL statements, and further process.

Convert query XML documents into SQL statements: connection database can use templates to define the mapping relationship between the query XML documents and SQL statements. Use Java based on the DOM ProjectX parser to parse XML query document [5], extract the query, and organize it into the SQL statement. To XML document defining strict document query model DTD defined, let applications identify and convert into XML sub-inquires. Inquires the student id number for 1201004 students “li ping” borrow books in the library of the case, inquires the XML document converter is converted to the following query the SQL statement:

```
SELECT book name, publisher
FROM order, book
WHERE stud name = 'li ping' and number = '1201004'
```

Relationship model mapping for XML Schema: results generator is part of the data source wrappers, it needs to be completed, and the main function is to get the data source from the relationship between query results mapping record an XML format [6]. Instead, XML data is any level of nested structure and has the characteristics of the standardization, good description of the mapping relationship between data is the starting point of the data format. From the relationship between the mapping relation database models for XML Schema method is:

First of all, get all the information of the relation table, Secondly, with appropriate XML namespace and target model space information create a model tag, Finally, establish description of root element, table element, record element, record field elements and type of data. Using the above method of conversion model, the result the processor will convert relation mode into XML Schema documents.

Mapping based on inquires: first constructed out of the complex inquires the view, treat the results view as a single list, and then the mapping for Schema, Again according to the structure set up a tree for Schema, Search result will be inserted into a tree right positions, according to the depth first, first root traverse method to traverse the tree, get target XML document [7, 8]. In the heterogeneous data system, the key is to realize the XML information and data sheet information mapping mechanism. This can be through the corresponding data model, through the program to switch to realize. When the heterogeneous data information system

receive to XML heterogeneous data processing system from the XML request information, will through the corresponding mapping mechanism to generate database operating statements, when from the database to return to get information, to mapping for XML response information, back to the upper level system.

This way is simple and nimble, it can realize the general data mapping requirements, and the execution of the efficiency is higher, has the very good maintenance and expansibility.

31.6 Conclusions

The paper according to the distribution of the database, autonomy and heterogeneous characteristics, combining popular Java technology in the application of database and XML technology and middleware technology, designed a university heterogeneous data retrieval system structure, and in the process of heterogeneous data retrieval results processing and distribution, and inquires integrated function, for college realization of unified retrieval of heterogeneous data provides a feasible solution. However, the plan also needs to be further optimized, for example in the query optimization, also on the college campus LAN should be focused on the characteristics of the further research, make inquires the shortest time and inquires cost minimum.

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References

1. Liu J-H (2009) Information management experience three big change. *Comput World* 43(38):34–42
2. Tang Y-E, Jie W, Zhang G-J, Li W-Q (2004) Web services based on the heterogeneous data retrieval systems, vol 435. pp 15–16
3. Li H-F (2005) Translation Java programming advanced tutorial, vol 83. Tsinghai University Press, Beijing, pp 14–15
4. Zhang Y-X (2011) Based on XML mode of heterogeneous data integration middleware, vol 295. Chongqing University, Chongqing, pp 146–149
5. Arciniegas F (2003) Day macro studio translation. XML development guidelines, vol 924. Tsinghua University Press, Beijing, pp 624–625
6. Pentaris F, Ioannidis Y (2006) Query optimization in distributed networks of autonomous database systems. *ACM Trans Datab Syst* 31(2):537–583
7. Wei Y-J, Tang P-L (2006) Based on XML data source wrappers of relational design. *Eng Geol Comput Appl* 53(2):23–27
8. Ying H, Li F-Q, Niu J-Z, Jiang H-Y (2011) Relationship model to modular XML schema mapping method of model. *Comput Eng Appl* 61(12):122–125

Chapter 32

Web Services Discovery Based on Service Description

Wang Min, Rong Chen and Rongrong Shi

Abstract The current Web services technology rarely involves how to build effective service semantic information, and most of them are based on a centralized registry, lacking of distributed search. At the same time, Web Services discovery engine can only provide basic information services, but not provide Web Services invocation mechanism. Based on some existing mature technology, integrated solutions for distributed Web Services discovery and invocation are proposed by this paper, which use a web crawler to obtain the service description, apply semantic information extraction technology to build the Web Services functional description, and add the information of the service context of situational information and quality of service to help find more relevant Web Services, and meet the non-functional discovery needs of Web Services.

Keywords Web services discovery · Service semantic · Context situation

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32.1 Introduction

Web Services discovery aims to find Web Services that match user needs from a large number of Web services, and its results relate to the quality of the service call, the Service portfolio compatibility and substitutability. As a key area of the Web services architecture, Web services discovery have a wide range of research in industry and academia. Web services discovery have many similarities with the traditional information retrieval, but the former has a higher complexity.

The current Web services discovery technology is based on a centralized service registry, a distributed Web Services discovery is not widely realized. The Web service discovery solution proposed by this paper enhances the discovery ability of Web services on the network. The program is constructed based on the technology of the Web search engine and information extraction, combined with the existing service discovery algorithm, and proposes some new complementary mechanisms.

First, The Web Services discovery solutions download the Web Service Description Language (WSDL) file from the site to provide Web services description file, and then parse the WSDL file to get the Web Services description element information extraction technology, create semantic information by information extraction technology based on natural language understanding, and add the concept of similarity and the context of the service context and quality of service information [1].

The rest of this paper is organized as follows. [Section 32.2](#) compares the related technologies for Web service discovery, [Sect. 32.3](#) describes the architecture and implementation of this solution, and [Sect. 32.4](#) presents the experimental tools and experimental data.

32.2 Related Work

Currently, most Web services discovery technology consider the effective use of semantic information and ontology, as the goal of automation and intelligent service discovery. The major Web services technology are the following:

Based on keyword matching, the current Universal Description, Discovery and Integration (UDDI) is a keyword-based and simple classification service discovery mechanism, by exact keyword matching service information for service lookup. UDDI can only match on the syntactic level, the lack of semantic information on the service functions, resulting in that many semantic matching services cannot be found [2].

Based on structural matching, this is service operation parameter type. This method represents parameter type as the structure of tree; includes the internal structure and external structure matching. The internal structure includes the value of the node, data types, attributes, constraints. The external structure is embodied

in the relationships between nodes. Structural matching considers similar services in the internal structure, especially the similarity of the data type. This method is relatively one-sided, using the similarity of the data type to exploit the hidden relationship between the services.

Semantic-based service discovery Semantic Web Services is one of the main directions of research based on semantic service discovery [2]. The most commonly used Web Ontology Description language based on Semantic is Web Ontology Language for Services (OWL-S) proposed by W3C. After W3C proposed OWL-S, Paolucci from Carnegie Mellon University proposed the Semantic Web Services OWL-S/UDDI matching algorithm [3], Web services match is divided into four different levels by the reasoning of the contains relationship between concepts in the ontology.

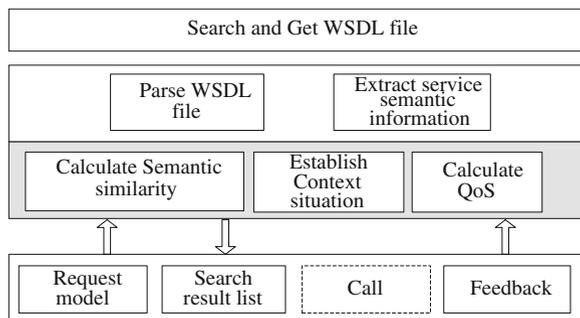
32.3 System Architecture and Design

The Web Services discovery overall framework is showed in Fig. 32.1.

32.3.1 Get and Parse Web Services Description File

Distributed Web Services discovery model firstly needs to obtain services description from the network. Manually set the initial site to search Web Services, rather than from the massive search of the vast network. Web crawlers used in Web discovery engines will be able to download the required documents, but the download site and the type of documents need to be customized. Web crawler needs to start from an initial site search, the initial site is specified by the user can define the depth of the reptiles crawling, that is, a site from the initial site can reach the farthest distance. The distance reflects the scope of the site search for. In general, the services provided by the site has some relevance, in which the

Fig. 32.1 The framework of web services discovery solution



application service, you can configure the initial site to find more relevant Web Services, but also greatly reduced the Services discovery range.

To obtain service semantic information first need to parse the WSDL document to obtain the functional description of each service. WSDL uses < wsd: documentation.../> element tags the service functions describe, and the content of the element is arbitrary text. In addition to the service function, you also need to get information about the description of the parameters. Output parameter determines what information the service can return. For most services, the result is the purposes of call services. Since the description of the parameters is optional, you need to parse parameter information about the parameters.

32.3.2 Extract Service Semantic Information

The following examples describe what content need to extract from Web Services to establish the key semantic information.

Zip2Geo Services Description: “This method will convert a zip code to Longitude and Latitude.” The core content of this function description is a verb phrase: “convert a zip code to Longitude and Latitude.” In order to avoid the described differences, getting rid of nonessential modifiers as far as possible can improve the accuracy of matching between the query and the actual service description. For the phrase, what you want to keep is the notional part, while all the words convert to lower case: “convert zip code longitude latitude.”

Because the sentence will be split into various parts, the information extracts loss of semantic links between words, such as “zip code” and “resource code” contains a code word, but both of them are not relevant. In order to preserve the links between words, “zip code” and “resource code” stored as a whole, rather than store separately.

This paper uses Link Grammar to extract semantic information described by the service function [4]. The services description phrase parsed by Link Grammar can be divided into smaller units according to the link relationships. As shown in Fig. 32.2 Zip2Geo service description statement can be divided into “convert”, “a zip code”, “Longitude”, “Latitude”, then remove the non-notional part of the word, and convert the word to what is expressed as the root.

After the above processing, the vocabulary of the service semantic information will still contain too ambiguous words, such as each service description may

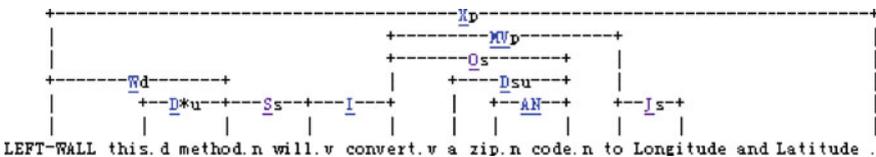


Fig. 32.2 The syntactic structure of Zip2Geo web services

appear the word “service”, “method”, In order to filter out those words lack of specific functions to limit the meaning of the word, it needs to build a stop word table, if a word contained in the table, it will be filtered out. Stop words table generally is created based on the specific application through some test data.

32.3.3 Calculate Semantic Similarity

Semantically similar concepts are in order to solve the mismatch problem of service request describes use and the actual same semantically service description but different synonymous words. This paper used lexical semantic network provided by Word Net to establish the semantic relationships.

Between the word distance and word similarity have a close relationship. In fact, the word distance and word similarity are the different manifestations characteristics of the same relationship; both of them can create a simple correspondence. In Word Net, each synonym collection was organized into a tree hierarchy, so it can calculate the similarity between two words according to the distance between words. Corresponding to the two words W_1 , W_2 , set their similarity $Sim(W_1, W_2)$, the above conditions the relationship can be expressed as (32.1):

$$Sim(W_1, W_2) = \frac{\alpha}{Dis(W_1, W_2) + \alpha} \quad (32.1)$$

Where α is an adjustable parameter, $Dis(W_1, W_2)$ is the semantic distance of two words. The semantic distance can be expressed as the shortest distance of two words in the tree.

From the formula, we know as long as two nodes the same distance as the similarity necessarily the same, however, a collection of synonyms synset in the top of the words to express the concept of the information contained in more abstract, close to the leaf node contains the information more valuable, such as “fish” contains more information than the expression “animal”. So considering the hierarchical relationships between them to get the similarity would be more accurate, this article uses the following formula (32.2)

$$Sim(W_1, W_2) = \frac{2 \times depth(lcs(W_1, W_2))}{depth(W_1) + depth(W_2)} \quad (32.2)$$

Depth (w) represents the depth of the node in the hierarchy tree of Word Net in the formula (32.2), $lcs(W_1, W_2)$ is the lowest common ancestor node of node W_1 and W_2 . We can get two nodes' nearest common ancestor node by calculating the path of the root node to the current node, but this needs to traverse the whole tree. Word Net records the relations between the sets, so we can get a path from the current node to the root node, and use a sequence table to record all the synonyms of a collection of nodes on this path.

The semantic information word collections are not stored directly, but build their group relations in accordance with the organizational structure, and store the relations and words together. All the synonyms word is organized into several groups (i.e. base type); such as the term is divided into 25 groups, the verb consists of 15 groups. Similarity calculation during the words, we can compare the words in the same group, and don't compare two different groups of words. The relationship between the two words is represented as tree-level relations.

32.3.4 Establish the Context Situation of Service

During service discovery, often only concerned with the matching relation about service description between service requester and service provider, and accordingly to find, ignoring the context situation of the service requester to use the service.

32.3.4.1 This Paper Establishes the Context of Service Scenarios in Two Ways

Access to domain information has expressed by the key words from the functional description of the services.

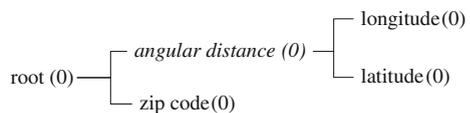
As service Zip2Geo converted zip code to latitude and longitude, what belong to the latitude and longitude location information, so the service can be applied to this field of application. Based on semantic hierarchy provided by Word Net, the context situation of the service is a tree structure. The context situations of Zip2Geo shown in Fig. 32.3, the number in brackets record the count to use the service in specific context situations.

In Fig. 32.3, the “angular distance” node appears as the nearest com-mon parent node of a combination of “longitude” and “latitude”, the “root” node is the root node of all nodes.

32.3.4.2 Create a Service Context Situation Based on User Feedback

The context scenarios established above only based on the description of the service itself, there is no practical application scenarios involving services, can be said that the context situations from the functional description of the services is only the basic shape in the case of the absence of other information, the real meaningful information needs in the practical application when the user calls the service.

Fig. 32.3 The context situation tree of Zip2Geo web services (1)



Before describe how to establish the context of scenarios based on user feedback, we look at how users describe a service request. Through the establishment of a structured service request to describe the services to find the demand, including the context situational of services, service discovery engine find the service results list based on the needs of user, verify the find service to meet the demand by actual service calls, feedback the result. According to the results of the feedback, add a new user application context to the context of situations of these services. Feedback results are calculated as a specific measure, if the value is higher than the minimum limit value of the services to meet user service discovery needs, add the context of situational in the request description to the context of the ser-vice context, treats description in the context and service functions description in the same way. Figure 32.4 is the context of situations of Zip2Geo service after many times the user feedback.

32.3.5 Web Services Search Request Model

The service request is used to describe how to build a search service request, Web Services is different from the ordinary unstructured text data, but with a specific description of the structure. The results can be customized for the characteristics of Web Services by creating a request. Figure 32.5 shows the model described in the service request:

A description of each attribute as follows:

- (1) Context: used to describe the context situation of the service.
- (2) Function: the function of the service.
- (3) Input: the input parameters of the service.
- (4) Output: the output parameters of the services.
- (5) Quality of Service (QoS): the quality of service information.

Through establishing the above service request, context situation can help the service discovery engine better understand the user’s purpose. Because the context situation has been established, in the application context, we can find the service more relevant. At the same time, results feedback to rich the service context situation. The function describes the main part of the service request which specifies the function what service wants to meet. Before service discovery, semantic information extraction on the content of the function, and then find in the services index based on this information.

Fig. 32.4 The context situation tree of Zip2Geo web services (2)

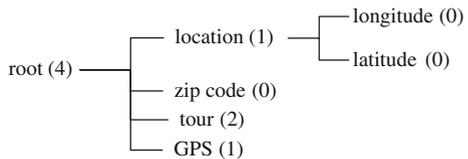


Fig. 32.5 Web services search request model

(context, function, input, output, qos)

Input and output part specified the input parameters and returns the result of the service. Input and output reflect the functionality of the service to a certain extent; also join this part to function part during service discovery.

The QoS specifies the other needs while find service, such as service availability, efficiency, accuracy, detail.

32.4 Experiments

Experiments of this section are based on the service information repository to search, including two test experiments:

He effectiveness Test the service discovery engine whether meet the requirements to get a better service search results.

The comparative has experiment of similarity of user evaluation data. The service discovery module adjust the semantic information of the services based on the user's evaluation, increase the words weights what play a key role in service descriptions and build quality of service.

In order to verify the effectiveness of the services discovery mechanism, here we find an area code converted to latitude and longitude of the service. There are a number of related services in the repository, however functional description of each service is different, and has a different quality of service. The system needs to get the most appropriate service list from a number of services based on the user's request description.

Figure 32.6 shows three results about services discovery, because the first service description is more consistent with the demand, and has a higher quality of service, the service is ranked first, which is fully compliance with experimental expectations, the description of second service is basically the same as the first, but use a different expression, with slightly worse quality of service. The third service, also returns the latitude and longitude information, but he service is based on IP address location information, which matches worst. From the service find result, service discovery engine implemented in this paper can get a better service find results.

Figure 32.7 shows the changes of the similarity of three services in a different number of evaluation data, the figure can be seen that the similarity of the services in the same service request model become a stable value with the increase in the number of user's evaluation, which indicates that description of the service function become more accurate.

In this paper, the service discovery module can get more effective experimental results, and with the increase of the request and the calls about services, the services discovery solution can get a better search result.

The screenshot shows the RCESB Web Service Search Engine interface. At the top left is a logo of a wrench and screwdriver. The main title is "RCESB Web Service Search Engine". Below the title, there are input fields for "function" (convert zip code to longitude and latitude), "context" (travel), "input" (zip code), and "output" (longitude and latitude). There are also dropdown menus for "qos" with values: Availability: 0.6, Accessibility: 0.8, Performance: 0.6, Reliability: 0.6, and Robustness: 0.4. Below the search parameters, it says "Search Results: There are 3 results".

GetLatLong

This method will convert a zip code to Longitude and Latitude. You will get better accuracy with the plus 4 added to the zipcode. Use a license key of 0 for testing.

Qos(assbilly:0.92,0.85,0.94,0.69,0.71) <http://ws.cdyne.com/zip2geo/zip2geo.asmx> [See WSDL](#) [Try it!](#)

ZipCode2Geo

This service will return Longitude and Latitude by zip code. And, if the zip code indicates a city which is recorded in the database, the return result will involve much more information.

Qos(assbilly:0.90,0.85,0.90,0.75,0.65) <http://202.117.118.46:10004/services/ZipCode2GeoUMO> [See WSDL](#) [Try it!](#)

IP2Geo

The IP2Geo Web service resolves IP addresses to Network Owner Name, City, State/Province, and Country. In most U.S. cities, it will also provide extra information such as Area Code and Latitude/Longitude.

Qos(assbilly:1.0,,0.80,0.76,0.65,0.50) <http://http://ws.cdyne.com/ip2geo/ip2geo.asmx> [See WSDL](#) [Try it!](#)

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Fig. 32.6 The service discovery request and the service list of results

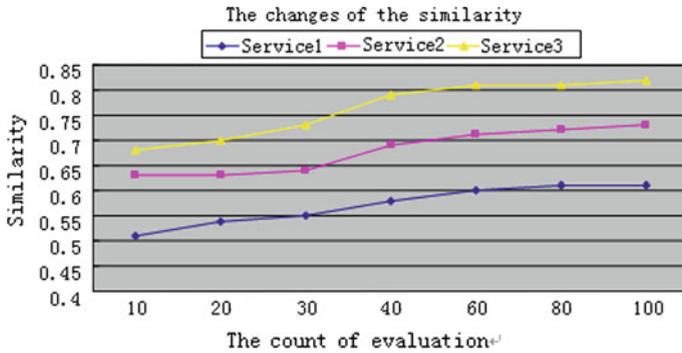


Fig. 32.7 The changes of the similarity of three services

References

1. Luo I (2003) QoS for web services: requirements and possible approaches, vol 63. pp 246–249
2. Zhizong L et al (2007) Web services discovery technology based on semantic 24:452–453
3. Paolucci M, Kawamura T, Payne TR (2003) Semantic matching of web services capabilities. Proceedings of the 1st international semantic web service, vol 356. Las Vegas, Nevada, pp 146–148
4. Ding J, Berleant D et al (2003) Extracting biochemical interactions from medline using a link grammar parser. Proc 15th IEEE Int Conf Tools Artif Intell 65(3):467

Chapter 33

Tactical Internet Reliability Evaluation with Variable Radio Transmission Range

Xuewang Wang, Ning Huang, Rui Kang and Zhitao Wu

Abstract As one of the most important performance measures of Tactical Internet (TI), reliability will be paid much attention to. Most of the existing techniques assume the transmission range is constant. It is not applicable for TI, due to the limited power and wireless transmission characters, the transmission range of nodes decreases with time. In addition, mobility of nodes for tactical missions is different from random waypoint mobility for MANET. This paper considered the impact of variable radio transmission range and tactical formatting mobility, by extending MC simulation algorithm proposed by Cook to approximate the dynamic reliability of TI (Cook JL, Arsenal P (2007) Capacitated reliability for ad-hoc networks. Reliab Maint Symp 563:192–195). Reliability evaluation results show variable radio transmission range and mobility impose a significant impact on TI's reliability. And sensitivity analysis allows the practitioner to quickly understand the interactions of the characteristics of TI, namely variable transmission range, tactical formation, limited links capacity and interference-aware routing protocol design.

Keywords Network reliability · Tactical internet · Variable radio transmission range · Monte carlo

33.1 Introduction

For satisfying the requirements of military tasks, mobile ad hoc network (MANET) was chosen to support TI's dynamic topology. Tactical ad hoc networks are more vulnerable to the node mobility and scalability compared with the

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commercial wireless networks [1]. When various complex tasks are performed in different environments, the ‘Communicating smoothly during moving’ feature not only exists in the deployment of troops, but also between the tactical units, which results in many difficulties for designing and analyzing the tactical internet. Therefore, the communication reliability during moving has become an important factor of TI’s design and analysis.

The transmission range of nodes is one key factor of the entire network connectivity, capacity reliability, and other performance metrics [2]. The simulation results show that the optimal range of mobile nodes is larger than the static nodes, and changes with the nodes mobility velocity [3, 4]. In addition, the number of its neighbour nodes increases with the square of the nodes transmission range [5]. Most of the existing techniques of network reliability evaluation usually assume the transmission range at different locations and in different directions is given and constant. Assuming the operations of the wireless links have the given probability, and all possible network topologies are given, the influence of the nodes failure, nodes mobility on two-terminal reliability were presented [6, 7]. However, many experiments shown that in practice the even homogeneous wireless nodes exhibit the transmission irregularity and spatial correlation at different geographic locations and in different directions, due to the non-isotropic path losses and heterogeneous transmission powers among different nodes [8]. In summary, the reliability evaluation of TI doesn’t consider the dynamic transmission range and interference. In addition to the nodes mobility, nodes failure, routings restriction, and transmission capacity requirement, the dynamic communication radius changing with time and interference between the mobile nodes are also important factors of the reliability of TI.

In this paper, the improved Monte Carlo algorithm for the dynamic reliability approximating calculation of TI is proposed by considering the impact of node mobility, failures of nodes, time-varying transmission range, interference-aware routing restrictions, capacity of wireless links on the whole network reliability. In addition, the uses of the normal cloud model for describing the tactical formations and sensitivity analysis of a network example based on MATLAB and NS2 are validated to evaluate the interactions of various elements of TI reliability.

33.2 Reliability Evaluation Model of Tactical Internet

As one of MANET with special network applications, in addition to common factors affecting the wireless ad hoc networks reliability, there are many elements of TI itself. For example, the military tasks of TI require the coordination and cooperation between the nodes to form a variety of tactical formations. During the mission, the reliability of nodes and wireless links change with the battery capacity, the relative location of nodes, transmission range, and the communication capacity over wireless channel et al. Hence, reliability computations in TI should consider the reliability of nodes, wireless links and route paths. It depends

on the relative movement of nodes, battery capacity, variable transmission range, communication capacity, and routes communications between forwarding nodes. Assumptions and notes used in paper are as follows:

The fault of node is independent of the mobility velocity and power consumption. The nodes are irreparable and the failure of wireless links is mutual independent.

$G_p = (V, E)$ a directed network where V is the set of nodes, and E is the set of arcs, $v_i \in V$ the i th node, $e_{ij} \in E$ the wireless link between v_i and v_j .

T the possible topology derived from the route discovery.

$n_i(t)$ the operational status of node v_i at time t .

$l_{ij}(t)$ the operational status of link e_{ij} at time t .

$r_i(t)$ the probability that node v_i is working normally at time t .

$R_{ij}(t)$ the coverage of transmit and received power of nodes.

I_i the interference of node v_i .

$Path_{st}$ the transmit path form source node s to destination node t is derived from the route discovery.

2TR the two-terminal reliability.

33.2.1 Reliability Evaluation Model of TI Nodes and Links

There are two main reasons for the failure of the point to point communication of TI. (1) Lacking energy for the relay nodes (the radio sending, receiving power, transmitted packet size and frequency directly related) or nodes failure caused by functional damage of hardware and software. (2) The disconnection due to relative movement of nodes, or link transmission failures caused by barriers, fading and noise. Therefore, the node failure criterion is defined as: the residual energy of the node cannot start the data transmission, or although energy is sufficient, the functional failure of hardware and software of node cannot guarantee the data sending and receiving. In this paper, let the node is binary, if the node is functional, $n_i(t) = 1$, else $n_i(t) = 0$. The reliability of node can be calculated as $r_i(t) = p(n_i(t) = 1)$. In this paper, we assume the failure function of node obeys Weibull distribution.

If the distance between any two nodes is less than or equal to the radio transmission range r , the link exists and the signal can be directly transmitted. Existing models assume that the wireless transmission range of each node is the same and constant, and it applied to the broadcast process. In fact, the point-to-point communication is commonly used. The wireless transmission must be accompanied by the energy consumption of node over time, and influenced by the transmission environment obviously. In addition, with routing protocols, each send, relay and receive packet with different frequencies, and transmission range of each node is no longer the same. The random distribution of the transmission range should be considered.

The effective transmission range depends on the loss model and the power of nodes [9, 10], considering the fading environment. Assuming the transmission range of node i is $R_i^e(t)$, its neighboring node j is $R_j^e(t)$. The sending radius of node i is not equal to the receiving. And the transmission range of nodes is required to cover the neighboring nodes. Therefore, the effective communication range is:

$$R_{ij}(t) = \min(R_j^e(t), R_i^e(t)) \tag{33.1}$$

Different from the probability that links exist [6, 7], the connectivity and sufficient capacity of the wireless links are both required for the military tasks. If the link is operational, both the connection and quality of radio transmission are assured. Therefore, (1) if the distance between the nodes exceeds the effective transmission range, the wireless link fails. (2) although the wireless link exists, it could not offer the demanded capacity due to the disruption of signal, it fails.

The coordinate of node $(x_i(t), y_i(t))$ can be derived from the mobility model. Let $d_{ij}(t)$ is the distance between nodes i and j , $c_d(t)$ is the demanded capacity and $c_{ij}(t)$ is the capacity offered. The available capacity [11] is computed as:

$$C_{ij}(d_{ij}(t)) = b^* \log_2[1 + \{\frac{P_0}{d_{ij}(t)^2} / N_0\}] \tag{33.2}$$

$$p(l_{ij}(t) = 1) = p(c_{ij}(t) \geq c_d(t) | d_{ij}(t) \leq R_{ij}(t), i \neq j) \tag{33.3}$$

33.2.2 Reliability Evaluation Model of Routing Path and TI

Both the traffic and topological path are the main factors. Therefore, the 2TR of TI is defined as the probability that the effective route exists between source and destination node. Mapping from traffic paths to physical elements, the optimal paths selected by routings are prevalent. Due to tactical environment and military tasks requirement of TI, the interference greatly influences its throughput, lifetime et.al. The paths found by the traffic load-based interference-aware routing (TIR) protocol are proposed to avoid the areas with high interferences, and reduce the number of collisions [12]. An interference model based on traffic load, the number and the distribution position of neighboring nodes is shown as follows:

$$I_i = \sum_{j \in S_{T(i)}} \frac{c_{dj}(t)}{d_{ij}^k} + \sum_{j \in (S_{2T(i)} - S_{T(i)})} \left(\frac{2}{3}\right)^k \frac{c_{dj}(t)}{(R_i^e)^k} \tag{33.4}$$

where, $S_{T(i)}$ is the neighboring nodes set within the effective transmission range of node; $S_{2T(i)}$ is the nodes set within the double transmission range of node; $C_{dj}(t)$ is the traffic load of node j ; k is the factor, $k \in [2, 4]$.

Let $path_{st}: n_s, n_1, n_2, \dots, n_t$ means the multi-hop route existing between the source node n_s and destination node n_t , the path interference is the sum as (Eq. 33.5).

$$I(path_{st}) = I(n_s) + I(n_1) + I(n_2) \dots I(n_t), MI(path_{st}) = \frac{I(path_{st})}{n} \quad (33.5)$$

where, n is number of links of path. When the source node sends data to the destinations, the path with the minimum $MI (path_{st})$ is selected. Then compute 2TR:

$$2TR = \sum 2TR_{T_i} P(T_i = 1) = E[2TR_{T_i}] \quad (33.6)$$

where, T_i is topology configuration I, α is the number of available links in T_i , β is the number of unavailable wireless links in T_i , and T_i consist the path graph.

33.3 Reliability Evaluation Algorithm of TI

In battlefield, the upper-level intention of mobility usually has fuzziness as well as the lower-level activities are more flexible. To evaluate TI reliability more precisely, cloud-mobility model is utilized to generate the tactical mobility formations. An improved MC algorithm is developed to approximate the reliability:

Initialization: define network input parameters: numbers of nodes, mission duration, Cloudy-mobility parameters, bandwidth, transmission power, spectral noise, nodes' reliability function, demanded capacity, random range of nodes' wireless transmission radius, and the limit of route hops.

step 1: Simulate the operational status $n_i(t)$ of nodes using random number from Weibull distribution and the transmission radius of each node, using random number from Normal distribution and compute the effective communication radius between adjacent nodes;

step 2: Simulate the capacity demanded of wireless links, using random number from Normal distribution, calculate the available capacity, and analyze the status of nodes and links to determine the connection matrix;

step 3: Determine the available paths and the reliability of TI, as Eq. 33.6;

step 4: Calculate the coordinate of nodes next time ($x_i(t + \Delta t)$, $y_i(t + \Delta t)$) and update position by cloudy mobility algorithm, $t \leftarrow t + \Delta t$, and return step 2;

Repeat the step 2–5, use the results of runs to calculate the approximation of TI's reliability $R_{con}(t)$ at each increment of time from $0-t_{max}$ as in Eq. 33.7.

$$R_{con}(t) = \frac{\sum_{m=1}^M R_{test}(m, t)}{M} \quad (33.7)$$

33.4 Examples

The simulations are carried out on the NS2&MATLAB 7.0 and the initialization parameters are shown as Table 33.1:

33.4.1 The Results of TI's Reliability

The R_{con} of TI with reference point group mobility model (RPGM) and Assaulting formation are depicted in Fig. 33.1, and the R_{con} falls gradually with time. The main reason is the failure rate of node increases with time, and the wireless links fail quickly due to the decreasing communication range. For different formations, to get the same reliability, the effective transmission range is obviously different. For example, to assure the reliability is 0.8 at time 15 s, the radio transmission range of RPGM is 560, and 230 in Assaulting. In addition, compared with the given same constant transmission range [13], the R_{con} of TI with variable transmission range is obviously different. Therefore, variable transmission range and mobility are important element of TI reliability.

33.4.2 Sensitivity Analysis

There are many factors affecting the reliability of TI. Therefore, the development and leverage of the TI schema should consider how to obtain the required reliability. The relationships between reliability and the individual component parameters must be understood by sensitivity analysis. The proposed method is used to illustrate these interactions and how it may be utilized to aid in the system engineering processes. Numbers of simulations and sensitivity analysis indicate that transmission range is most sensitive for the TI including 50 nodes with Assaulting. Figure 33.2 shows TI's reliability with Assaulting from 250 to 350. Therefore, we can adjust various other parameters by sensitivity analysis to improve the reliability.

Table 33.1 The initialization parameters of TI

Parameter	Value
$ N , t_{max}, h, M$	50, 55 h, $h \leq 10$, 1000
$r_i(t)$	$\theta = 500, \beta = 1.5$
b, p_0, N_0	$b = 50$ MHz, $p_0/N_0 = 500$
$c_d(t)$	$\mu_d(t) = 150$ bps, $\sigma_d = 10$
Transmission range	$R_{tr} = 560$ (RPGM), $R_{tr} = 230$ (Assaulting)
RPGM ¹³	$E_x = E_y = 500, E_{nx} = E_{ny} = 1.5, H_{ex} = H_{ey} = 0.5$
Reference point	(0,2), (2,0), (4,2), (2,4)
Assaulting ¹³	$x = 0, E_x = E_y = 0, E_{nx} = E_{ny} = 5, H_{ex} = H_{ey} = 3$

Fig. 33.1 Reliability of TI with RPGM and assaulting

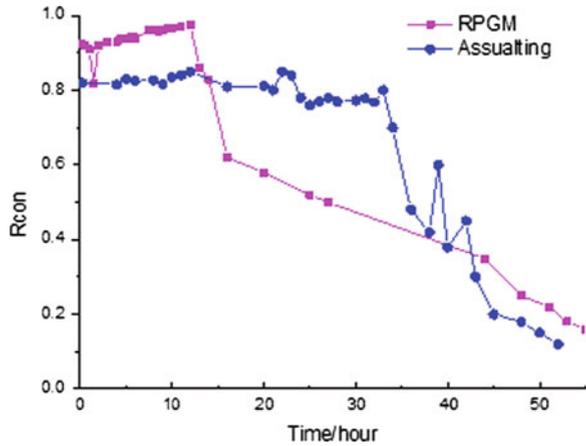
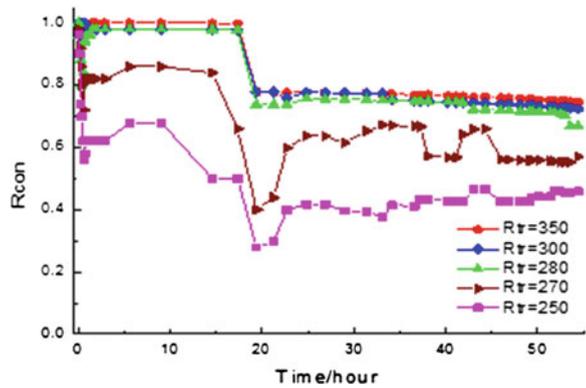


Fig. 33.2 The effect of R_{tr} with assaulting



33.5 Conclusions

This paper provides an initial finding on the dynamic reliability of Tactical Internet under tactical formations and time-varying transmission range. By simulating, variable transmission range is important element of TI reliability. To improve the reliability and optimize TI, this paper help practitioner to understand the interactions of traffic load, dynamic transmission range, available capacity, routings and reliability by sensitivity analysis.

References

1. Chuanhui L, Xinli Z, Yantao L (2008) Architecture of tactical internet. *J Nav Aeronaut Astronaut Univ* 23(1):43–48
2. Hongsheng L, Poellabauer C (2010) Balancing broadcast reliability and transmission range in VANETs. *Veh Netw Conf* 73:247–254
3. Kleinrock L, Silvester J (1978) Optimum transmission radius for packet radio networks or why six is a magic number. *Proceeding of IEEE national telecommunications conference*. Birmingham 245:431–436
4. Royer EM, Melliar PM, Moser LE (2001) An analysis of the optimum node density for Ad hoc mobile networks. *Proc IEEE Int Conf Commun Helsinki IEEE* 156:857–861
5. Jianbing M, Yuming M, Supeng L (2008) Analysis of transmission range impact on throughput performance in multi-hop wireless networks. *Appl Res Comp* 25(8):2491–2494
6. Cook JL, Ramirez-Marquez JE (2007) Reliability methods for Ad-hoc networks. *Proc Annu Reliab Maint Symp* 92:42–50
7. Kharbush S, Wang W (2007) Computing two-terminal reliability in mobile Ad hoc networks. *Wirel Commun Netw Conf* 356:2831–2836
8. Yang L, Jianping X (2011) 3D node localization scheme used in wireless sensor networks with random communication range. *Chin J Sens Actuators* 24(1):88–92
9. Xiang HH, Liu JK, Kuang JM, Wang C (2010) Analysis and simulation of connectivity of mobile Ad hoc networks in shadow fading environment. *Trans Beijing Inst Technol* 30(5):558–561
10. Goldsmith A (2007) *Wireless communications*, Beijing. People's Posts Telecommun Publ House 95:324–332
11. Cook JL, Arsenal P (2007) Capacitated reliability for Ad-hoc networks. *Reliab Maint Symp* 563:192–195
12. Zhang XM, Liu Q, Dai SF, Liu YZ (2009) Traffic load-based interference-aware routing protocol for mobile Ad hoc networks. *J Softw* 20(10):2721–2728
13. Wang X, Kang R (2011) Reliability evaluation of Tactical Internet based on cloud mobility model, *ESREL 2011*, 18–22th September. Troyes, France 438

Chapter 34

Design of Wireless Auto Monitor System on Transfusion

Jiang Ma, Shunling Chen, Yuqiao Wen, Xiaoxiao Liang,
Chonggang Wei and Jing Lan

Abstract In order to avoid the defects of the present manual monitor transfusion used in the hospital, the wireless Auto monitor system on transfusion is designed. This monitor system is consists of master station and slave station. The slave station is used to collect the transfusion data, and the master station is data processing and displaying the monitor result. The master station and slave station is connected by wireless radio frequency chip nRF24L01. This system could help the nurse checking the transfusion of each patient at the nurse workstation conveniently so that the working strength is been reduced for nurses.

Keywords Transfusion · MCU · Master station · Slave station · nRF24L01

34.1 Preface

Venous transfusion is the most common medical method at the hospital. When giving treatment by fluid therapy, usually the transfusion speed should be based on the patient's condition and the medicines used. At present, manual monitor is widely used for the venous transfusion, and the nurse will in charge of the adjusting the drip speed. If there is no nursing people or medical personnel around or they did not change the medicines or withdraw the syringe needle timely, the air will get into the blood vessel and caused air embolism or needle plugged by blood coagulation etc., which will cause treatment delay or even medical incident [1].

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Therefore, a convenient, reliable, and easy manipulated auto monitor system on transfusion is needed. The monitor system could check the whole transfusion process and send alarms automatically. And the doctors as well as the nurses could check the transfusion status of each patient clearly at the nursing work station, and make preparations for the next step in advance, which could largely reduce the work intensity of the nurse, and better serve the aim of treatment effects and service. This design could reduce the work intensity of nurse, and improve the medical safety on certain extent, which will help to improve the whole nursing level of the hospital.

34.2 The Whole System Structure

This design is composed of one master station and several slave stations. The slave station consists of transfusion data acquisition module and wireless transmission module. Except computer, the master station is mainly composed of wireless receiving module and computer interface module. Located within the ward, the transfusion data acquisition and wireless transmission module connecting with the infusion outfit, is used to collect the transfusion data and send it out. Wireless receiving module, setting along the hospital corridors appropriately, is used to receive the transfusion data. Set at the nurse workstation and connected with the wireless receiver by data wire, the computer interface and computer display module is used to process the transfusion data and display transfusion status. As the wireless radio frequency chip used for wireless transmission module for the slave station and wireless receiving module for the master station is the same-nRF24L01, they are all called wireless radio frequency module. The topological graph of this design is as Fig. 34.1 below:

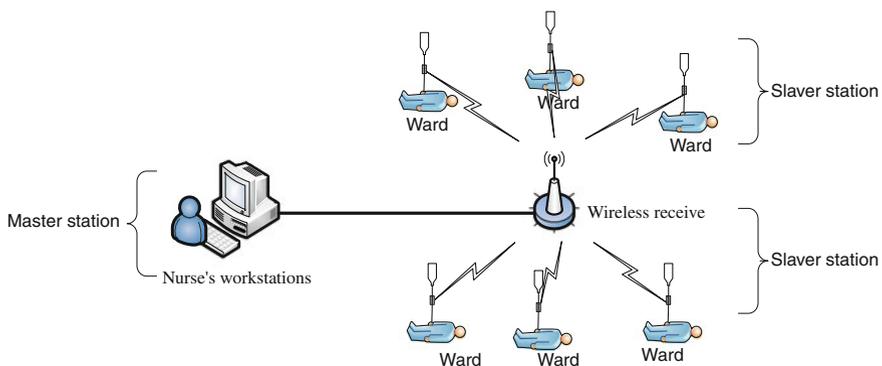


Fig. 34.1 Topological graph of auto wireless monitor system on transfusion

34.3 The Hardware Design of the System

The hardware circuit mainly consists of transfusion date acquisition module, wireless radio frequency module and computer interface module.

34.3.1 Transfusion Data Acquisition Module

Taking STC12C5206AD MCU as the core, the transfusion date acquisition module also include drop testing circuit, sound alarm circuit etc. as its periphery parts.

34.3.1.1 STC12C5206AD MCU

Since the slave station is fixed to the infusion outfit, then its size should be small and easy to be moved, which requires battery as its best electricity supplying device. While since the capacity of the battery is limited, and most of the time, transfusion is a long period, during which the slave station need to be under a long term working status, reducing the power consumption have to be considered when designing the system.

STC12C5206AD single chip microcomputer could use clock divider control register CLK_DIV to divide the clock frequency, which could help to let the single chip microcomputer working with low frequency to lower the consumption. This is why STC12C5206AD single chip microcomputer is used as the central control unit for the slave station. STC12C5206AD single chip microcomputer minor applying system is show as below in Fig. 34.2.

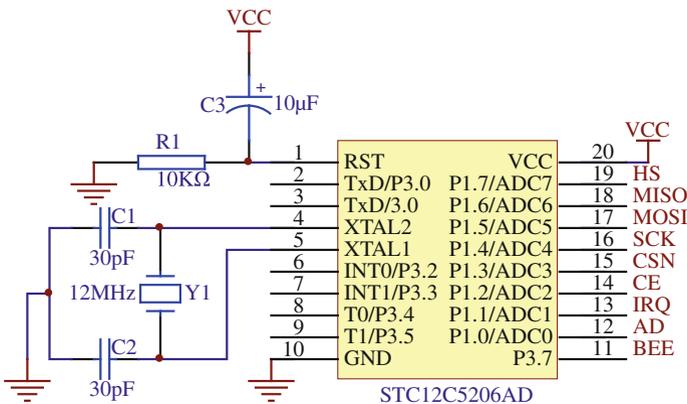


Fig. 34.2 STC12C5206AD MCU minimum application system

34.3.1.2 Droplet Detection Circuit

Photoelectric Detection Technology will be used for droplet detection. The infrared photoelectric sensors are installed on Murphy's dropper both sides, when no liquid medicine drop in the Murphy's dropper, the output current of phototransistor will be stronger with stronger light signal from infrared light, emitted from the infrared LED, by penetration of transfusion tube; when liquid medicine drop in Murphy's dropper, the output current of phototransistor will be weaker with weaker light due to absorption and scattering of light by liquid medicine [2].

This design, adopting LTH-301-32 photoelectric switch for detection of droplet, with integration infrared emitting and receiving tube can realize the function shown by Fig. 34.5. When the object blocks the infrared photoelectric sensors, the infrared light-receiving tube cannot conduct due to emitting source blocked by object, and high level will be output. The above mentioned will be adopted to judge the liquid to pass through the middle of infrared photoelectric sensors or not. Droplet detection circuit is shown as Fig. 34.3.

The real-time speed of liquid medicine and balance time of transfusion will be obtained by counting processing, each counting, i.e., each high level obtained by connection between P1.0 interface of STC12C5206AD MCU and infrared receiving tube.

34.3.1.3 The Sound Alarm Circuit

Slave station will alarm by loudspeaker when abnormal occurrence or coming completion of transfusion is in the period of transfusion. About 10 mA drive current, for piezoelectricity loudspeaker working, should be connected drive circuit due to non-availability of direct connection of MCU output signal to loudspeaker. The loudspeaker as VT3 collector load, When the VT3 conducts, the loudspeaker alarms; and when the VT3 doesn't conduct, the loudspeaker doesn't make sound, and R is current-limiting resistance. The sound alarm circuit is shown as Fig. 34.4.

Fig. 34.3 Droplet detection circuits

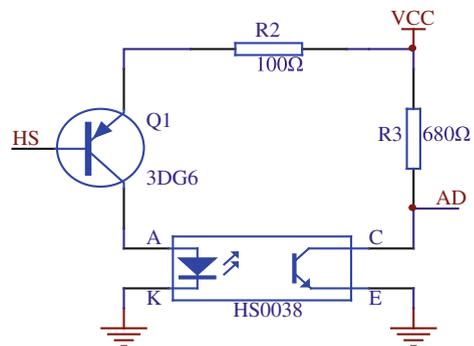
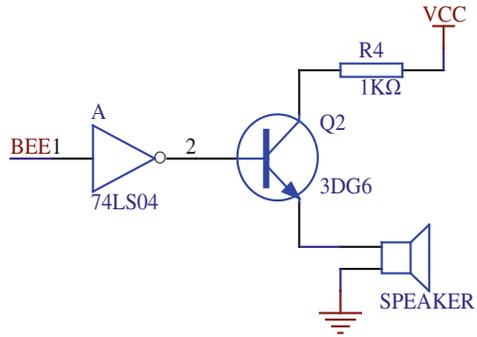


Fig. 34.4 The sound alarm circuit



34.3.2 Wireless RF Module

The nRF24L01 chip will be used for wireless data transmission module for this design, which is the new-type monolithic RF transceiver working between 2.4 and 2.5 GHz ISM frequency [3]. Wireless RF circuit of this design consists of nRF24L01 and other peripheral components, shown as Fig. 34.5.

34.3.3 Computer Interface Module

PDIUSB12 is high-performance USB interface chip, which can transfer the data signal to signal in accordance with USB protocol. If protocol processing and data exchange should be done, STC89C52RC MCU as external microprocessor will be needed to control PDIUSB12.

34.3.3.1 STC89C52RC MCU

STC89C52RC MCU possesses with the structure of FLASH, RAM, frequency divider, bit timer and counter and has the characteristics of strong encryption, indecipherability, strong anti-interference, low electromagnetic radiation, ultra low power consumption—4-7 mA in normal working pattern [4]. The minimum application system is shown as Fig. 34.6.

34.3.3.2 PDIUSB12 Drive with USB Interface Circuit

Main station connects the computer by USB. The PDIUSB12 chip of Philips Company is used for USB outer control chip, whose interface is very convenient and flexible, with characteristics of SoftConnet, Goodlink, programmable clock

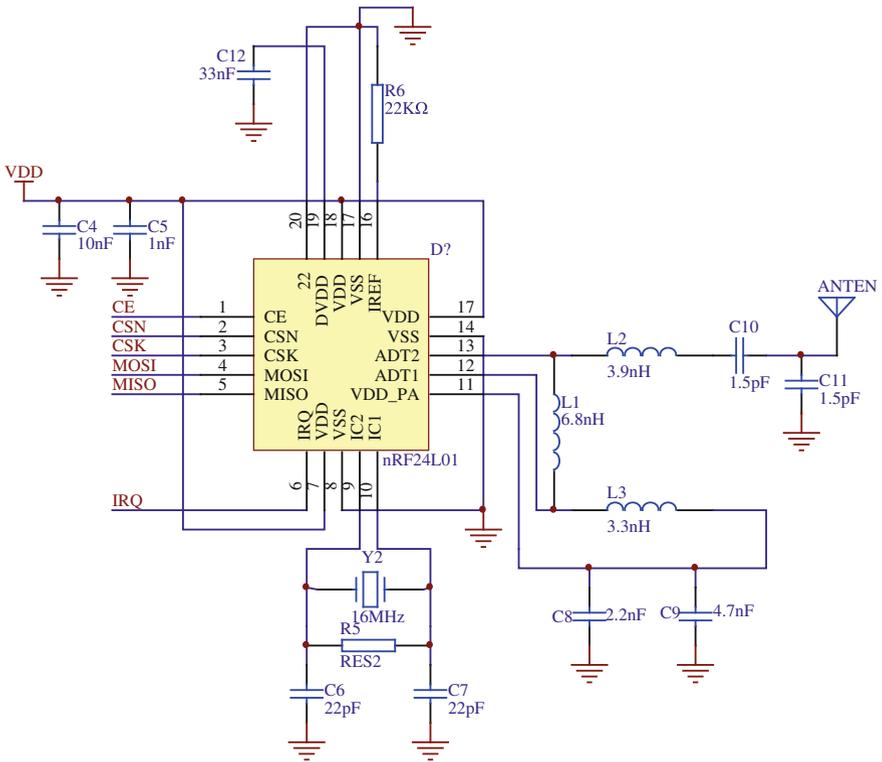
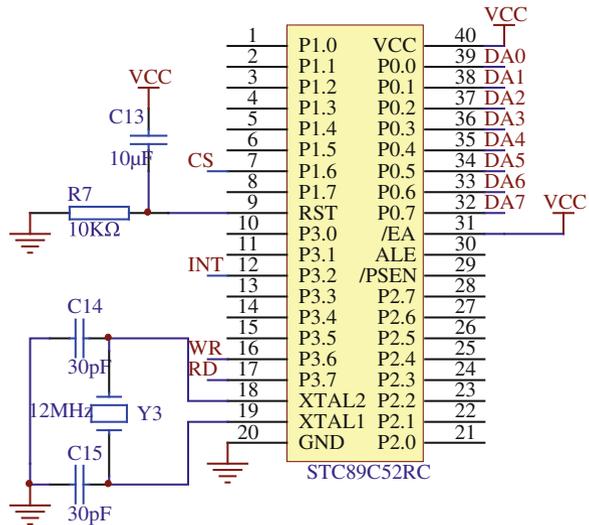


Fig. 34.5 Wireless rf circuit

Fig. 34.6 STC89C52 MCU minimum application system



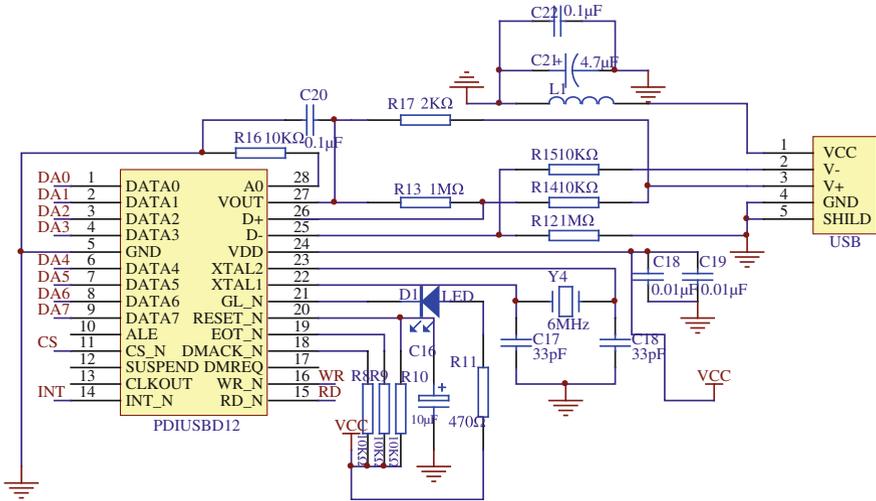


Fig. 34.7 PDIUSB12Drive with USB interface circuit

output, low frequency crystal oscillator and terminal resistance etc., the cost will be saved when the system is realized and the much advanced USB function will be easily realized on the peripheral equipment [5]. The PDIUSB12 drive with USB interface circuit is shown as Fig. 34.7. What’s more, PDIUSB12 connects the pin 2, 3 of USB connector by pin 25, 26.

34.4 System Software Design

The system software design mainly includes two parts of program design of main station and slave station MCU and display interface design of computer. The MCU program design will use C language, which adopts modulization to compile corresponding performance function group mainly inclusive of droplet numbers detection function group, sound alarm function group, wireless transmission function group, wireless receiving function group, PDIUSB12 control function group. Program of display interface of computer is mainly used for human-computer interaction by adopting MFC for design. Microsoft Office Access is selected as development tools, when transfusion information management system created, for database design. Display interface of computer of this design is shown as Fig. 34.8.

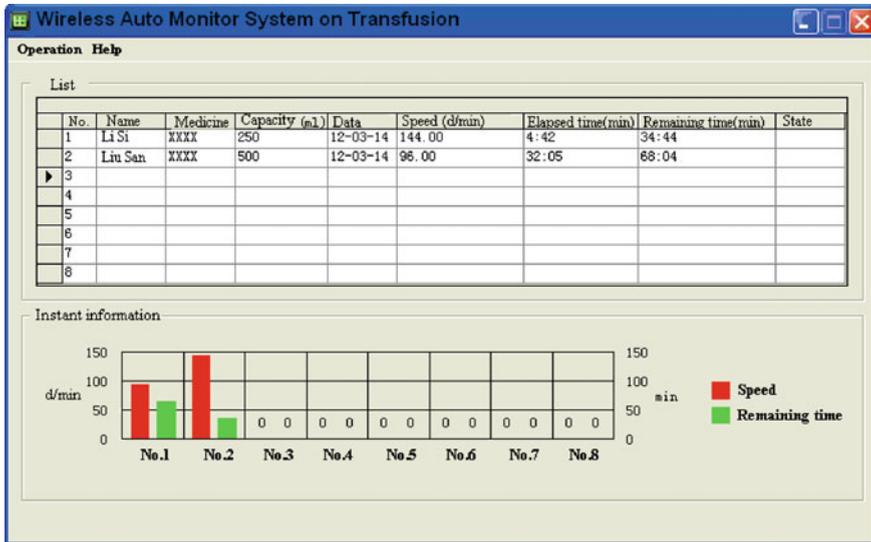


Fig. 34.8 Display interface of computer

34.5 Conclusions

MCU is the core of design of wireless auto monitor system on transfusion, which includes hardware and software design. Wireless auto monitor system on transfusion can realize the function of droplet-speed display, abnormal transfusion alarm, coming transfusion completion warning, as well as real-time detection and monitoring during the transfusion to relieve from pain of patient and to reduce the amount of work of doctors and nurses for improving work efficiency and for effectively reducing rate of medical accidents.

Acknowledgments Key scientific and technological projects of ZiGong city key scientific and technological projects of ZiGong city (Project No.:10J02)

References

- Huilong D, Xudong L (2004) The current status and trend of the medical information system. China Med Dev Inf 10:1–6
- Minli Y, Tong W, Yanling H (2007) Design of a transfusion speed monitor based on infrared technology. Laser Infrared 37(10):1095–1097
- Wenyan H, Ming-hua J (2011) Wireless environment monitoring system based on DSP and nRF24L01. Microcontrollers Embed Syst 3:51–54
- Xinghui Z, Shouman C (2011) Design of wireless calling system based on STC89C52RC. Mod Electr Tech 13:186–188
- Junbo C, Hai-hua L, Yaguang C (2002) USB interface device Pdiusb12 and its application. Int Electr Elements 11:47–49

Chapter 35

A Correlation Analysis Method for Network Security Events

He Wei

Abstract In order to solve the issues that there are high false alarms and missed alarm rate existing in single network security equipment, this paper proposed alert events correlation algorithm based on attributes similarity, which is the application of clustering algorithm, with measuring the similarity of properties. In accordance with the character of different clustering methods, this method achieves the correlation for the alarm event.

Keywords Correlation analysis · Network security · Similarity · Attributes similarity correlation

35.1 Introduction

With the rapid development of computer technologies and internet technologies, the applications of network are developing and strengthening [1]. Internet has brought us great convenience. Secure network has become foundation of the country's political, economic and military security, and also has placed important impact on people's life and commerce [2, 3]. However, network security has become more and more sensitive and important. The internet is suffering from a growing number of security threats. At present, attack techniques takes on the characteristics of complicatedness, covertness and distribution, and firewall technology, intrusion detection systems and vulnerability scanning technology have been used to discover and resist the attacks [4]. Yet, most of the security device

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will not only generate massive duplication of alarm, but also difficult to provide the correlation between the different alarms [5, 6]. The network security management faces three major issues: the huge amount of security alert data, redundancy and false positives. So it is necessary to apply alert correlation methods to correlate these data, mine the essential relationships between alerts and discover the latent attack intentions effectively [7]. This paper proposed alert events correlation algorithm, based on attributes similarity, to solve the issues that there are high false alarms and missed alarm rate existing in single network security equipment. This algorithm is the application of clustering algorithm, with measuring the similarity of properties, we can decide the clusters, and we also design an algorithm to measure the similarity of the new event and the overall cluster [8]. Finally, we put forward an event correlation model according to the events correlation algorithm.

35.2 The Status of Network Security

35.2.1 Security Threat Becoming More Serious

With the construction of network infrastructure and Internet penetration, Network security threats becoming more serious. The damage of security threats shows an increasing trend.

Endless attacks occur everywhere on the internet, and become worse and worse.2) with the complexity of computer systems, more and more system vulnerabilities emerge and lead to more risk.3) Many threat technologies are integrated, especially the integration between the Virus technology and hacker technology, which make the attack become more harmful.

35.2.2 Common Network Security Technology

Firewall technology. Firewall technology is special networking equipment used to strengthen the access control between the networks to prevent the external network users to enter the internal network through an external network with illegal means and access to internal network resources, thus to protect the internal network operating environment.

Intrusion detection system intrusion detection technology is a network security technology to initiatively protect themselves from attacks. As a reasonable supplement of the firewall, intrusion detection technology can provide real-time protection for internal attacks, external attacks and misuse, which is to collect information from a number of key points in computer network system and analyze them to timely intercept and respond before the network system being endangered.

Virtual private network technology VPN-Virtual Private Network is the expansion of a private network in a public network such as the Internet. VPN is to simulate a special line on the public networks through the private tunnel, so as to achieve the purpose of secure data transmission.

Data encryption technology compared with the firewall technology, data encryption technology is more flexible, more suitable for open network. Data encryption is mainly used for dynamic information protection.

Anti-virus technology in all computer security threats, computer viruses are more serious, which not only have a high frequency of occurrence, large loss, but also have strong latency and wide covering ranges

These products protect the security of networks from different aspects. Because of the defect of the security products, it can not protect the overall network only relying on accumulation of the products.

35.3 Correlation Analysis

Correlation analysis is useful for determining the direction and strength of a relationship between two variables. In the processing of handling the security events, correlation analysis refers to excavate inter-relationship among security information (such as: logs, alarms et al.) to generate effective security events, assess these security events and provide technical reference for network management.

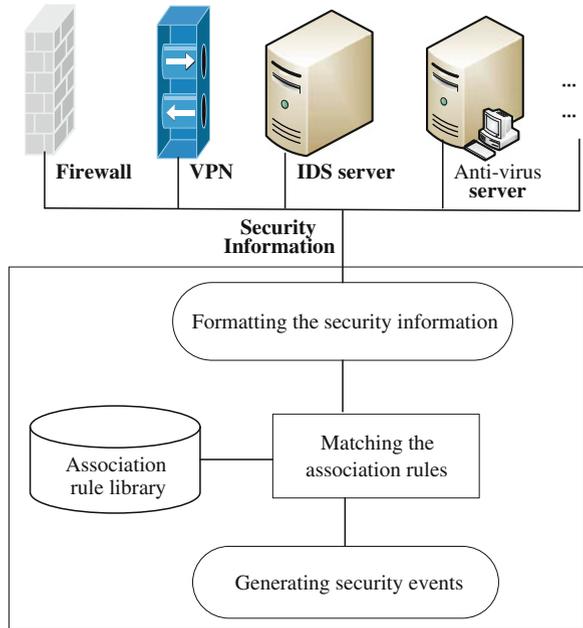
35.3.1 Classification of Correlation Analysis

There are two classifications commonly used. One classification method is based on data sources; the other is based on correlation method. Based on data sources, correlation analysis can be divided into single data source and multiple data sources correlation analysis. Based on correlation method, correlation analysis can be divided into sequence of events and heuristic algorithm correlation analysis.

35.3.2 The Processes of Correlation Analysis

The correlation analysis can be divided into three parts, namely: (1) Formatting the security information; (2) Matching the correlation rules; (3) Generating security events. The framework of the correlation analysis is described in Fig. 35.1.

Fig. 35.1 The framework of the correlation analysis



35.4 Correlation Analysis Algorithm Based on Attribute Similarity

Through the analysis of the network behavior, we can find that the change of security events is with a certain continuity and similarity, so we can polymerize the alarms according to the similarity of them to compress the amount of alarm. This algorithm is proposed based on the idea, and it can improve the analysis efficiency of network administrator. Alarm similarity identified by the similarity of the characteristic attributes to measure includes the definition of the attribute similarity function, alarm similarity measure, alarm and clustering the overall similarity measure. Where, the attribute includes Source IP, source port, destination IP, destination port, BuGTRAQ_ID and time properties. The algorithm is described as follows. We calculate the similarity of each attribute firstly, and the result ranges [0, 1]. The bigger the value, the higher the similarity is. “0” denotes no similarity, “1” denotes completely similar. And then calculate the similarity between the alarms according to the pre-defined alarm similarity formula. Finally, calculates the similarity between the alarm and overall clustering using the method exponential moving average method.

The definition of the attribute similarity function

IP address: set the $add_1.add_2.add_3.add_4$ stand for the IP address, and each field can be mapped into a binary representation. Compare two alarm information, the corresponding fields were calculated similarity, and then calculate the IP overall similarity. The formula is as follows.

$$S(field) = \frac{\overset{\circ}{a} \text{ the same bit}}{\text{the total number of bit}} \tag{35.1}$$

$$S(IP) = \frac{\overset{\circ}{a}_{i=1}^4 (s_i * a_i)}{\overset{\circ}{a}_{i=1}^4 s_i} \tag{35.2}$$

Where a_i stands for the i th field σ_i stands for the weight of i th field. Because the high bit is more important, so we assigned weights “4”, “3”, “2”, “1” for a_1, a_2, a_3, a_4 respectively.

Port: The similarity is calculated as follows:

$$S(port) = \begin{cases} \frac{10 - |X_p - Y_p|}{10}, (|X_p - Y_p| \leq 10) \\ 0 (|X_p - Y_p| > 10) \end{cases} \tag{35.3}$$

Where X_p, Y_p denote the value of the port.

Time: in the continuous attacks, time has certain coherence. Especially for a variety of DOS attack and scan attack, time distribution density is concentrated, so the similarity of time is calculated as follows:

$$S(time) = \begin{cases} \frac{1 - |X_t - Y_t|}{\tau}, (|X_t - Y_t| \leq \tau) \\ 0 (|X_t - Y_t| > \tau) \end{cases} \tag{35.4}$$

Where τ denotes the threshold of time. We only calculate time similarity within τ . X_t, Y_t denote the time of event X, Y. $S(time)$ denotes the time similarity and its value ranges between 0 and 1.

Calculate the similarity between the events.

The formula used to calculate the similarity between the events is as follow.

$$S(X, Y) = \frac{\overset{\circ}{a}_{f=1}^p w^{(f)} SIM_{ij}^{(f)}}{\overset{\circ}{a}_{f=1}^p w^{(f)}} \tag{35.5}$$

Where, $w^{(f)}$ denotes the weight of the attribute f, and its value is “1”, “2”, “3”, “4”, “5”; $SIM_{ij}^{(f)}$ denotes the similarity of f of the events X, Y; p denotes the number of attribute.

The formula used to calculate the similarity between the events and the corresponding cluster is as follow.

$$S(X, C) = a * S(old) + (1 - a) * S(X, Y) \tag{35.6}$$

Where, $S(old)$ stands for the similarity of existing cluster; $S(X, Y)$ stands for the similarity between new event and recent alarm in cluster and a denotes weight parameter.

The pseudo code of the correlation algorithm is described as follow.

Correlation Algorithm

Global variable: match log _list, directive _list

Correlation (event)

```

{
    For each match log in match log _list
    {
        For each child _node in match log.current _node.children
        {
            If match (child _node, event)
            {
                Append alert to match log's event _list;
                Set match log's last _time as now;
                Match log.current _node = child _node;
                If child _node is leaf
                Match log.matched = true;
                Break;
            }
        }
    }
    For each directive in directive _list
    {
        If match (directive _root, alert)
        {
            Create a match log object with directive;
            Set match log's variable correctly (alert _list, etc.);
            Append match log to match log _list;
        }
    }
}

```

The process of correlation analysis algorithm based on attribute similarity shows in Fig. 35.2.

35.5 The Correlation Algorithm for Severity Event Sorting

The algorithm can get weight value for the security event. This value reflects the security threat level and it combine the follow information: the probability of

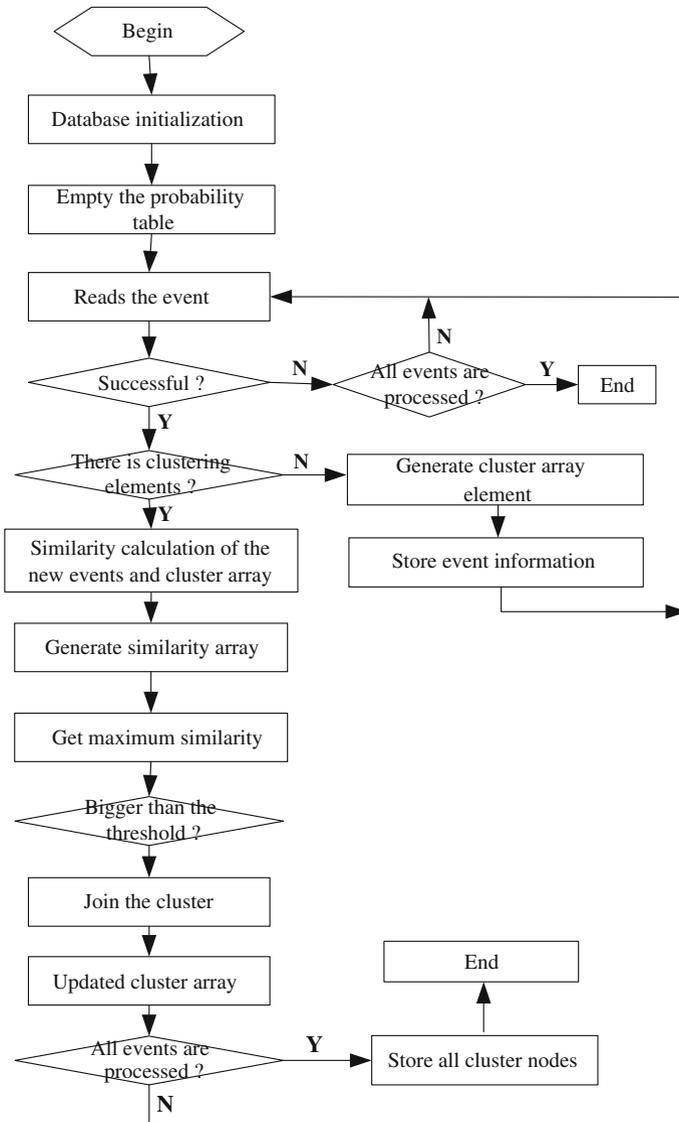


Fig. 35.2 The process of correlation analysis

successful attack, the importance of target asset and priority of security event. The algorithm can be described as follows.

Input: a security event;

Output: a weight value *Alert_weight*.

We can calculate the weight value as the assessment results according to the formula:

$$Alert_weight = \frac{d_1 * reliability + d_2 * priority + d_3 * asset}{d_4} (d_i > 0, i = 1, 2, 3, 4) \quad (35.7)$$

Where *reliability* stands for the probability of successful attack, and the value ranges between 0 and 1, “1” denotes success, “0” denotes the alarm is no useful. *asset* It stands for the importance of target asset. It is the inherent value of assets and doesn’t matter to attack. The value ranges between 0 and 10. *priority* Reflects users concern degree and attack severity of security event, and the value of $\delta_1, \delta_2, \delta_3$ are “1”, “1”, “1”. The calculation process is described as follow.

Get the alarm event from the list;

Scan the target host and get the vulnerability information and host information, such as so, port, service, application and version;

Calculate *reliability*, *asset* and *priority* according to bays Network.

Calculate the *Alert_weight* according to *reliability*, *asset* and *priority*;

Sort the alarm event according to *Alert_weight*.

35.6 Conclusions

Correlation analysis for security events have become a hot topic and research focus in the security field. This paper, with the goal of centralizing management of network security events, identifying real threats real-time, reducing false alarm rate and improving the detection accuracy, proposed alert events correlation algorithm based on attributes similarity, introduced the attribute similarity function and the process of correlation analysis in details.

References

1. Yong W, Huihua Y, et al (2004) Distributed intrusion detection system based on data fusion method. Proceedings of the 5th world congress on intelligence control and automation, vol 25. Hangzhou, China, pp 256–257
2. Wenhui X, Kaiyong ZB, Wang B (2010) On network security event correlation analysis and active response mechanism. *Comp Appl Softw* 4:25–26
3. Kruegel C, Robertson W (2004) Alert verification: determining the success of intrusion attempts. *Proc First Workshop Detect Intrusions Malware Vulnerability Assess* 4:378–395
4. Jian G, Haibin M, Yong D, Dehao W (2005) Multi-feature correlation redundance elimination of intrusion event. *J Southeast Univ (Nat Sci Edition)* 03:56–58
5. Wei L (2008) Knowledge representation and correlation analysis of the security incidents in a complex Network. *Environment* 12:54–59
6. Zheng-ping H, Feng-juan C, Rong-sheng X (2006) Research and application of network security information correlation technology. *Appl Res Comp* 54:10–14

7. Julisch K (2003) Clustering intrusion detection alarm's to support root cause analysis. *ACM Trans Inf Syst Sec* 6(4):443–471
8. Xiang Z, Chang-zhen H, Wei Y (2007) Research of network threat analysis technique based on event correlation. *Comp Eng Appl* 524:04

Chapter 36

Research on Mode of English Teaching and Learning Based on Multimedia Network

Shan Chang

Abstract English autonomous learning mode based on multimedia network is a network resources platform, students actively constructing knowledge model. The model's main purpose is to play the main part of college students, to make the learners to actually acquire knowledge, in this mode, the student through teacher's modest lead and monitor, use of network resources suitable for learning needs and characteristics of the creative ways of learning. Based on multimedia network of independent learning English with traditional classroom teaching compared, can obtain better learning effect, in addition, multimedia network of autonomous learning and the combination of classroom teaching model can get the best learning effect.

Keywords Multimedia network resources · Autonomous learning · Classroom teaching

36.1 Introduction

As we know, in the traditional teaching method, students and the communication between teachers are simple and the students' cognitive and accept the effect not beautiful [1, 2]. Modern multimedia teaching broke the traditional teaching mode, it USES the multimedia equipment will focus on the many kinds of teaching media at an organic whole, by the teacher according to different requirements of class, flexible use of related media teaching practice activities [3]. The multimedia

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teaching make full use of the diversity of audio and video files, and make the teaching activity with more fun, in the teaching the students were feeling, get the stimulation of various learning excitement, so that can enhance their learning interest and enthusiasm, and greatly improve the quality of teaching [4]. In English teaching, if we can reasonable, timely to use computer multimedia teaching systems, and making practical strong courseware, and give full play to the teacher's leading role, exert the students' subjectivity and creativity, can create vivid English learning environment, help students deeply perceive English language material, the development of listening and speaking skills, in order to make students get basic knowledge of English at the same time, train their integrated language skills, training students' direct to think in English and the habit of expression [5, 6].

Western modernism and postmodernism art art collectively referred to as the western modern art, western modernist art is in the negative traditional norms set and habits know developed on the basis of, postmodern art practice activities designed to break the boundaries of art and life. The beginning of the twentieth century, the western art atmosphere began to change, and gradually formed a share from the trend of the realism. Most scholars believe that the trend from Cezanne and impressionism after beginning, which has experienced by Matisse, as a representative of the beast pie, with Picasso as a representative of cubism, kandinsky, as a representative of the abstract art school, etc. "From the theory is clearly impressionist standard broke traditional a little perspective.

36.2 The Importance of Multimedia in English Teaching

The multimedia teaching model in English knowledge and express application can play a unique role, such as through the pictures or video way, has the scene is lifelike, close to life, smooth and natural language etc., and this will cause the student to study English the contents have strong interest, make its active use English vocabulary and the structure of language knowledge, to the picture, speech and expression method tone to imitate.

The multimedia courseware rich content, form and lively, provides figure, voice, text, as with language learning objects and the various forms of exercise tool, fully mobilize students' eyes, ears, mouth, hand and so on many kinds of senses work together, so that the students can better build a strong perceptual knowledge base, fully mobilize students' English learning initiative, active the student thought, completely broke traditional jug-and-mug teaching model, make learners from passive learning into active learning. At the same time, through a variety of the interaction of the multimedia tools, formed the students as the center of the multidimensional information space, in this process, the students will feel the image of the knowledge, true, and interest, thus stimulates the student to interest in learning English.

Grace ohaim in the art and the visual perception of art to the definition which is this: the essence of art is that it is a concept and idea of the substance of the unity of appeared. Here said the idea, that is, for objects in the consciousness of the emotional expressivity and overall understanding thoughts significance, etc. The idea of material appeared, it is to point to an artist with a substance used to select media performance this whole grasp of the structure of the form. Unity is to point to this form structure itself should not be realistic material bound, and should contain consciousness of the overall assurance sufficient to perform the style of the force. That idea and concept of material should be done with the form of heterogeneous appeared. The meaning of art required to present this significance structure and the style of the structure to achieve consistent between. This consistency, aesthetic psychology is called with form sex. Here, refers to the artistic creation abandon the real details, the direct expression of the integrity and essential things. Grace ohaim thinks, a worthy of the name must meet art two conditions: first, it must be strictly and real world separation.

36.3 English Autonomous Learning Mode Based on Multimedia Network

Since the 1960s, western educators began to advocate developing learners' autonomy as the ultimate goal of education, Holec will "autonomy" this concept is introduced in English teaching, and considered that the autonomous learning is to study the learners responsible for ability, multimedia network education technology extensive application for the student to realize the independent study provides tremendous may. Figure 36.1 for multimedia autonomous learning in comprehensive English study, training comprehensive utilization ability roles.

All-round experience of English society and culture and realize the interest to learn. And the students' language development and communication ability, the optimization classroom structure, raise review efficiency. Multimedia technology from the function, characteristics and the teaching of English law, the use of multimedia technology is a kind of active teaching mode, it changed the classroom of the inherent mode, to English class teaching new vitality into, be helpful for complete manifests English communicative language teaching principle. Based on computer multimedia technology and the quick development of the Internet, make the computer aided teaching in the classroom become inevitable, it will be through the entire process of English teaching and will become the main teaching means and methods. At the same time, to the traditional English teaching methods possible problems, and multimedia teaching method under the network environment of the discussion is very important.

In addition, our recent 500 university students to carry on the investigation, which in the extracurricular network multimedia autonomous learning for the data, such as Table 36.1 shows.

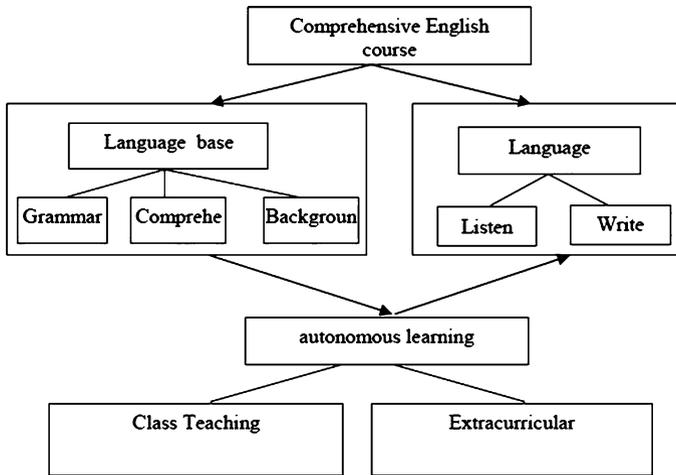


Fig. 36.1 The role multimedia autonomous learning in comprehensive English learning

36.4 The Combination Mode of Independent Study and Classroom Teaching

Multimedia network application in English teaching, the requirements for teachers higher than traditional teach, teachers should be familiar to the teaching content, and application of multimedia network technology is skilled, constantly updating the teaching concept and method and so on. On the other hand, students of new ways of learning should have a correct understanding of the form to get rid of the previous everything by the classroom knowledge, and out of the classroom at a loss of passive accept the habit of knowledge. Therefore, we proposed the student under the teacher guidance of autonomous learning and the combination of classroom teaching mode, independent study focusing on students listening skills and language learning strategy training, classroom teaching in oral English is to give priority to. Autonomous learns and the combination of classroom teaching model shown in Fig. 36.2.

Table 36.1 Table of multimedia autonomous learning student performance

Question	Very good (%)	Good (%)	General (%)	Bad (%)
The independent learning ability, and their calculation for autonomous learning	17	26	31	26
Can seriously preview, review the teacher assigned homework	11	46	23	22
Can finish and submit assignments	26	45	21	8
Self assessment and adjustment to extracurricular independent study plan	8	23	43	26

The whole model is divided into teaching system, learning resource and management system three plates. Teaching system to each network course as a support, the students on-line learning, submit assignments, teacher on-line instruction, upload teaching courseware, decorate learning tasks. In the network teacher and students in classroom teaching, students and students to interact and consultation, and through the channels have BBS, BBS, E-mail, through this channel, the teacher can in time of student learning feedback, solve the independent study study problems, in a period after the online testing, inspection study circumstance. Learning is illustrated in a resource, set listening, speaking, reading and writing in one of the multimedia resources, and the teachers and students to build costs. Management system has student online learning records, students' log, evaluate feedback system. One online learning record including learns time, the process of learning, learning accuracy, etc.

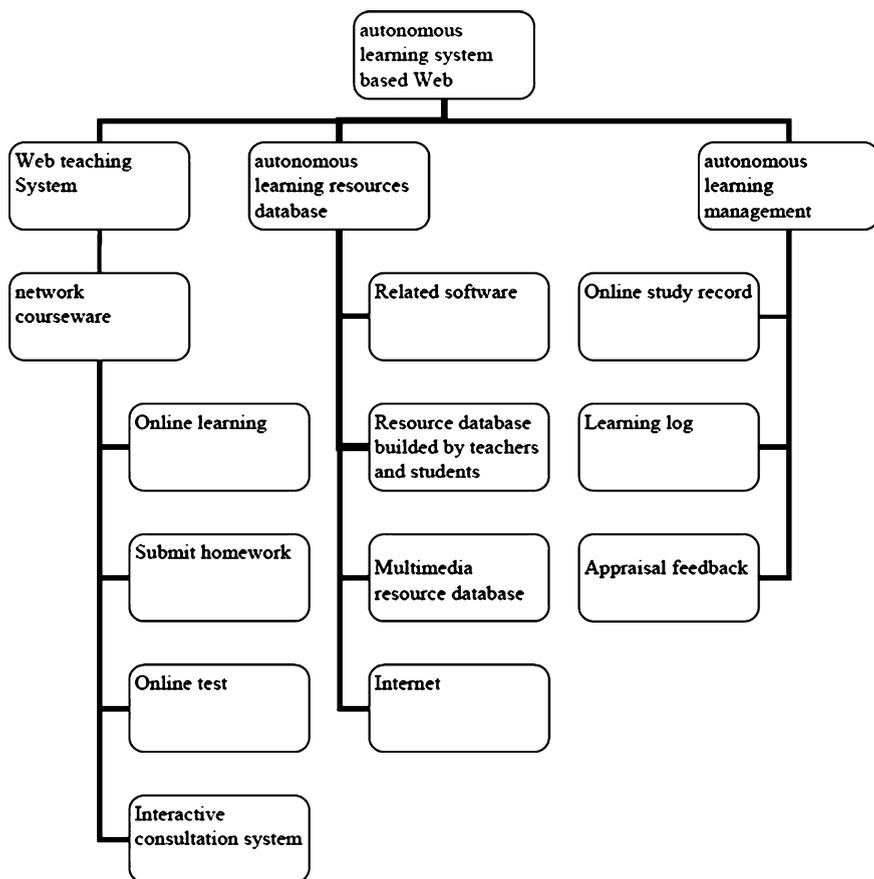


Fig. 36.2 Mode of combination of autonomous learning and teaching

Table 36.2 Investigation combined mode autonomous learning and teaching

Question	Agree (%)	Disagree (%)
For multimedia autonomous learning feel comfortable	65	35
Think self-study and multimedia classroom teaching than the traditional teaching mode	77	23
Autonomous learning to a great help	83	17
Multimedia classroom teaching mode of self-study and improving his interest in learning English	81	19

Table 36.2 is the investigation of middle school students' independent learning and class teaching pattern combined with approval of the situation of the data in the table, it is known that the student to study independently and class teaching of combining the teaching pattern held a positive attitude, compared with the traditional teaching mode, and welcome new teaching mode.

About the function of art, grace, haim think: art high reputation is that it can help mankind to know the outside world and itself, it in the human eye present before it can understand or believe that is the real thing. In his view, the function of art is that it is human a way of understanding the world, and from the Angle of understanding and believe to understanding the world, that is, from the point of view of the subjective to understanding the world. To grasp the art world with scientific understanding the world has its common: that is is an abstract, but the scientific theory of the law is with abstract, and art is with the abstract structure rules. This structure rules is a force structure rule. Thus, the grasp of the art of the world, in fact, a kind of music type discussed. The force of the structure by direction and the strength which will have a rise and fall, the weak and strong, forward and backward fundamental key, thus make it has emotional expressivity. At the same time, the music type discussion is also a kind of to the world of the grasp of the emotion. And this kind of emotional grasp and is different from the ordinary pleasant sensation, often contain some kind of moral and religious significance. Based on network English interactive learning mode is a network resources platform, student's actively constructing knowledge model. This model is the idea of constructing, learners to actually acquire knowledge, not only through teacher's classroom transmission, and should make full use of necessary resources of learning, students will play a main role, lets the student with other people or machines consultation, communication and cooperation.

36.5 Conclusions

This paper discusses the traditional teaching method, students and the communication between teachers is simple, and the students' cognitive and accept the effect not beautiful, defects, analyzes the multimedia teaching in the students interest in

learning English, and other aspects of the importance, and is given based on multimedia network English autonomous learning mode, finally proposes the autonomous learning and the combination of classroom teaching mode of teaching, and gives the students of the model of the satisfaction of data. The data show that compared with the traditional teaches mode, the new teaching pattern is more popular with the students, and improves the learning interest of the students.

References

1. Zhu G (1984) The history of western aesthetics. People's Lit Publ House 1:152-159
2. Zhu D (1984) The contemporary western aesthetics. People's Publ House 1:259-268
3. Ci G (1985) The Yankees. Artist Psychol 14:587-592
4. Gao N (1988) The artistic psychology. Liaoning People's Publ House 25:789-793
5. Tong QB (1993) Modern psychology aesthetics, vol 1. China social science press, China, pp 563-577
6. Yin S (1997) Some problems of acceptance aesthetics, vol. 2. Fudan University Press, Fudan, pp 478-489

Chapter 37

Research of Ideological and Political Education in Independent Colleges Under Network Environment

Jianming Lu, Jinping Wang and Yingzhong Li

Abstract With the development of the independent college network and growth, network of independent college ideological and political education is faced with many new problems. To make independent institute of ideological and political education out of difficulties, we must go socialization, the way of the network, the government, society, school together, make full use of network resources to improve the ideological and political education of the independent college effect.

Keywords Independent college · Ideological and political education · Network

37.1 Introduction

From the 1990s began, the network (in this paper refers to the international INTERNET INTERNET) in China skip-type development, the number of INTERNET users every year there is a big growth, according to CNNIC (China INTERNET network information center) of the 27th China INTERNET network development state statistic report shows that by the end of December, 2010, the scale of users reached 457 million, INTERNET penetration rate climbed to 34.3 %, China's mobile phone users size of 303 million. Along with the network of development, China's higher education in the century began to leapfrog development, and there is a new mode of running school-independent institute. In only a few years, the development speed of the independent institute in China with the development of the network at the same rate as astonishing, "by the end of 2009,

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China had had independent college students and 322 of 2.414 million, accounting for the run by 54.1 % of the total number of ordinary university students, among them, the independent college undergraduate 2.19 million, accounting for 86.7 % of the total number of undergraduate students run by” [1]. Can say, independent institute of higher education in our country has become an important power. Independent institute of development cannot leave the network times this era background, independent institute of business management, political education work under the network environment was in trouble. How to capture network ideological and political education new positions, eliminate network of independent college student’s harmful influence has become education workers and even the whole society must face the problem.

37.2 The Status of Ideological and Political Education in Independent College

37.2.1 The Status of Education Behavior

37.2.1.1 The Attention Lack of the Colleges

Independent college is a private property of university, the benefit is the independent institute and managers of the biggest target pursuit. This led to the independent institute for students in education emphasizing professional quality improvement and enhancement of the ability; because these qualities can help students improve employment competitive, so as to improve the school the prestige, promote the school performance. And not to the school has immediate benefits of the ideological and political education effect is gradually being marginalized.

37.2.1.2 Poor in the Theory Course Teaching Effect in Ideological and Political Education

Ideological and political course is college ideological and political education of college students, serve as the main channel is “help students establish correct world outlook, the outlook on life and values of the important way” [2]. However in the independent institute, ideological and political theory course role of main channel of severely weakened, the effect is little. Independent college students in the survey, we found that their ideological and political theory course of general lack of interest, the ideological and political theory course are often their lowest satisfaction course, thought politics theory class teacher always is also their satisfaction of the lowest group of teachers. Ideological and political theory course of lecture also often is in a mess, the cut, who for all students, LiaoTianZhe, the sleep, see the other books, make a phone call, the.

37.2.1.3 Poor Inn Daily Education Effect

Student worker department, counselors and teacher in charge through the daily management to the student's political consciousness, moral consciousness the penetration of the ideological and political education of colleges and universities one of the important means. However, in most of the independent college, this way is endless also and the results are satisfactory. In order to save the cost of running, of the independent college teachers strength depends heavily on maternal school teacher, administrative department staff is also cut, cut again, but also there are parts of the independent college is not professional counselor. To students of the daily management of the more depend on the teacher in charge, and most are each professional teacher teaching full-time teachers, they more is to the student for professional guidance, for ideological and political education of passion and ability is to be raised.

37.2.2 The Status of Political Consciousness and Moral Consciousness of the Independent College Students

In today's the kinds of conflicts highlights of the social transition, the general public's political consciousness, moral consciousness to the direction of the diversified development, the contradictions and conflicts is very significant. These fields of ideology and conflicts through various channels to penetrate to the independent college campus, independent of the university students political consciousness and moral consciousness worrying.

37.2.2.1 Lost and Conflict of Political Participation Enthusiasm and Political Beliefs

During the investigation, we found that of the independent college students has strong political participation enthusiasm, patriotic passion high, CARES about the country and national events and to the country's powerful, the revival of the national gradually and felt proud, many students also willing to actively participate in political activities. But with their positive political participation enthusiasm of the corresponding political belief is lost, and this is the current ideological and political education independent colleges facing the most serious problem. Many of the independent college students to our country the mainstream ideology attitude tendency to fade, on the communist beliefs not firm, even there are a lot of students in a state of no religion. They learn marxist theory, Mao zedong thought and the Chinese characteristic socialism theory system of theory initiative is not enough, and when these theories hold a skeptical. Many students to pursue party membership, but party and not pure motives, a lot of people is for the purpose of

pursuing party and utilitarian, really with on the communist noble beliefs and not many people joined the party.

37.2.2.2 The Apart of Personal Ideal and Social Ideal

Undeniable, of the independent college students is also ideals have the pursuit of the teenagers. But they in the ideal faith issues relatively narrow field of vision. Face the increasingly severe employment situation, in obtain employment competition in an inferior independent college students more limited in the ideal of personal ideal, or even just located in the find a satisfactory job. They can't realize personal ideal only in society under the guidance of the ideal to better implementation, can't realize the ideal and the social individual only ideal combined, the initiative to assume the construction of socialism with Chinese characteristics and realizing the great rejuvenation of the historical mission, personal ideal will have the deep social base and the lasting vitality.

37.2.2.3 Deviating from Moral Cognition and Moral Behavior

In the moral cognition on look, of the independent college students as part of the contemporary college students groups, their cognitive level is relatively high, identification of people's behavior moral binding, often exists in the society to various phenomena in moral judgment, to pose as moral models. Many students to speak of moral presentation, but one to action, is looking for an excuse to push to take off, although they appreciate the noble, but and don't want to have a noble, in favor of the heroic, greatly, but can't convert it into their own action. In daily study life, they heavy intelligent development, light moral accomplishment; Utility, light virtue; Heavy enjoy, light struggle. These erroneous ideas to make all kinds of moral misconduct often upon them appear.

37.3 Negative Influence of Political and Moral Consciousness on the Network Behavior of Independent College Students

In the network of mainstream ideology still accounts for mainstream position, but it "as a multimedia information tools, with a strong consumption and entertainment function, which has greatly stimulate the mass culture is complicated, it for political culture, the construction of the elite culture have digestion role." As a highly networked generation, of the independent college students have the network as its daily life is an important part of their political consciousness, moral consciousness also because this resolution by the impact of the unprecedented role [3].

37.3.1 Negative Effect

37.3.1.1 The Influence of the Information Network

According to CNNIC survey data indicate that the current university students' network behavior to leisure entertainment as the main purpose, music, network news network, instant communication, network video, search engine, E-mail, online games, BBS etc. is their main network application forms. In addition, developed in recent years to blog, social networking sites and so on also gradually get their favor. As part of the university student group, of the independent college students' network behavior preference and general college students and there is no big differences, they use the Internet also has very strong leisure entertainment tendency.

We in the independent college students to the regular use of the network application form survey found, they often browse web sites such as Sina, Netease, Sohu, Tencent, etc., they commonly used software like a storm, QVOD video, the thunderbolt, UUSEE, contains a lot of bad information. These bad information can be roughly divided into the following several kinds: the first kind is in the social dark side especially government corruption of news information. The information to a large number of the existence of world outlook, values are in the formation of college students have great misled effect, make them to the party and government have not trust, and the society are disappointed, produce QiuFu revenge and hostile to the social psychology, and then to the mainstream values suspicion. This state is very easy to be used by western anti-china forces, to educate them the marxist concept of value, eventually lead to their political beliefs lost, values chaos. The second is related to pornography information. The spread of pornography information has been a persistent ailment of the network, China in recent years has increased the porn sites, and content of the rectification dynamics and made brilliant achievement, but it is undeniable that the kind of information in network still present in large amounts in the extremely easily to get it. Even in such as Sina, Netease, Sohu this kind of formal portal sites, with sex, sex for selling point as the contents and found in large, college students in contact with this kind of information, appear easily psychological barriers and lead to act out of control. The third is the information involving violence. The information in the network news, network video, network game in a large exist, these information on college students' growth also bring immeasurable negative effect. A fourth is containing the wrong political tendency of information.

37.3.1.2 Influence of Network Occult

Since the date of the network popularization, the network moral question becomes one of the focuses of public concern. Because the network peculiar to the occult, users of the Internet anonymous exists, the traditional social moral constraint

forces in the middle of the network in intangible resolution, users of behavior not ethical effective constraint. The requirements of the network moral, is a “self-supervision” is the characteristic of moral self-discipline. Such moral requirements for is in world outlook, the outlook on life, morality in the process of the formation of the independent college students is difficult to achieve. As a special group of college students, of the independent college students on the overall than normal universities and colleges of undergraduate course of college students of self-control worse, to resist the temptation of more weak ability, the moral constraint force after weakening, their network behavior more easy to lose control, leading to the emergence of network loss DE behavior, even someone so become criminals.

37.3.2 Influence of Internet Addiction

Of the independent college students to use the network are so common, Shang-WangLv almost 100 %, because their self-control is weak, the Internet is more also. Part of students because of long time in the man-machine dialogue in the state, and social and others relationship is weakened. They long time in the virtual environment roaming, to their physical and mental health brought about many negative effects, a few students because Internet addiction and cause is withdrawn, depression, waste even suicide studies.

37.4 Root

We think, the ideological and political education in the independent institute under the network environment, the root of the college students in trouble with the traditional FengBiHua increasingly socialization of college ideological and political education system the contradiction between. Network society is realistic social network space in the report, “the Internet of things to do, to appear on the Internet phenomenon and state is, in essence, the social status of living reflect. The Internet is like a true mirror shine upon society, reflected in the mirror in social economic movement and the state of human life.” so individual network process essentially is the individual socialization process [4]. As a network generation, of the independent college students are increasingly socialization through the network. However, the socialization process is a spontaneous, blind, lack of the correct guidance of the process. Because of their world outlook, the outlook on life and values have not fully established, tell the difference between right and wrong, good and evil is still very limited the ability of, they in the complex of network can easily lose our, form the wrong world outlook, the outlook on life and values. In the process, this should undertake to education college students to set up the correct world outlook, the outlook on life and values of the independent college ideological and political education of the failed to adapt to the requirements of the network times, according

to the traditional theory of still into primarily way, the ideological and political education is still closed in the university campus in the narrow space.

37.5 Countermeasures

Through the above analysis, we believe that the network environment of the independent college ideological and political education want out of the difficulty must go network, and the way of the socialization, dissolve and college students, the contradiction between the network socialization. In this process, the government, the society and the independent college must work together, to take on under the network environment independent college ideological and political education for the students of the important task.

37.5.1 The Government Should Strengthen the Network Legislation and Standard Network Management

Since 1994, the law of the People's Republic of computer information system safety protection regulations issued since, our country has been introduced and the network related policy laws and regulations to more than forty, network legal system construction has a certain scale, network communication activity basically realized there. But with the rapid development of the network than practice, network policy laws and regulations issued obvious lags behind; the system also wasn't strong enough. And those commercial web sites and Internet cafe in the interests of the drive, trying to drill laws, policies and regulations of the government issued in its actual practice process often is fraught with difficulty, can't get the due effect. This is the network of bad message overflow one important reason. Therefore, only strengthen the network legislation, regulating the network management, establish and improve the commercial web sites and Internet cafe management system, can effectively regulate commercial web sites and Internet cafe operator's commercial behavior for the healthy growth of the independent college students create a good network environment.

37.5.2 The Social Should Strengthen the Legal Consciousness and Moral Consciousness and Promote Site Operator and the Public Literacy

On the network environment, the moral evaluation of public opinion because of the direct it is difficult to analyze, the external moral sanction is weakening.

The public in daily social life is suppressed negative emotions through the network unique occult popular; make a network with pornography, violence, gambling, crime, rumors, abuse and other bad information. And as your business web site operators, for their own economic interests, not only do not take the initiative to resist these bad information, but managed to exploiting legal loopholes, bad for the spread of information to provide convenience. Therefore, the website operators and the public must strengthen the moral self-discipline, improve their sense of social responsibility and the accomplishment, according to law, do nets, civilized Internet, builds a healthy Internet environment. At the same time, as the owner of the network technology and developers site operator also should be active in ideological and political education for college students' services for the university students with the value orientation of the correct all kinds of information, using the Internet for educators to ideological and political education to provide technical support, to regulators shielding, investigate and deal with illegal information provides the technical support.

37.5.3 Independent College Should Change Education Methods of Ideological and Political to Improve the Quality of Ideological and Political Education

First of all, to strengthen the construction of campus network, make it become the independent college students' ideological and political education of the new position. According to our research, of the independent college campus network construction also relatively lags behind, some independent institute have their own independent web site, but the website construction and daily management is short of, some independent institute have not even their own independent web site. From the present situation look, most of the independent college campus network can't very good play the ideological and political education function, the website has a low, and ideological and political education related edition piece is almost deserted. Investigate its reason, on the one hand, because independent college student access the purpose of entertainment tendency, on the other hand because of the construction of campus network behind. Therefore, should strengthen the campus network construction; make it become the students study, the life, entertainment indispensable spiritual home. The direction of the campus network construction should be toward the direction of the comprehensive development of students to provide more services, such as: news and information, lifestyle, chat rooms, BBS, classmate alumni, movies, music, games, etc. Only by vigorously develop the function of the campus network, provide enough information and application of students both ways, campus network was able to hold her pupils' attention eyes, web site to student's ideological and political education function to it all possible. At the same time, the ideological and political education into the core content of the network information, into a lively network forms, lets the

student in the campus network and browse exerts a subtle influence accept these thoughts, this is the network era of the ideological and political education best way. In the development of web sites, construction and maintenance of the process, can let students participated in jointly. In the process, students can learn and improve their network knowledge and application ability, and can enhance their own political consciousness and sense of responsibility.

Second, the reform of the ideological and political theory course teaching content and method, strengthen their independent college ideological and political education as the main channel of the position. In the network environment, the independent institute of ideological and political theory course almost fell to be poor, teaching and learning effect is very bad, the role of main channel severely weakened. Network bad information on students' political consciousness and moral consciousness and the impact of the traditional force-feeding teaching is the way into trouble important reasons.

Again, build a high level of the instructors, the teacher in charge team. Independent college should put the head teacher training and a student in the network of the space spiritual mentor. Instructors, the teacher in charge can through the class QQ group and students' individual QQ better in touch with students and communication, to strengthen the management of the class and grade and students, understand their individual character, pay attention to their thoughts, helping them to grow up. And the teacher in charge should focus on the campus BBS, class QQ group students in network such as intensive space dynamic public opinion, and know the student's ideological and political status and mood changes, take positive guidance and individual communication way, to guide college students. In addition, mentors and teacher in charge can open a personal blog, make it become the exchange of ideas and students of the place and by our own thoughts charm guide the student to form the correct world outlook and values.

37.6 Conclusion

As in daily life, from students recently with their ideas have the biggest impact on a group, mentors and teacher in charge of ideological and political education they has its unique advantage. The ideological and political theory course independent college ideological and political education is the main channel of the class, the teacher in charge work and should be independent college ideological and political education in daily life and network space another channel. Therefore, the independent institute must strengthen the construction of teacher in charge in instructors, team dynamics, the establishment of full-time counselor system, expansion of team, while strengthening their political quality and computer network technology training, to improve their network space in the ideological and political education ability and level.

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References

1. Yi Y (2010) Grasp the opportunities for the development of Gong Hua innovation achievements the national independent institute commendation congress and Chinese independent institute. *Educ Prof* 22:15–20
2. The State Council of the Communist Party (2004) The central committee of the communist party will be strong and the state council on further improve college students’ ideological and political education opinion, vol 1, pp 759–760
3. Li B (2006) Introduction of network politics. *China Social Sciences Press* 1:291
4. Xin J (2010) Real or virtual: four question in internet. *China Social Sciences Press* 1:47

Chapter 38

Implementation of Teaching Management System Based on the Web

Qiang Liu

Abstract This paper introduces ASP and Database techniques, and describes in detail the design concepts of the Web-based management system for experimental teaching. It also introduces how to alternate the front stage and backstage information of a Web-based management system for experimental teaching which is realized with ASP technique. Based on this system, a kind of brand-new mode of experimental teaching is developed, it can promote the networking and informatization of experimental teaching management.

Keywords Web-based · Management system · Overall structure and function · Control

38.1 Introduction

The rapid development of Internet and the building of campus network, accelerate the teaching network course. The social information change at the same time, the school also is faced with informatization management challenges. As an important part of teaching management, teaching management, teaching and research, teaching should be responsible for the assessment, management and many other tasks, complex, cumbersome, fixed pattern, information exchange is frequent. Therefore, in some disciplines of basic courses, it is necessary to establish a teaching management system based on Web. Coverage of the campus network for

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the establishment of management information system based on Web provided a good foundation. And the various departments of the popularization of the computer, using the computer more and more, it is management system operation and maintenance provided by the personnel security. In addition, the management system is also conducive to leaders of all levels of timely, comprehensive understanding of teaching.

38.2 The Design Target of the System

Teaching management system based on Web should have the feature [1]: campus in any networked computer, students can undertake project related query, teachers can also conveniently log student achievement; there is a reasonable assessment mode, can give full play to the role of the penalty award ground idle; the corresponding security security, avoid the reservation information is lost or destroyed, and the results will not be tampered with; have very strong statistical and reporting output function; to establish effective teacher-student communication channels.

To achieve these objectives, a system must be designed to follow the following principles:

- fast response speed and high work rate;
- make full use of existing resources, including local area network, data, to minimize duplication of investment;
- a strong ability to adapt, scalable, easy maintenance, simple operation;
- take the student as the main application object, considering the students' affordability;
- the effective processing data access concurrency operation.

38.3 The Thought of System Development

Teaching management system based on Web is in fact the campus online reservation information database remote Web access. In Web platform, database access in a variety of ways. It can not only through the common gateway interface (CGI), JDBC (Java Database Connectivity, Java connected with the database technology), SSI (Server Side Include, server-side plug-in), ISAPI (Internet Server Application ProgramInterface, server application programming interface), can also be used as Oracle, Sybase database system provide dedicated development tools,

Build dynamic HTML pages and database connections, the browser can use the SQL statement to achieve a database query, Even increase, delete, modify the database information. In a physical realization, the system uses the C/S(Client/Server, client/server) structure system [2], see Fig. 38.1.

The front end of the Web browser through the Web server to send or receive data database command request, Web server and database between using ODBC

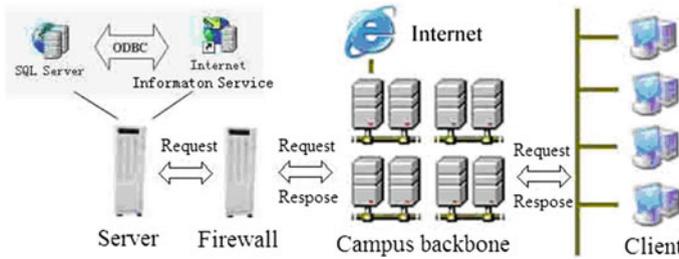


Fig. 38.1 The physical topology of the teaching management system based on Web

communications. By adopting the structure is convenient for centralized management. Application, database and related components are concentrated on the server; the client only needs to have the Web browser can. And the system update, maintenance and data management in the server to achieve the above, in favor of system management.

38.4 The Overall Structure and Function of the System

According to the modular design, we designed the system framework, see Fig. 38.2. The system is composed of the supreme administrator module, the administrator module, teachers and students module, four modules, at the same time with the setting database, access the database, modify the database functions, each function module of coordinated working.

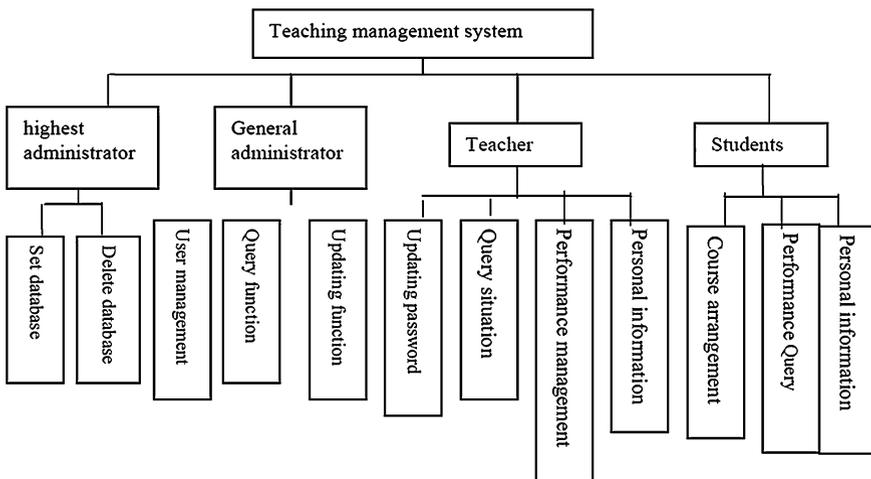


Fig. 38.2 Function structure diagram of the system

In addition to the above features, but also take into account the system using range is big, involve an area wide, including students, teachers, using the object manager, administrator, the use of different levels, the system in terms of safety to make corresponding processing. Such as a system administrator to the administrator work arrangements, administrator for teachers to arrange work. According to the user's different permissions, system provides the corresponding range of function.

38.5 System Design Details

38.5.1 The Selection of Development Technology

At present, for the development of interactive dynamic Web site technology mainly for the active server page (ASP), personal home page (PHP) and java server page (JSP). This system is currently more popular ASP technology to prepare. ASP is a Web application development ideal. ASP (Active Server Page, dynamic service page) is the IIS version 3 and above of the additional components, integrated the traditional HTML files, ActiveX scripts and ActiveX component technology. The use of ActiveX Data Objects (ADO) module and database dialogue, users can also define their own assemblies joined among them, make their own dynamic webpage is almost unlimited capacity expansion, which is the traditional form of CGI than. Compared with the traditional way, ASP has high development efficiency, easy to compile, good, strong safety, cross platform, can be expanded and the object oriented and many other advantages.

38.5.2 The Building of Web Server

Since the system uses the ASP technology to prepare the application program, and ASP as IIS3.0 products over the incidental component, ASP application development platform Windows NT preferred Web server on Server IIS (version 3 or above). You can also use Windows NT workstation or Windows 95/98 Personal Web Server (PWS); can also use other options, such as Chili from Soft company Chili ASP.

The system uses the IIS5.0 operating system, using Windows2000 Advanced Server. Compared to previous versions, IIS5.0 edition added a lot of functions [3], contribute to the Web administrator to create scalable, flexible application, such as a secure communications, gateway server encryption, permissions wizard, process limit, the improved custom error message, and the application protection.

38.5.3 The Building of Database Server

As a result of the system, involving professional, student number is more, it is necessary to use a relational database. Compared to non-relationship model, the data structure is simple and clear, the user easy to understand and use, data independence, high safety, help programmers development, work. This system uses the relational database for Microsoft SQL Server2000. As Microsoft in relational database with respect to the main product, it is closely connected with Windows NT system. It was established in mature and strong relationship model, Windows is a series of platform choice for data storage and retrieval model.

This system the most important information is the arrangement of the courses and student achievement statistics. As the semester and course, these data will change. Therefore, we designed four relational tables. User information table for the preservation of administrators, teachers, research intern and student information, such as passwords, name, contact information. Group information table for storing various professional grade basic situation, including the number, number, group number and name. Group information table for storing various teams of basic settings, including group where the largest group, team, group number time, teacher. Student performance, for the preservation of all students in every specific scoring. Each table will automatically complete the validity test, such as a student may not appear at the same time in the two groups of medium.

38.5.4 Access to the Database

ASP recommended data mode of operation is a ActiveX data object (ADO). It features a powerful, easy to use, is one of the core technique of ASP. In ASP webpage using ADO must first configure the server, providing a ADO positioning, identification and database communication pathways, namely the establishment of a data source. Data sources included how to talk to a data provider to connect information. Database driver using Data Source Name (DSN) localization and marking of specific ODBC (Open DataBase Connectivity, open database connectivity technology) compatible database, information from a Web application to database. Using ODBC advantage is good generality. Not only the development of procedures for database will not change and make changes, improve the efficiency of system development, but also enhances the system expansion, upgrading capacity.

On the database operation directly through the Transact-SQL (Structured Query Language) language to realize the. Transact-SQL on the use of Microsoft R SQL Server it is very important. And SQL Server communication when all applications by sending a Transact-SQL statement to communicate, and the user interface of the application. The SQL is a universal, highly functional relational

database language. It sets the data query (Data Query), data manipulation (Data Manipulation) (Data Definition), data definition and data control (Data Control) functions, language style, can be independently completed the database in the life cycle of all activities, including the definition of relation mode, insert data, database, query, update, maintenance reconstruction, database, database security control and a series of operational requirements [4]. In addition, SQL language although the function is very strong, but because of the ingenious design, language is very simple, the completion of the basic core function using only nine verbs (including for data query for SELECT, CREATE, DROP data definitions for data manipulation and ALTER, INSERT, UPDATE and DELETE, GRANT and REVOKE for data control etc.). It is close to the English, easy to learn, easy to use [5].

38.5.5 Application Development

According to the idea of modularization design, the system consists of a supreme administrator module, the administrator module, teachers and students module module four modules, at the same time with the setting database, access the database, modify the database functions, each function module of coordinated working. At the same time, the specific function of each module in order to reduce the complexity also used the modular design concept, to establish a smaller scale module.

The above function module design is mainly around the interaction with the user and database operations in two aspects. The ASP interacts with the user through the built-in Response, Request, Session and Application objects, and ADO database exchange via a built-in Connection, Command, RecordSet and Errors object implementation.

ASP built into Request, Response, Server, Session, Application and Object-Context six objects. These objects by ASP itself, when used without any statement or the build process, so called the ASP built-in object. These objects allows users to more easily collected through browser request to send information, in response to the browser and storing user information, thereby reducing the development workload. This system mainly uses the Request, Response, Session and Application four objects. The four built-in object functions are given in Table 38.1.

Table 38.1 The function of ASP built-in object

Object name	Object function
Request	Receive information from the user terminal
Response	Transmission of information to the user
Session	Storage of individual information of the user
Application	Storing data for multiple users

38.5.6 Concurrency Control

The database is an important characteristic is to allow multiple users at the same time; the same time can have hundreds of affairs while running. This may happen multiple users' concurrent access to the same data. If the concurrent operation of uncontrolled may access and storage of incorrect data, destroy the database consistency.

In this system, by using the following methods to control concurrent mechanism: Strictly control the user permissions. For example, some students only guide a teacher have permission to modify the student the result permissions, only an administrator can modify the large group and small group setting, students can only query results and cannot be modified.

The blockade (Locking) technology. The transactions in a data object, first to the system. Request, the lock. After locking the transaction T on the data object had certain control right. In the affairs of T end control, release its lock; other transactions cannot update the data object. Reduce the administrator user number. Because the administrator has a higher authority, the authority to grant the teaching principle. While the highest administrator privileges are granted only to system maintenance officer.

38.5.7 Safety Control

As a result of the system in teaching management plays a very important role, so it is very important to the safety of. This system adopted a number of measures to ensure the security of data.

Grading management. For different users are assigned different access rights. To set up a password for all users, each user root.

According to their own password login, system confirmation to the appropriate permissions page.

Regular backup database.

The server operating system and database security independent. NT Server SQL Server with a total of three An Quanmo. Type: overall safety, security and safety standards. This system uses the standard safety, safety support of trusted connection. User login database server username and password and login NT Server account password is different.

Set up a firewall. Use a firewall to flow into the information to selectively control the difference, which data access.

Is allowed by the system, so as to ensure that the server does not suffer encroach.

To ban Windows NT Guest account. Since anyone can use this account to access the operating system. If on the server to establish a FTP server, illegal users can use this account to damage the system information.

Control directory browsing. Because NT system security vulnerabilities, the ability of the user can skip the registration step directly. So for the sake of safety, be in the NT safety management mode control directory browsing.

The control visit IP. Due to the system for internal use in teaching, the Web server set visit IP control. Allow only the IP landing system, banning all off-campus IP.

Using Windows NT NTFS security mechanism and disk partition. This arrangement makes it easy to control. Record structure of access and control, effective management of safety. In addition, the destruction can be restored in a timely manner.

Using the RAID disk array.

38.6 Conclusion

This article introduced based on the C/S structure, using SQL, ASP as the developing tool of teaching management system, is essentially a network database system. It is in the collection of information, to update the information, information processing and other fields has great advantages, in the use, management, also have excellent characteristics be richly endowed by nature. Therefore, the development of teaching management system based on Web has the very strong practical significance, for the promotion of teaching management to scientific, networking, paperless track has a major role, is a very good application value in teaching management system.

Because the network information age of rapid development, requirements have a development space, so in the design of the system structure, the function module of collaborative work between the ability to consider a lot of, have a lot of room for expansion. Now, system mainly includes the data query, update, maintenance and other functions. Later, new functions such as printing, automatic report generation, statistical data generation, can accord need to join the system.

References

1. Jun W, Ju-Ling P (2000) Web based experimental teaching management system design and Implementation. *Microcomput Appl* 16(11):27–29
2. Andrew ST (1998) *Computer networks*, vol 3. Prentice Hall, Upper Saddle River, pp 148–156
3. HongFeng L, Jing-Bo C (2001) *Dictionary of ASP Technique*, vol 1. People's Post Press, pp 1421–1429
4. Date CJ (1995) *An introduction to database systems*, vol 6. Addison-Wesley, New York, pp 25–36
5. San S, Wang S (2000) *Introduction to database system*, vol 1. High Education Press, China, pp 252–263

Chapter 39

Research on Ideological and Political Education Based Mobile Internet

Yu Zhang

Abstract As a new communications carrier in today's rapid development of modern technology, cell phone is a new media fusion, whose features include mobile newspaper, mobile radio, mobile Internet and other forms. Cell phone plays an important role in college students in daily life. From the influence on the college students by analyzing the internet function, this paper used the gray theory analysis and anonymous questionnaire to propose how to carry on Ideological and political education from the Internet management, publicity and online education, networking and moral cultivation Ideological and political educations. Finally this paper discussed how to establish a sound contemporary system of college students' political education into order to help students form a correct outlook on life, society and values.

Keywords Mobile phones · New media · Gray theory · The questionnaire · Network publicity and education

39.1 Introduction

The rapid development in modern technology today, cell phones as a new communications carrier, but also new media fusion, its features include mobile newspaper, mobile radio, mobile Internet and other forms, plays in the daily life of college students a very important role [1–3]. College students have cell phones major groups, the main function of most of the phone to the Internet, especially the prevalence of 3G networks, high-tech advances, the leisure life of the college

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Fig. 39.1 The proportions of the occupational characteristics of mobile Internet users in 2010

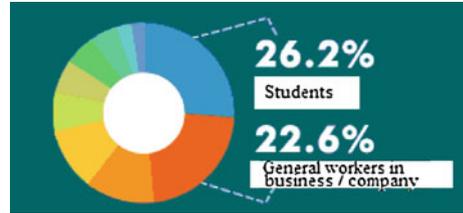
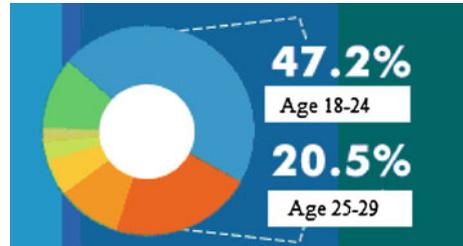


Fig. 39.2 The proportions of the age of mobile Internet users in 2010



students a variety of fresh and stimulating. The mobile Internet refers to the use of mobile phones that support Web browser through the WAP protocol, associated with the Internet, so as to achieve the purpose of surfing. Mobile Internet convenience, anytime, anywhere, has become increasingly broad, and gradually become one of the Internets in modern life. With the development of information technology, mobile phones, Internet and other new media is becoming an integral part of people's lives. Perceptual groups of young people, their pursuit of happiness, joy, happiness, passion, adventure, enjoy, and so on, accept the desire of new things and all kinds of information more strongly than adults, they also constitute the new media of mobile phone user base backbone Figs. 39.1, 39.2 [4].

39.2 Analysis of Mobile Internet of China's University Students

Phone and the formation of new media, mobile phones and the Internet has become an increasingly young people access to information, learning and entertainment, the indispensable tool of communication and helpers, youth exchange, aggregation, liaison and an important way to organize and mobilize and carrier area fundamental change in the lifestyle of young people, ways of thinking, behavior, change the lives of modern youth. Young people curious about new things, fashion trends with highly sensitive, cell phones new media allows them at any time via SMS, mobile news, mobile Internet, mobile search and other means to obtain information [5]. By the form of questionnaires, six colleges and universities in Beijing undergraduate college students, the anonymous questionnaire to collect relevant information, analyze data, can be roughly summed up, college students

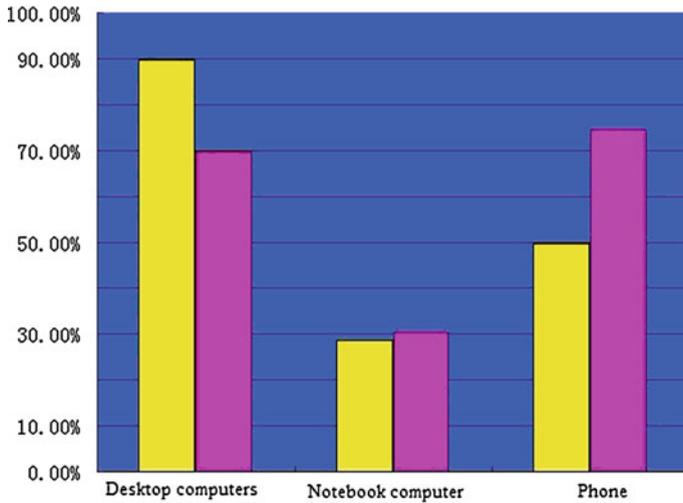


Fig. 39.3 China's online behavior among young people

major Internet carrier is the phone, and the rate of mobile Internet in 2009 increased by 49.7 % in 2008 to 74.0 %, shown in Fig. 39.3.

Mobile new media era, has been completely changed the lives of college students on their mobile phones new media like a double-edged sword, both the best of times, it could be the worst of times.

39.2.1 The Characteristics and Methods of Mobile Internet

The mobile Internet refers to the use of mobile phones that support Web browser through the WAP protocol, associated with the Internet, so as to achieve the purpose of surfing. WAP Wireless Application Protocol is an open standard protocol that can send information on the network to the mobile phone or other wireless communication terminals. Similar to the HTML markup languages WML, WAP is a direct access to the general web and through WAP Gateway. Through WAP, anytime, anywhere using a wireless communication terminal to obtain real-time information on the Internet or the company's Web site, truly wireless Internet access. The mobile Internet is a form of mobile Internet is an extension and supplement of the traditional computer access [6]. Open the question of the 3G network, making the mobile Internet started to enter people's lives, to enjoy the high-tech achievements. WAP this technology can be a lot of information in the Internet and a variety of business introduced to the mobile phones, PALM, the wireless terminal. No matter when, where, as long as necessary, to open a WAP phone, users can enjoy the endless online information or online resources: News, weather forecasts, stock market dynamics, business reports, the current exchange

rate. E-commerce, online banking will be achieved. WAP phone users anytime, anywhere access to sports results, entertainment anecdotes, add fun to life, you can also use the online booking function, orderly living arrangements.

39.2.2 *The Ideological and Political Quality of Mobile Internet*

The mobile Internet is a double-edged sword, its ideological and political quality of both the positive part and negative part, the key is that college students how to choose the reliability of the information. Undergraduate Students in Beijing on the phone to the Internet to influence the ideological and political quality survey, opinion surveys [7]. Which can clearly be seen that 43.7 % of college students believe that the mobile Internet to promote the improvement of the quality of ideological and political, most of them believe that the Internet via mobile phone to read and understand the national situation and political, to correctly analyze the current situation, increase their ideological and political quality; and 40.8 % of the students believe that mobile Internet is a waste of the University of valuable time, does not really surfing the mobile Internet to learn knowledge, but because of some of the negative news reports, interfere with the students the correct way of thinking, and cannot promote the improvement of the quality of ideological and political.

39.3 The Development of Prediction the Mobile Internet on the Ideological and Political Quality Based on Gray Theoretical Analysis

39.3.1 *Gray Model*

It is one part research information clearly, some do not know and with the uncertainty of the phenomenon of Applied Mathematics, Gray Forecast Model forms of expression to the differential equation, it shows a continuous process of the mobile Internet on the impact of ideological and political qualities. In this paper, the DPS to mention the software for the gray system prediction model GM (1, 1) for analysis [8].

(1) Data sequence (1) an accumulated generating operation:

$$X^{(0)} = \{ x^{(0)}(1), x^{(0)}(2), \dots, x^{(0)}(N) \} \tag{39.1}$$

$$X^{(1)} = \{ x^{(1)}(1), x^{(1)}(2), \dots, x^{(1)}(N) \} \tag{39.2}$$

Where, $X^{(1)}(t) = \sum_{k=1}^t x^{(0)}(k)$

(2) To construct cumulative matrix B and constant vector Y_N , namely

$$B = \begin{pmatrix} -\frac{1}{2}(x^{(1)}(1) + x^{(1)}(2)) & \cdots & 1 \\ \vdots & \ddots & \vdots \\ -\frac{1}{2}(x^{(1)}(N-1) + x^{(1)}(2))n & \cdots & 1 \end{pmatrix} \tag{39.3}$$

$$Y_N = [x^{(0)}(2), x^{(0)}(3), \dots, x^{(0)}(N)]^T \tag{39.4}$$

(3) Gray parameter solution with the least squares method \hat{a}

$$\tilde{a} = \begin{bmatrix} a \\ u \end{bmatrix} = (B^T B)^{-1} B^T Y_N \tag{39.5}$$

(4) Gray parameters into a function of time

$$\hat{x}^{(1)}(t+1) = \left[x^{(0)}(1) - \frac{u}{a} \right] e^{-at} \tag{39.6}$$

(5) The formula $\hat{x}^{(1)}$ Derivation of reduction with

$$\hat{x}^{(1)}(t+1) = -a \left[x^{(0)}(1) - \frac{u}{a} \right] e^{-at} \tag{39.7}$$

(6) To calculate the difference $\varepsilon^{(0)}(t)$ between $x^{(0)}(t)$ and $\hat{x}^{(0)}(1)$

$$\varepsilon^{(0)}(t) = x^{(0)}(t) - \tilde{x}^{(0)}(1) \tag{39.8}$$

39.3.2 The Application of Gray Model

From 2007 to 2010, China’s university students mobile Internet users and the ideological and political quality standards in Table 39.1, Fig. 39.4 for the 2007–2010, China University of mobile Internet users and the ideological and political quality standard score. As can be seen from Table 39.1, the number of university students mobile phone users is increasing year by year, the rising trend is more obvious. The ideological and political quality score in a small-scale fluctuations, appears to the ideological and political quality of the mobile Internet, and are not necessarily linked, in fact, it is not.

From Table 39.1, the gray prediction model, the ideological and political quality of our students and the mobile Internet function of the dynamic development trend of long-term forecast, calculation and analysis, the following Table 39.2 and shown in Table 39.3 data.

Table 39.1 The ideological and political quality standard score of China Students mobile Internet in 2007–2010

	2007	2008	2009	2010
The phone number of Internet users	0.18 billion	0.28 billion	0.46 billion	0.78 billion
Standards of quality score	87	85	88	86

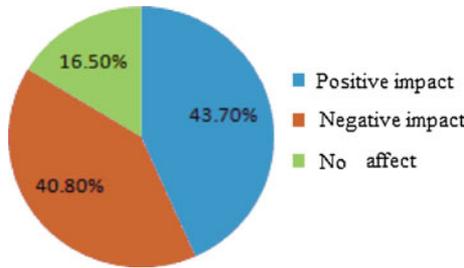


Fig. 39.4 The ideological and political quality of mobile Internet

Table 39.2 The gray prediction results of students’ mobile Internet users, the number of (unit: million)

Years	2007	2008	2009	2010	2011	2012
Students mobile phone Internet users	0.18	0.28	0.46	0.78	0.93	1.06
Prediction error (%)	0	1.373	-3.331	1.07	—	—
Prediction model	$\hat{x}^{(1)}(t+1) = -0.003866 + 0.004781 e^{0.141348t}$					
Prediction accuracy	$c = 0.3282 \quad p = 1.0000$					

Table 39.3 Students ideological and political quality gray prediction results

Years	2007	2008	2009	2010	2011	2012
Ideological and political quality standards ratings	87	85	88	86	88	90
Prediction error (%)	0.0300	0.0349	0.0394	0.0444		
Prediction model	$\hat{x}^{(1)}(t+1) = -0.241453 + 0.271453 e^{0.120947t}$					
Prediction accuracy	$c = 0.3099 \quad p = 1.0000$					

39.3.3 Data Analysis

Forecast results from Tables 39.2 and 39.3 shows the number and ideological and political quality of the 2011–2012 China’s University of mobile Internet users are showing a rising trend, explain the whole mobile Internet to promote the improvement of the quality of ideological and political; at the same time, can be seen from the table, the high accuracy of the gray prediction model, the relative

error is small, to illustrate the application of the model is reasonable, gray prediction GM (1, 1) model and its procedures used to predict the next few years China Students mobile Internet user growth rate of feasibility.

39.4 Conclusion

The gray prediction GM (1, 1) model and its procedures can be used to predict the growth rate of China's University of mobile next few years. In the next few years we can predict that the number of mobile Internet of college students can be roughly determined by the ideological and political level of quality.

References

1. Xuan W, Wei Z (2010) Network culture and ideological and political education. *People's Forum* 23(29):31–34
2. Gao Z (2008) Network cultural context of ideological and political education, innovation and development. *Radio and TV Univ* 3(2):41–43
3. Chen H (2000) How to give full play to multimedia, network technology to the moral education teaching role. *Ideolog Theor Education* 42(8):44–47
4. The CPC Central Committee and State Council (2004) Further strengthening and improving ideological and political education views
5. Cao K, Chen X (2002) The ideological and political education of the network environment. *Yan'an Coll Education* 21(1):77–79
6. Haiguang X (2009) internet and ideological and political work practice, vol 12(1). Fudan University Press, Shanghai, pp 665–666
7. Xu L (2008) College moral education strategy based on network and information technology. *HuaiBei Coal Ind Teachers Coll* 2(10):250–253
8. You S (2002) The environment on the ideological and political education, vol 1(4). Fudan University Press, Shanghai, pp 448–449

Chapter 40

Campus Safety Culture Construction Under the Network Environment

Xue Li

Abstract With the rapid development of the information age, although the network environment on the traditional campus culture brings a lot of new vitality, but we have to admit that the network environment has been greatly influenced by the teachers and students' work, study and life, it is for the construction of a harmonious campus safety culture brought grim challenge, therefore, we next the work is to choose the network environment on the construction of the campus safety culture favorable local, as well as to abandon those who affect our country to build the campus safety culture factors. The article from the importance of the construction of the campus safety culture, how to build the campus safety culture and the campus safety culture evaluation several aspects are discussed.

Keywords IRT · Political ideology · Quantitative methods

40.1 Introduction

With the advent of the Internet era, now coupled with the rapid development of the information age, make our country in campus safety culture construction in the process of the difficulties encountered, hitherto unknown, because the Internet and our life more and more closely, which causes the students can easily access to those negative information, or make more students indulging in online virtual worlds, seriously affecting their personal growth, this a series of responses to school safety management work has brought great difficulties, a serious impediment to China's campus and also fast and good development, therefore, based on the network

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environment under the campus safety culture construction is imminent, we must establish a good system of safety culture, to adapt to the modern rapid development of the network has brought about a series of reaction [1].

40.2 Campus Safety Culture Generation

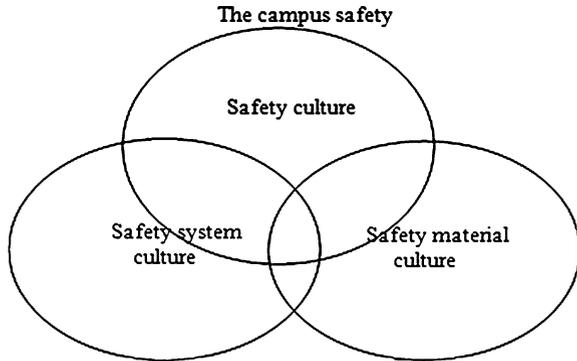
Safety culture is the human survival and development and produce, and then get ceaseless creation, inheritance and development, such as the current enterprise safety culture, safety culture, safety culture and campus safety culture and so on. Safety culture in human culture, it does not move with subjective volition of the person, is a kind of objective existence, is a human production, life and survival of the practice, by human wisdom and strength as well as the progress of science and technology of condensed.

The campus safety culture safety culture, safety is composed of system culture and material culture of safety components, as shown in Fig. 40.1.

First of all, safety must be human in the ideological awareness, our security policy is “safety first, prevention first”, so, be the first to bear the brunt is aware of the importance of safety, thereby creating the campus safety culture. Again, because the people realize the importance of safety, and to promulgate relevant security system, so as to regulate human behavior, the track crossing theory, we learn that, accident is unsafe condition of things and human unsafe behavior cross, therefore, to regulate human behavior is particularly important, the leader must establish a safety system culture. Finally, there is the corresponding standard, must one put in the corresponding equipment, this is our safety material culture [2].

With the advent of the information age, the network environment has changed our traditional campus safety culture construction, if we do not follow the foot-steps of society, the campus security problem will be get out of hand, so, it is this can bring convenience for us network, such as network teaching, also can bring countless hardship information, such as yellow website, so we have to generate a new campus safety culture, as shown in Fig. 40.2.

Fig. 40.1 The composition of safety culture



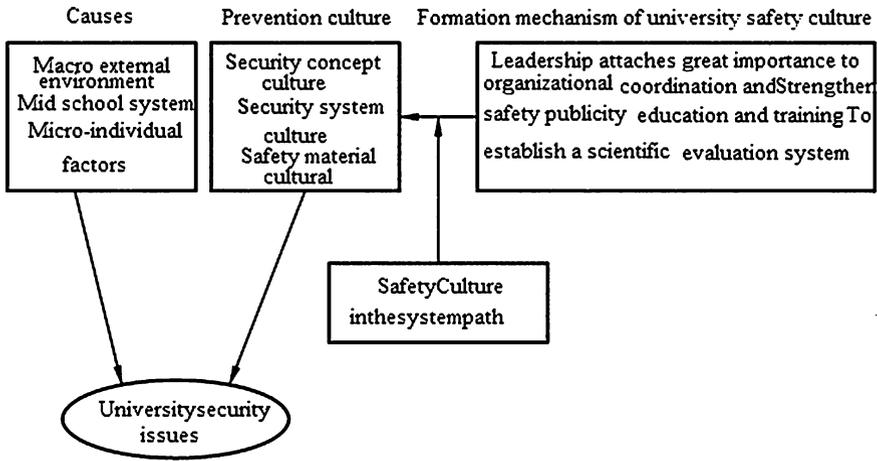


Fig. 40.2 The campus safety culture based on the network environment

40.3 The Campus Safety Culture Construction Under the Network Environment

40.3.1 Popularizing Network Knowledge

As a result of people’s living conditions are getting better and better, everyone for his own children to a computer, the child’s life because the network becomes more convenient at the same time, lots of pornography, fraud, adverse information influences the child ‘s physical and mental health. A few years ago, the Political Bureau of CPC Central Committee on the development of network technology and Chinese network culture construction and management problems of collective learning. President Hu hosted learning points out clearly, leading cadres at all levels should attach great importance to study the Internet knowledge, improving the level of leadership and control ability, and strive to create a new situation of Chinese network culture construction. Therefore, to strengthen the study of network knowledge, you put the network knowledge skillfully applied to work study and life, you is the campus safety culture construction is an important part of. Therefore, the school should be in the setting of network curriculum based on knowledge, must also often hold some network knowledge, to give students systematic curriculum. Students in the universal network knowledge at the same time, the teacher should improve the network knowledge, thus better to teach students, management of students [3].

40.3.2 Strengthen the Management of Network Information

The Internet has become every one of us in the life indispensable important information platform, how to bring into full play its positive role, make it better for our country campus safety culture construction, we must now a problem to be solved. Internet based campus network is the important infrastructure in school teaching, scientific research, shouldering the important task of management and foreign exchange, network information safety is directly related to the teaching and research activities such as safety [4]. Therefore, various departments in the school to further study the relevant laws and regulations, and actively improve and implement the relevant rules and regulations, fully aware of the importance of computer network security, improve the work of network security awareness, strengthen security concept, cogent safeguard school in network information security. The school authorities to network safety into the school security focus positions, with the school security work together, together, together to implement the deployment check, ensure the school network information flow, safe, effective, and ultimately makes the safety culture construction is fast finish [5].

40.3.3 Improve the Network Quality of Teachers and Students

According to statistic, at present our country online number already crossed 100 million, which accounted for more than 80 % of adolescents. Network has become the teenagers learn knowledge, exchange ideas, the most important recreational platform through the Internet, they gradually realize the colorful world of every hue, solve problems, make every kind of friend, accept the resplendent with variegated coloration information. The Internet has changed the original way of thinking. At the same time, the students most likely to be unhealthy phenomenon of network infringement, Internet on students' Ideological and moral formation will have a greater impact, so should actively seek to cultivate pupils' network moral method [6].

Teachers' words and deeds to students, itself is a kind of guidance; therefore, teachers should take the teacher his noble personality to influence the students. Teachers should constantly improve their own network quality, continuous learning network operating skills, and constantly improve the network utilization ability, learning, scientific research type teachers. Only by mastering the computer skills, familiar network, can guide the students to use the cyber source, can have the conditions of deeper understanding of student's awareness of the network and psychological changes, timely solve the network communication problems, according to the process of teaching students appear various moral problems found timely flash point, praise, in time to capture enough points, using the effective methods and means, to conduct moral education, so that the net thought education. In short, in the full implementation of revitalizing the nation through science and

education today, moral education is still a great banner, in the network world, only correctly guide the future of the motherland, the network moral education work to the last step, the students can grow up healthy and happy, the children have today, will have a bright tomorrow [7].

40.4 Fuzzy Evaluation of Campus Safety Culture

The campus safety culture construction, the problem of the evaluation can not be used for a simple score to evaluate, his evaluation is the evaluation set up a fuzzy subset, so we use the fuzzy comprehensive evaluation. Fuzzy comprehensive evaluation based on fuzzy mathematical knowledge, the system of multiple interacting factors comprehensive evaluation [8].

40.4.1 The Mathematical Model of Fuzzy Comprehensive Evaluation

Evaluation is given : $Y = \{y_1, y_2, y_3, \dots, y_m\}$.

Determining the evaluation object the factor set $X = \{x_1, x_2, y_3, \dots, x_m\}$.

Establishment of a fuzzy mapping from X to Y $f: x \rightarrow F(y)$.

By F we can induce the fuzzy relationship between R, in matrix form:

$$R = \begin{bmatrix} r_{11} & r_{12} & r_{13} & r_{14} & r_{15} \\ r_{21} & r_{22} & r_{23} & r_{24} & r_{25} \\ r_{31} & r_{32} & r_{33} & r_{34} & r_{35} \end{bmatrix} \tag{40.1}$$

Establishment of weights: factors according to their importance of different concentration, gives the corresponding weights are assigned to:

$$A = (a_1, a_2, a_3) \tag{40.2}$$

On the evaluation subjects for evaluation, selected reviews set M, adopt international practices:

$V = \{AAA \text{ (very good), AA (better), A (general), B (poor), C (badly)}\}$.

Comprehensive evaluation and results: a single factor evaluation matrix R and the various factors weights A, can make a comprehensive assessment, the formula is

$$B = A * R = (b_1, b_2, b_3, b_4, b_5) \tag{40.3}$$

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

Table 40.1 Evaluation table

Comment	AAA	AA	A	B	C
Evaluation of the value	100–90	90–80	80–70	70–60	60–0

To get an accurate evaluation results, each grade variable values in the range of AAA (good): 100–90, AA (good): 90–80, A (general): 80–70, B (poor): 70–60, C (poor): 60–0.

Then corresponds to Table 40.1, find the corresponding evaluation results.

40.4.2 Case Analysis

According to the method of fuzzy evaluation, cited the following example:

Determine the weights of evaluation factors:

Analysis of the use of reasoning method to get the weight of every factor:
 $A = (0.30, 0.20, 0.20, 0.30)$.

The establishment of fuzzy matrix:

Invite 10 relevant experts on a school campus safety culture evaluation. The 10 experts that safety evaluation of aggregated, and will appear in the five grade the results of the final assessment, the corresponding frequency, i.e., the probability of the occurrence of, see Table 40.2.

Evaluation on the results:

$$B = (a_1, a_2, a_3) * \begin{bmatrix} r_{11} & r_{12} & r_{13} & r_{14} & r_{15} \\ r_{21} & r_{22} & r_{23} & r_{24} & r_{25} \\ r_{31} & r_{32} & r_{33} & r_{34} & r_{35} \end{bmatrix} = (0.65, 0.149, 0.135, 0.066, 0) \tag{40.4}$$

Finally, according to the assessment of safety culture in campus subsystem, calculate the final results:

$$C = B * P = 82.36 \tag{40.5}$$

The school campus safety culture belongs to the better grade.

Table 40.2 Evaluation factors of the frequency of safety culture system

Safety culture system	AAA	AA	A	B	C
The campus safety culture	0.78	0.14	0.06	0.02	0
Campus security system culture	0.69	0.17	0.11	0.03	0
Campus safety material culture	0.70	0.10	0.12	0.08	0

40.5 Conclusion

With the advent of the twenty-first century, the network era in our daily life becomes mainstream, Internet is a modern fashion in the new era. However, the campus culture is an open culture, so the network culture will be absorbed by the campus culture, become a part of ourselves, but we can't all be network culture into its, must abandon the bad factors, using the network is advanced, fast and open to students to create a better campus safety culture atmosphere. We should make full of the campus network to every corner of the world, whether in teaching or in the dormitory, but must be strict control of network information security, security of school network security, we can construct the campus safety culture.

References

1. Chunyi L (2005) The construction of campus culture under the network environment. *J Youth Guide* 5(9):42–43
2. Juhua J, Ke Z (2006) The network environment of college campus culture under the new change. *Edu Teach* 3(5):781–782
3. Jianwei W, Lina S (2003) Analysis of university campus culture under the network environment the construction. *J Luoyang Technol Coll* 13(4):48–49
4. Lixin Z (2006) Safety problem and its countermeasures of university campus. *J Chinese Saf Sci* 16(3):65–70
5. Chaomin L (2011) The campus safety culture construction from the perspective of harmonious campus. *J Hunan Univ Sci Eng* 32(1):114–116
6. Miao D (2011) The approach to construct campus safety culture. *Changchun Coll Edu* 27(7):119–120
7. Zhang H (2004) Attention should be paid to the campus safety cultural construction. *Exp Technol Manag* 4(3):119–122
8. Yang Q, Zhou Q, YeShengfu (2007) The fuzzy comprehensive evaluation of campus safety culture. *J Taizhou Univ* 29(6):91–94

Chapter 41

Analysis and Practice of Integrated Curriculum System Model of English Teaching

Ning Zhang and Zehua Wu

Abstract The ultimate goal of foreign language teaching is that students can use foreign languages in work or life. In China we are still using the traditional teaching mode, and in the English language learning and teaching, the use of multimedia integrated curriculum system is not satisfactory. How to make English learners to feel the real circumstances and context of language learning is worth our study. This paper studies the integration of the teaching system in the English classroom teaching, so as to provide a theoretical basis for English language teachers to improve their teaching standards, and for English learners to improve their language skills.

Keywords English language teaching · Integrated system · Teaching model analysis

41.1 Introduction

The ultimate goal of English teaching is to enable students to use foreign languages in working or living [1, 2]. Current foreign language teaching practice does not enable students to communicate and interact in a real and appropriate language with others. The goal of English teaching is to expand the communication range,

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so that the students will not have any hindrances in learning. Students' spontaneity is completely ignored in the English-learning teaching methods, which is mainly caused by years of teaching drawbacks [3]. The first is in oral teaching, for many years we have been using textbooks for students in oral teaching. We often use our mother tongue to teach students grammar in teaching activities, and usually use the phrase or sentence fragments to make decomposition for a complete sentence, which makes the students cannot understand, and also lead that the students have learning disabilities [4]. The second reason is that the teaching form of reading and reciting. Teachers require students to recite, usually recite the text in the form. Studies have shown that the form will only lead the students to produce a rapid response capability. In addition, in the later stage of reading in the teaching of reading, teachers tend to rely on reading and require an understanding of the problem, or require students to repeat the sentence content [5]. Sometimes they require the translation of the article. We believe that these activities are insufficient to meet the students' learning tasks. Teachers should provide opportunities to students, and let them read what they love to read, so you can let them know their feelings and the students can really grasp the language they have learned.

Here we are to explore a new teaching system, that is, integrated teaching system. This allows the students to have an incentive in their own learning. And this will make their learning pressure greatly reduced. In addition, there is enough space to improve their creativity [6].

41.2 System Model Analysis

In this paper, an integrated curriculum system is introduced to analyze the English language teaching. In this model, the integration model is composed of language input, language output, and language memory [7].

41.2.1 Model Assumption

Students were divided into two groups according to their English proficiency level: high level and low level. Separate these two types of students in teaching. For students of high level, we are using the normal mode of teaching while for students with low standard of English, we are teaching through integrated curriculum system [8]. After some time, their performance is analyzed through data envelopment systems analysis. The structural model is shown in Fig. 41.1.

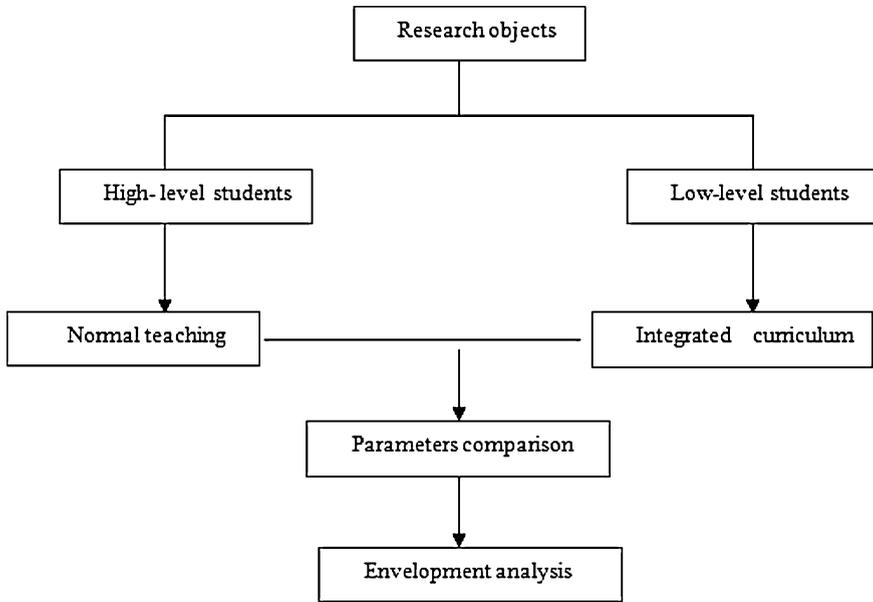


Fig. 41.1 Integrated system model

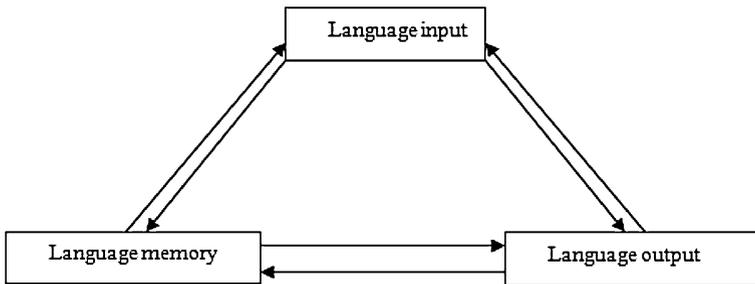


Fig. 41.2 Three-dimensional model of the integrated curriculum system

41.2.2 Model Introduction

There are three key links in the integrated curriculum system in English teaching, ‘namely, language input, language output, and language memory, also known as three-dimensional circulation models. Language learning in three dimensions can be transformed into each other and restrict each other, in order to achieve the “transformation—constraint—transformation—constraint” process. The model is shown in Fig. 41.2

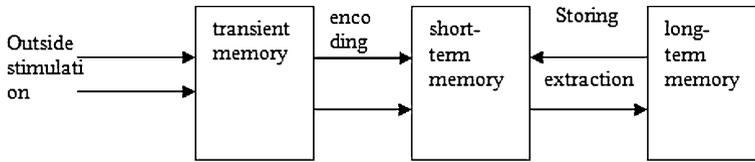


Fig. 41.3 Language storage memory

41.2.2.1 Language Input

Learning any language must have an input process. The premise of language learning is language input, which plays an important role in the language learning process. In the teaching of English, you should take some of the vivid pictures and other multimedia information to help students of language input. Only formed in the brain and 1 memory and through repeating the training can the students have associative memory through the vocabulary, thus improving the students' interest in reading.

41.2.2.2 Language Memory

Most of the learning of English is taught in the classroom, and the students have little time outside the classroom to learn English. Although computers and other multimedia information technology, but many students it is difficult to seize the opportunity to learn, and this inevitably make the student's brain has a memory of storage space.

According to the time of memory storage, psychologists divide the time of memory into transient memory, short-term memory, and long-term memory. But the three stages are linked to each other: the transient memory changes into short-term memory by encoding; short-term memory, after brain extraction, forms long-term memory; long-term memory storage has formed a short-term memory. Its storage structure is shown in Fig. 41.3:

41.2.2.3 Language Output

Language output is that according to the learning of language the students can use the language, and language output should pay attention to the selection of the appropriate input terminals. Make a wide range of feasible language input preparation; pay attention to the output of the language and traditional culture; language output should fit the cultural backgrounds.

Thus, the learning of a language must start from language input, and then to the language processing, and finally carrying out a process of language output.

Table 41.1 Input and output indicators of each class

DMU _j		Class 1	Class 2	Class 3	Class 4	Class 5
Input indicators	X _j	3.77	3.62	3.59	3.40	3.79
Output indicators	Y1 _j	3.79	3.72	3.75	3.45	3.64
	Y2 _j	3.85	3.78	3.65	3.56	3.78
	Y3 _j	3.95	3.72	3.55	3.64	3.57

Table 41.2 Evaluation results

DMU _j	Class 1	Class 2	Class 3	Class 4	Class 5
θ_j^*	1	1	0.974	1	0.932
S_1^{-*}	0	0	0	0	0
S_1^{+*}	0	0	0	0	0.005
S_2^{+*}	0	0	0.130	0	0
S_3^{+*}	0	0	0.375	0	0.330

are effective. Therefore, by applying integrated system in English teaching, the students' achievements have increased significantly [11, 12].

41.5 Conclusion

Integrated teaching model system provides a good platform for teachers to improve their English teaching level, and the students also increase their interest in learning. It allows learners to have an opportunity in the right place at the right time to use languages. This gives the students an incentive in their own learning process, and makes their learning pressure greatly reduced. There is plenty of room to improve their own creativity. Therefore, adopting the integrated teaching model is of great significance to develop the students' ability to accept new things and improve their language skills.

References

1. Wei Q (2004) Data envelopment analysis, vol 1(2). Beijing, Science Press, pp 243–244
2. Du D, Pang Q (2005) Comprehensive evaluation methods and selected cases, vol 5(5). Beijing, Tsinghua University Press, pp 453–455
3. The application of the DEA method in the evaluation of academic performance relative effectiveness. Value Engineering, 2008, (11), pp 23–25
4. Xu Y (2002) Practical model and skills of contemporary English teaching. vol 12(2). Beijing, Tsinghua University Press, pp 111–113
5. Gao Y (2006) Communicative approach in oral English teaching. vol 2(3), Inner Mongolia Normal University, a master's degree thesis, pp 27–34

6. Littlewood W (1981) *Communicative language teaching*. vol 12(2), London, Cambridge University Press, pp 77–79
7. On the Role-play in English Language Teaching. <http://www.englishthesis.cn>, 2007
8. Hornby AS (2006) *Oxford advanced Learner's English-Chinese Dictionary*, vol 23(9). London, Oxford University Press, pp 771–778
9. Harmer J (1983) *The practice of english language teaching*, vol 11(3). New York, Longman Press, pp 78–82
10. Huang D (2007) The application of role-playing in English teaching, 4(02). Shaoyang Teachers College, pp 20–26
11. Zhou X (2007) How to implement task-based language teaching. *New curriculum study elementary education* vol 3(09), pp 25–27
12. Zou Y (2007) Role-playing in English teaching. *Learn English newspaper*, vol 1(03), pp 45–47

Chapter 42

Research on Education Model of and Diversity Based on Mathematical Statistic Law

Junling Wei and Chenling Li

Abstract When the competition is so fierce in today's society, students faces with a lot of pressures. How to make students better access to education, a separate teacher education programs for regular and special education, need not be provided with an expected role, functions and responsibilities comprehensive knowledge of the course teachers. In order to meet the diversity of learning needs in the classroom, the purpose of this paper is to establish a new educational model, and the theory will focus on regular and special education with the help of teachers, as well as all levels of teacher education stage to develop an overall teacher, to promote a diverse and inclusive of pre-service teacher education programs are embedded in all subject areas.

Keywords Diversity · Inclusive · Overall teachers' way · Special education

42.1 Introduction

The basis of the principles is compulsory, the school should provide education for all children, regardless of the student has any perception of difference, disability or other social, cultural and language differences [1]. For the diverse needs of these learners and the pursuit to make the school more the need for regular and special

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education teachers and learners as well as family and community to consult and cooperate with each other, strategically effective teaching and learning. In China, independent of teacher education courses, regular and special education do not have the desired effect, a comprehensive knowledge of the functions and responsibilities in line with the diversity of learning needs in the classroom. The purpose of this paper is to establish a new mode of education requires teachers with the attitudes, knowledge and ability of the various factors to be effective in the classroom to meet the diverse learning needs. The paper will focus on the need for regular restructuring and special education, teacher education and education programs to develop the overall teacher “in order to promote an inclusive pre-service teacher education courses to students of all disciplines [2].

Reorganization of teacher education programs is based on the assumption that if we are to address the diversity of students in the classroom to make schools more inclusive and learner-friendly, traditional homogeneous and independent of the teacher education curriculum is no longer feasible. In short, in order to create a favorable and effective learning environment for all children, general and special education teachers must be to respond to the needs of all students. This inclusive education model many years ago had spread, but some educators and school system may not be ready or willing to implement this model to solve the diversity of students in the classroom.

42.2 Inclusive Model of Teacher Preparation

Inclusive school teacher in this area of the limited research, pointed out to prepare the model, there are three aspects [3]: (1) an additional model (2) immersion model (3) of the unified model. Existing courses modified or teachers in general to join the special educational content related to additional education curriculum model. It is mainly characterized by the special needs according to the characteristics of students and other content, including the general education environment and teaching classroom, strategies for these children. However, in addition to special education content teachers for non-disabled people in the general classroom preparation. The immersion model of teaching is characterized by general and special education disciplines and Union College to supervise the education of a mode of experience. From the disciplines of the two schools into general and special education content with the existing curriculum to meet the diverse needs of the student’s regular teachers.

Influential factors inclusive of teaching not only include teaching materials, teachers will be involved in education, curriculum and school leadership, namely the following diagram.

The unified model is the unified origin of talk about teacher education is separated from the general (mainstream) the design of the preparation of teachers and special education teachers. The basic principles of a unified Simply put, a merger of the general and special education in the collaboration of all teachers of children

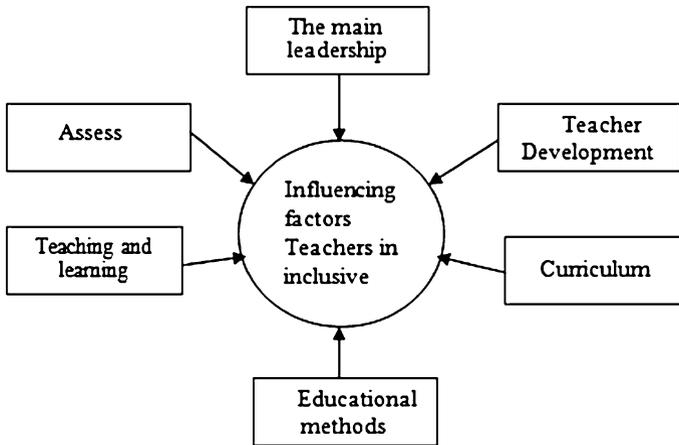


Fig. 42.1 The influencing factors of teacher teaching inclusive

in professional training courses. A unified teacher-training programs combined with the views of all the professional standards to a new conceptualization of general and special education courses for their respective programs. In order to more effectively cultivate a collaborative and inclusive, pre-service teachers should develop a program of pre-service teacher education courses and professional practice and the concept of shared vision, establish a comprehensive program to provide opportunities for special education and general education to work together. It is in this context, the negotiation model of collaborative rationalization, so that different people use the expertise of the joint efforts of the education of students of different abilities and backgrounds to receive education in ordinary classrooms [4] (Fig. 42.1).

42.3 Concept Definition and Analysis

The objectives of the reform of teacher education programs is a unified concept to define and adopt a uniform principle to build around their courses, teacher education should seek to make this principle clear part of each program. School inclusive of all learners and the nature of human variation requires a re-conceptualization of teachers’ roles, and ways to teach students and schools to fulfill an educational role in society.

The Internet has become every one of us in the life indispensable important information platform, how to bring into full play its positive role, make it better for our country campus safety culture construction, we must now a problem to be solved. Internet based campus network is the important infrastructure in school teaching, scientific research, shouldering the important task of management and foreign exchange, network information safety is directly related to the teaching

and research activities such as safety [4]. Therefore, various departments in the school to further study the relevant laws and regulations, and actively improve and implement the relevant rules and regulations, fully aware of the importance of computer network security, improve the work of network security awareness, strengthen security concept, cogent safeguard school in network information security. The school authorities to network safety into the school security focus positions, with the school security work together, together, together to implement the deployment check, ensure the school network information flow, safe, effective, and ultimately makes the safety culture construction is fast finish.

Pre-service teacher professional learning, must have professional knowledge and theoretical basis of three elements [5]: (1) awareness of the teaching profession; (2) the role of technology and the skills needed by the basic tasks actually carried out; (3) ethical aspects education, professional attitudes and beliefs of the way. Cognition by including the following areas of knowledge and theoretical foundations course, can be achieved: the nature of child and human development, particularly the disabled and special needs children how to learn, teaching specific difficulties related to types of strategies, classroom organization and management, identification and assessment is difficult to assess and monitor student learning, legislation and policies.

42.4 Research Methods and Analysis

This paper is mainly school-based survey data to mathematical statistical analysis, to allow a combination of theoretical literature and the actual data analysis, the classification of groups of students conduct research teachers for student diversity and inclusive education from the teaching methods and strategies, the cultural perspective of the teachers 'self and students, classroom environment, teachers' attitude towards diversity, campus culture, involving families and communities in these six areas to be broken down to understand.

The evidence from Table 42.1 and Fig. 42.2 shows, the teaching methods and strategies of the reference value in the project theme, the cultural perspective of the teachers 'self and students, classroom environment, teachers' attitude towards diversity, involve families and communities in five areas is greater than group number of the case, the first two quite different, and the remaining difference is relatively small. But in the campus culture is equal.

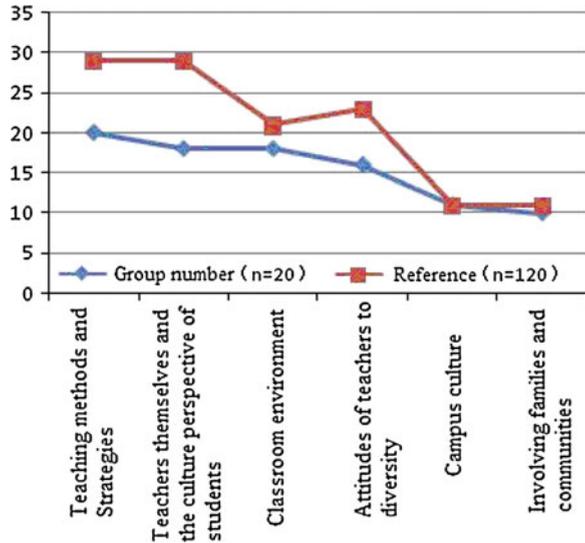
Up in the basis of the following two formulas to establish the conceptual model

$$N = \sum_{i=1}^m n_i, R = \frac{N!}{\prod_{i=1}^m n_i!} \quad (42.1)$$

Table 42.1 The number of groups with the reference value of each project theme

Project theme	Number of groups (n = 20)	Reference (n = 120)
Teaching methods and strategies	20	29
Cultural perspective of the teachers' self and students	18	29
Classroom environment	18	21
Attitude of teachers towards diversity	16	23
Campus culture	11	11
Involving families and communities	10	11

Fig. 42.2 The reference comparison chart of group numbers in each subject

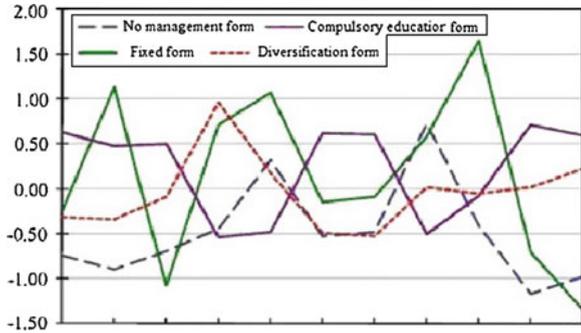


Where N denotes the total number of individual students, and m is the number of categories, n is the number of groups, n_i is the number of individuals, said the students where the class is:

$$H = \frac{\ln R}{N} = \frac{1}{N} (\ln N! - \sum_{i=1}^m \ln n_i!) \tag{42.2}$$

Theory with practice, this is the beginning teachers as well as most teachers. They know that, in the university study and learn in school the gap. Therefore, as an attempt to bridge this gap, technical and practical skills required by internships and project-based learning, including: the transition to a knowledge into action, practice ahead of evidence used in the action research to improve practice, learning how to work with colleagues and children to become “activists” professional. Ethical and moral aspects of teacher attitudes and beliefs, the basis of the formation of the third element included in the education curriculum. Teachers’

Fig. 42.3 Renderings of the various forms of teacher education



attitudes and persons with disabilities and special learning needs of faith and their ability to manage heterogeneous classroom has been the subject of many studies. The teachers believe and recognize the development of new ways: that all children can learn, all children are worthy of education, they have the ability to impact on the lives of children is their responsibility (Fig. 42.3).

As a result of people’s living conditions are getting better and better, everyone for his own children to a computer, the child’s life because the network becomes more convenient at the same time, lots of pornography, fraud, adverse information influences the child ‘s physical and mental health. A few years ago, the Political Bureau of CPC Central Committee on the development of network technology and Chinese network culture construction and management problems of collective learning. President Hu hosted learning points out clearly, leading cadres at all levels should attach great importance to study the Internet knowledge, improving the level of leadership and control ability, and strive to create a new situation of Chinese network culture construction. Therefore, to strengthen the study of network knowledge, you put the network knowledge skillfully applied to work study and life, you is the campus safety culture construction is an important part of. Therefore, the school should be in the setting of network curriculum based on knowledge, must also often hold some network knowledge, to give students systematic curriculum. Students in the universal network knowledge at the same time, the teacher should improve the network knowledge, thus better to teach students, management of students.

In the efforts of restructuring teacher education programs, it is important to discuss the problem of teacher education, and agreed to the concept of a unified, aware of its content and process in an atmosphere of openness and trust. Traditional education is often the method of division, differentiation, and experts on the work, and now education is no longer relevant, this is a special education opportunities is clear values, hopes to promote the education of students’ diverse and inclusive .

42.5 Conclusion

The purpose of this paper is to discuss how the structural adjustment of the existing teacher education programs, to make teacher education to better meet the diverse learning needs, including the special needs of students with disabilities. This paper presents the premise of these discussions is that the reorganization requires expertise in curriculum and teaching in special education (general education), these will be mixed. It must be emphasized that the content and process of integration and unification of the special education teacher pre-service preparation, but that does not mean the end of the training of special education teachers as experts. The knowledge base of education, special education resources and capabilities, also need to be reviewed in order to be able to communicate effectively with other professionals and parents to cooperate, so students can better, more diverse and inclusive education.

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References

1. Li L (2011) Socialist core values of inclusiveness, and in the ideological and political education. *J Bijie Coll* 3(06):57–59
2. Zhao Z (2011) Inclusive development of college students a special group in the perspective of educational research. *J Chifeng Coll* 21(11):225–227
3. Zhou W (2012) Sport firefly instrument of inclusive diversity theory construction. *Psychology* 12(1):111–112
4. Yang W (2008) The construction of the overpass and open education system of personnel training thinking and exploration. *Contin Educ* 14(12):22–25
5. Xu X, Xu H (2009) Starting point the diversity of undergraduate training mode. *Electr Electron Teach* 4(10):37–38

Chapter 43

Robustness of Complex Heterogeneous Networks Under Node Weighting Strategies Against Cascading Failures

Lin Ding and Si-Ying Zhang

Abstract In many real networks, the information or energy flow often communicates through the shortest paths between pairs of nodes, whereby the betweenness centrality may play an important role in the robustness problems against cascading failures. In this paper, a betweenness-based node weighting strategy is proposed to explore the robustness of weighted heterogeneous networks against cascades of overload failures. The optimal weighting parameter obtained by the betweenness-based strategy is almost the same as that of the degree-based strategy. However, with the optimal weighting parameter, the betweenness-based strategy makes the networks more robust. This manifests in the more significantly reduced possibility of the occurrence of cascading failure and the size of the cascade in case of occurrence.

Keywords Cascading failures · Weighting strategy · Robustness · Complex networks

43.1 Introduction

The robustness characteristic of complex networks in response to attacks and random failures has recently attracted a great deal of attention [1]. The key factor prompting this research is the discovery that many real complex networks, such

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as the Internet, the power transmission grids, and financial networks, etc., are heterogeneous in that their nodes connectivity distributions follow a power-law [2]. The heterogeneity of the connectivity makes these networks, called scale-free (SF) networks, tolerant to random failures. But they are susceptible to failure of specific nodes that are highly connected and if such removals occur, the networks disintegrate rapidly [3]. When the redistribution dynamics of flows on the network are also examined, another weakness, i.e., susceptibility to cascading failures (or avalanche), is revealed [4].

Cascading failures are common phenomenon in real-world systems and can happen in many infrastructure networks. Evidence has demonstrated that in such networks, very locally emerging random failures or attacks can largely affect the entire network, even resulting in global collapse. Typical examples are Internet congestions and several largest blackout events in some countries. Owing to the need of understanding and controlling such catastrophes, cascading failures in complex networks have been investigated quite intensively recently [1]. In many previous cascading models, the global redistribution of the load on a failing component (i.e., node or edge) was considered [4–7]. This might not agree with the fact that the load on the failing component is redistributed among its neighbor components in many real networks. Furthermore, the network weights were not taken into consideration [4–6], regardless of the facts that real networks display a large heterogeneity in the weights which have a strong correlation with the network topology. Recently, some progresses were achieved using the cascading model with a local weighted flow redistribution rule [8–11]. In detail, the local weighted flow redistribution rule reflects the local redistribution of load and the weighted features in the real networks. Moreover, it was found that weighted features play a key role in the robustness of the networks, where the weights of network edges (nodes) depended on the degrees of nodes [8–10]. In particular, considering different strategies of network edges, a very recent work [11] indicated that the networks weighted through a certain strategy had the most robustness by researching cascades of edge overload failures. This is very important for designing protection strategies against cascading failures.

However, the weighting strategies and cascading behaviors on the network edges have been considered [11]. In the present work, we focus on a cascade of overload failures when nodes (rather than edges) are sensitive to overloading, and study the effects of different node weighting strategies on the robustness of heterogeneous networks against cascading failures.

43.2 Local Weighted Flow Redistribution Rule Based on Node Failure

We consider the local weighted flow redistribution rule (LWFRR) based on node failure introduced by Wu et al. [9]. In this rule, when a node i is subject to an attack and removed from the network, the load on the broken node i (i.e. the flow

passing through it) is redistributed to the neighboring nodes. The additional load ΔL_j received by the neighboring node j is proportional to its weight, i.e.

$$\Delta L_j = L_i \frac{w_j}{\sum_{l \in \Gamma_i} w_l}, \quad (43.1)$$

where Γ_i is the set of neighboring nodes of i , and L_i is the load on the node i before being broken.

Each node j in the network has a weight threshold or capacity C_j , which is the maximum load that the node can handle. The capacity C_j of the node j is assumed to be proportional to its initial load w_j , i.e., $C_j = Tw_j$, where the constant $T (\geq 1)$ is a threshold parameter characterizing the tolerance of the node j to additional load [4, 5]. So, for a neighbor j of the node i , if

$$L_j + \Delta L_j > C_j = Tw_j, \quad (43.2)$$

then the node j will be broken, inducing further redistribution of load $L_j + \Delta L_j$ and potentially further nodes' breakdown. Cascading failure process does not stop until the load of each node is less than its capacity.

43.3 Weighting Methods

A key issue in the characterization of networks is the identification of the most central nodes in the network. Centrality can be quantified by various measures. The degree is a first intuitive and local quantity that gives an idea of the importance of a node. The degree (or connectivity) k_i of a node i is the number of edges incident with the node. However, such local measure does not take into account non-local effects, such as the existence of key nodes which may have small degree but act as bridges between k_i parts of the network. In this context, a quantity widely used for investigating node centrality is the betweenness, which counts the fraction of shortest paths between pairs of nodes that passes through a given node. More precisely, if σ_{st} is the total number of shortest paths from s to t and $\sigma_{st}(i)$ is the number of these shortest paths that pass through the node i , the betweenness B_i of a node i is defined as

$$B_i = \sum_{s \neq t} \frac{\sigma_{st}(i)}{\sigma_{st}} / (N(N-1)), \quad (43.3)$$

where N is the network size, i.e., the total number of nodes in the network.

These centrality measures can be used to estimate the weights in a weighted network. Reference [9, 10] used the power-law function of degree of a node as measure for node centrality to model the weight of the node, i.e., $w_i = k_i^\theta$, where θ is a tunable weight parameter, governing the strength of the node weight. We call this method as a degree-based weighting (DW) method. It is found that $\theta = 1$ leads to the strongest robustness on SF networks against cascading failure.

Here, we propose a betweenness-based weighting (BW) method, and the weight of a node is defined as the power-law function of its betweenness, that is, $w_i = B_i^\theta$. This weighted method is in accordance with the fact of many real networks. For example, in the Internet data packet often communicates through the shortest paths between pairs of nodes, so the more the shortest paths the router is passed by, the more probable it is to be chosen when sending a packet.

43.4 Results and Analysis

In order to better investigate the robustness of weighted SF networks against cascading failures, a typical network, i.e., a Barabási-Albert SF network [2] is considered and weighted through the different strategies including the DW strategy and BW strategy.

To explore the effect of a small initial attack on the cascading model, we remove only one node i initially and calculate S_i (here S_i denotes the avalanche size, i.e., the number of broken nodes, induced by removing i). Since $0 \leq S_i \leq N - 1$, we adopt the normalized avalanche size $S = \sum_{i \in N} S_i / (N(N - 1))$, where the summation over all the avalanche sizes is obtained by removing each node initially at each time. The lower S , the more robust the network is against cascading failure. There exists a minimum threshold, i.e., the critical threshold T_c . When $T \geq T_c$, no cascading failure arises and the system preserves its normal functioning; while when $T < T_c$, S suddenly increases from 0 and cascading failure emerges, causing the whole or part of the network to stop working. Here T_c is a significant measure in determining a network's robustness, since it is the least value of protection strength to avoid cascading failure. Apparently, the lower the value of T_c , the stronger the robustness of the network against cascading failure.

It has been shown that the values of $\theta = 1$ are optimal for the DW method. Here, we investigate the relationship between the weight parameter θ and the critical threshold T_c on BA networks with the weights assigned by the BW method. As shown in Fig. 43.1, all these networks display the strongest robustness level at $\theta \cong 1$ for all different average degrees. We also derive some theoretical analysis for better understanding this observed phenomenon.

In order to avoid cascading failure in a network, the flow passing from each node after flow redistribution should remain less than its capacity [see Eq. (43.2)]. From Eqs. (43.1)–(43.2) and using the weighting method as $w_j = B_j^\theta$, one can derive

$$\frac{B_i^\theta B_j^\theta}{\sum_{l \in \Gamma_i} B_l^\theta} + B_j^\theta < T B_j^\theta. \quad (43.4)$$

Here $\sum_{l \in \Gamma_i} B_l^\theta = \sum_{B'=B_{\text{Min}}}^{B_{\text{Max}}} k_i P(B'|B_i) B'^\theta$, where $P(B'|B_i)$ is the conditional probability that a node of B_i has a neighbor of B' . BA network does not show any

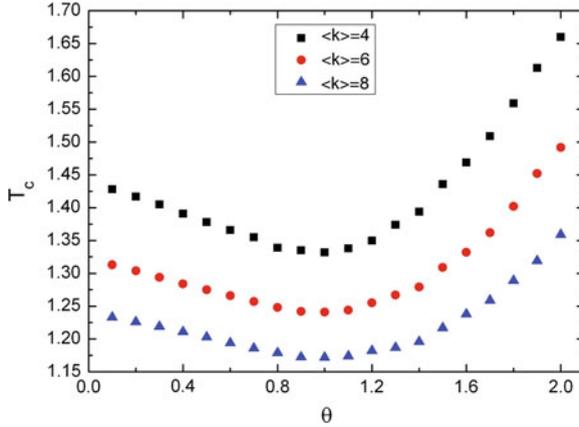


Fig. 43.1 T_c as a function of θ for different average degrees $\langle k \rangle$ on BA networks. $N = 1000$. Each data point is averaged over 20 different network realizations. For the BA model, $\langle k \rangle = 2m$, where m is the number of edges attached to the existing nodes from the new node and $k_{\min} = m$

significant betweenness–betweenness correlations [11], and thus, one can write $P(B^l | B_i) = P(B^l)$. Hence, we have $\sum_{l \in \Gamma_i} B_l^\theta = k_i \langle B^\theta \rangle$. Therefore, one may rewrite Eq. (43.4) as

$$\frac{B_i^\theta}{k_i \langle B^\theta \rangle} + 1 < T. \tag{43.5}$$

Noting that Eq. (43.5) gives us an estimation for T_c . Assuming $\theta \geq 1$ in Eq. (43.5), we can derive the solution for T_{c-1} by replacing B_i with B_{\max} as

$$T_c(\theta \geq 1) - 1 = \max\left(\frac{B_i^\theta}{k_i \langle B^\theta \rangle}\right) \approx \frac{B_{\max}^\theta}{k_i \langle B^\theta \rangle}. \tag{43.6}$$

We have

$$\begin{aligned} \frac{B_{\max}^\theta}{k_i \langle B^\theta \rangle} &= \frac{B_{\max}^\theta}{k_i \frac{1}{N} \sum_{i=1}^N B_i^\theta} = \frac{B_{\max}}{k_i \frac{1}{N} \sum_{i=1}^N B_i (B_i^{\theta-1} / B_{\max}^{\theta-1})} \\ &> \frac{B_{\max}}{k_i \frac{1}{N} \sum_{i=1}^N B_i} = \frac{B_{\max}}{k_i \langle B \rangle} = T_c(\theta = 1) - 1. \end{aligned} \tag{43.7}$$

Hence, we can get $T_c(\theta > 1) > T_c(\theta = 1)$. For $\theta \leq 0$, we can derive the solution for $T_c - 1$ by replacing B_i with B_{\min} in Eq. (43.5).

$$T_c(\theta \leq 0) - 1 = \max\left(\frac{B_i^\theta}{k_i \langle B^\theta \rangle}\right) \approx \frac{B_{\min}^\theta}{k_i \langle B^\theta \rangle}. \tag{43.8}$$

We have

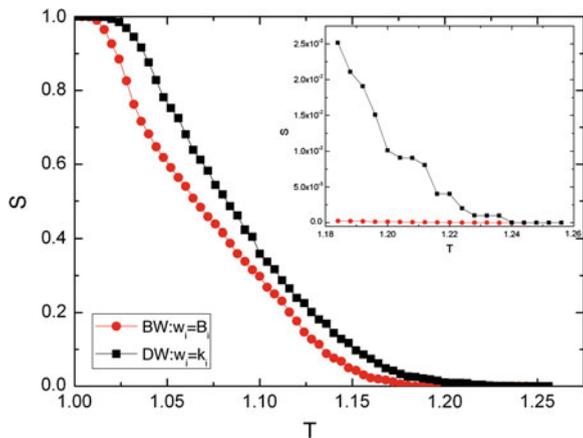
$$\frac{B_{\min}^\theta}{\langle k_i \langle B_i^\theta \rangle \rangle} = \frac{B_{\min}^\theta}{k_i \frac{1}{N} \sum_{i=1}^N B_i^\theta} = \frac{1}{k_i \frac{1}{N} \sum_{i=1}^N (B_i^\theta / B_{\min}^\theta)} > \frac{1}{k_i} = T_c(\theta = 0) - 1 \quad (43.9)$$

Similarly, we can also get $T_c(\theta < 0) > T_c(\theta = 0)$. Apparently, the network reaches its strongest robustness level at $0 < \theta < 1$.

Although we cannot derive an equation for approximating the T_c for $\theta \in [0, 1]$, we can estimate the T_c for $\theta \in [0, 1]$ numerically. As Fig. 43.1 shows, the strongest robustness level results from $\theta \cong 1$, which indicates that the BW method has the optimal weighting parameter, which is almost the same as that of DW method. So we adopted $\theta = 1$ for the further comparative analysis.

In the case of $\theta = 1$, for DW and BW strategy the weight of each network node is its degree and betweenness, respectively. To explore which of the weighting strategies can result in the stronger robustness of SF networks against cascading failures, we investigate the relationship between S and T for BA networks weighted with the two strategies discussed above. As shown in Fig. 43.2, the BW strategy results in the less T_c . In order to facilitate the observation, a detail when $T > 1.18$ is given in the inset, $T_c \approx 1.256$ for the DW strategy; while $T_c \approx 1.241$ for the BW strategy. In addition, on networks weighted with the BW strategy the normalized avalanche size develops in a slower rate. This point is reflected by the smaller S for the BW strategy at a given value of T and denoted by $S_{BW} < S_{DW}$. For instance, when $T = 1.036$, $S_{BW} \approx 72\%$ and $S_{DW} \approx 92\%$. These indicate that our weighting strategy (BW strategy) can more significant reduce the chance of an overload avalanche and its size in case of occurrence. Hence, we can conclude that heterogeneous networks in which the weight of each node is its betweenness have the more robustness against cascades of node overload failures.

Fig. 43.2 S as a function of T for BA networks weighted with the two strategies. The inset is a detail when $T > 1.18$. $N = 1000$, $\langle k \rangle = 6$. Each data point is averaged over 20 different network realizations



43.5 Conclusion

In this paper, we study the robustness of weighted heterogeneous networks against cascading failures triggered by a small node initial attack. Different from the previous degree-based node weighting strategy, a betweenness-based node weighting strategy is proposed, namely the weight of a node is defined as the power-law function of its betweenness, where power exponent is a tunable weight parameter. With the two strategies, we apply the local weighted flow redistribution rule to investigate cascading phenomenon on BA scale-free networks, by making the initial load of each node be its weight and the capacity of each node be proportional to its weight. For the betweenness-based strategy we obtain the optimal weighting parameter, which is almost the same as that of the degree-based strategy. However, with the optimal weighting parameter, the betweenness-based strategy makes the networks more robust, showing that the possibility of the occurrence of cascading failure and the size of the cascade in case of occurrence are more significantly reduced. Our studies reveal that a heterogeneous network against a cascade of overload failures can be made much more robust by assigning proper weights for nodes. In particular, recently Ercsey-Ravasz and Toroczkai [12] showed that the betweenness can be well approximated in a local manner to reduce its computational complexity. This makes our proposed strategy can be used practically for the robustness problem of large-scale real networks against cascading failures.

References

1. Boccaletti S, Latora V, Moreno Y et al (2006) Complex networks: structure and dynamics. *Phys Rep* 424:175–308
2. Barabási A-L, Albert R (1999) Emergence of scaling in random networks. *Science* 77:286–509
3. Albert R, Jeong H, Barabási A-L (2000) Error and attack tolerance of complex networks. *Nature* 406:378–382
4. Motter AE, Lai YC (2002) Cascade-based attacks on complex networks. *Phys Rev E* 67:66–102
5. Huang L, Lai YC, Chen GR (2008) Understanding and preventing cascading breakdown in complex clustered networks. *Phys Rev E* 78:3–16
6. Li P, Wang BH, Sun H et al (2008) A limited resource model of fault-tolerant capability against cascading failure of complex network. *Eur Phys J B* 62:77–89
7. Yang R, Wang WX, Lai YC et al (2009) Optimal weighting scheme for suppressing cascades and traffic congestion in complex networks. *Phys Rev E* 12:79–112
8. Wang WX, Chen GR (2008) Universal robustness characteristic of weighted networks against cascading failure. *Phys Rev E* 77:26–101
9. Wu ZX, Peng G, Wang WX et al (2008) Cascading failure spreading on weighted heterogeneous networks. *J Stat Mech* 5:5–13

10. Wang JW, Rong LL, Zhang L et al (2008) Attack vulnerability of scale-free networks due to cascading failures. *Phys A* 27:387–667
11. Mirzasoleiman B, Babaei M, Jalili M et al (2011) Cascaded failures in weighted networks. *Phys Rev E* 84:5–29
12. Ercsey-Ravasz M, Toroczkai Z (2010) Centrality scaling in large networks. *Phys Rev Lett* 77:105–387

Chapter 44

Algorithm of Webpage Update Detection Based on Body Text

Guowei Chen and Pengzhou Zhang

Abstract In the process of Internet information recycles, especially in the application of resource download, we need to judge whether a webpage is updated or not. So we can decide the resource that whether it needs to be downloaded or not. In this paper we put forward an algorithm about the webpage update detection which is based on the webpage's body text. This algorithm is based on extracting Chinese text feature and judges whether a webpage need to be updated or not by analyzing the feature. The result shows that this method has high detection rate and quick progressing speed.

Keywords Body text · Update detection · Update degree · Detection rate · Resource download

44.1 Introduction

In the process of Internet information recycles, especially in the application of resource download, it will account for a large proportion and take much time to download the resource [1, 2]. The update detection at present has two situations. One situation aims at updating detection of different WebPages. There's a lot of research about it and some of the research is in-depth [3]. There're also many solutions, such as information fingerprint algorithm, segmentation signature algorithm, copying webpage algorithm based on keywords [4], random mapping

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algorithm, approximate webpage found algorithm and so on. The second situation is about whether updating or not in the same URL. It is called webpage update detection. There's little research about the second situation. So we do a lot of research and finish this paper which is about the second situation.

Hash value algorithm is one of the traditional webpage update detection algorithm [5]. It makes any length of binary value map for fixed length smaller binary values. The smaller values are hash values. Hash value is a data only and extremely compact numerical representation. If there're a paragraph of plaintext and even only change a letter of a word, then the hash value will produce a different value. Through the comparison of webpage hash values we can judge whether the webpage update or not. Its advantage is very quick, but it has obvious shortcoming that in the webpage if there's any small change such as advertising change or the changes of page views which will lead to hash results different. In fact these changes have no effect on webpage content. That's to say that the webpage has no update. If we couldn't judge whether a webpage updates or not accurately, it may lead to repeat download. It not only influences retrieval accuracy, but also wastes much time to download and much space to store it. So it's great work of practical application value. Based on this, this paper puts forward an update detection algorithm about webpage's content, aiming at detecting the condition of webpage updating. We will quickly discover that if the webpage has been maliciously modified, which is of vital importance on content and resources supervise of Internet.

44.2 Algorithm Design

In the process of algorithm design, to guarantee the advantages as well as the performance especially used in the special context use, we choose the principles as follows.

44.2.1 Design Principles

- a. Veracity principle in this algorithm, we strive to have a high veracity in the process of update of WebPages. To accomplish this goal, we adopt the strategy integrated of more than one judge regulation, which will be particularly introduced in the third part of my article.

Why to choose the strategy of judging whether the webpage need to be updated or not? Because in the practical application, if we cannot give the exact judgment, we have to download many resources which still keep as before. And as we can see, the process of downloading will cost quite a lot of time, and the storage will cost large space, which will reduce the function or performance of the whole system. In the other scene, we will miss the latest content of the WebPages information as well as the resources.

So we should choose an appropriate algorithm to make sure we can make a veracious judgment.

b. Quick principle

On the Internet, it means high efficiency of the algorithm that if we can make quick update detection. In the practical application, web crawlers will decide to crawl the resource or not on the basis of the result of judgment. So, the algorithm should give a quick response to the recognition.

c. Adaptability principle

There are three patterns of the WebPages when updating, the first pattern is entire update, i.e. replace the entire content of the webpage. The second pattern is particle update, i.e. replace part of the content of the webpage. The third pattern is copy update, i.e. the webpage adds some content quite similar to the original content. And we design special judge principle on the basis of each of the patterns.

At the first step, we judge which pattern fit the given webpage, if none, we will use integrated judgment pattern, to judge whether the webpage update or not.

44.2.2 The Characteristic of the Algorithm

a. Chinese word segmentation, i.e. using the pattern of semi-natural language

Concerning the Chinese text processing, basic processing is the Chinese word segmentation, feature extract. Then use all sorts of different calculation methods for different application processing. As our aim is to detect whether the webpage content updates or not, it's reasonable and right to detect the content based on Chinese word segmentation and feature extraction.

b. High recognition rate

In the process of verification and testing of the algorithm, we test on different testing sets. The result shows that this algorithm has high recognition rate.

c. High efficiency

As we use the Chinese word segmentation method is selected, and the screening of word segmentation method is also in our experiment conditions. So firstly Chinese word segmentation is relatively fast. Then in a follow-up treatment process, we use a simple calculation method which makes the algorithm has the faster speed and response.

d. Update recognition based on the body text of the webpage

We detect webpage's update based on body text, which filter out some redundant information update discrimination caused by mistake, as follows, the change of AD messages, the change of the information of navigation bar and so on.

The information is not the webpage's content, so their changes don't influence webpage contents.

44.3 The Algorithm of Webpage Update Detection Based on Body Text

Our work focuses on how to extract the body content of Chinese webpage properly; We get the body text at different time from the same URL, extract their feature, compare them, and ultimately determine the content text which's specified by the URL whether is updated; If the result of our determination is updated, it means that the webpage was updated, otherwise webpage wasn't updated. The algorithm consists of three major steps, as follows, webpage preprocessing, Chinese word Segmentation, and update detection.

44.3.1 Algorithm Model

There are three important steps in the algorithm designed for the webpage update detection based on the body text of the webpage, the first step is to preprocess the data of the webpage, and the second is Chinese word segmentation, and the third step is to judge whether the webpage was updated or not.

a. Preprocess of the data of the webpage

There are some basic parts constituting a webpage, such as title, description, keywords, main body, advertisement, and navigation bar and so on. The goal of the preprocess is to extract the title, description, keywords, and body text of the webpage, wiping out the unimportant content, then constitute a standard Chinese text, where weight of the information resource is not distinguished. And the content extraction algorithm is on the basis of knowledge base, and the paper introducing the algorithm is being written.

b. Chinese word segmentation

As is known to all, the first step of Chinese natural language processing is Chinese word segmentation, and the second step is feature extraction. So, at first we will make Chinese word segmentation on the text from the preprocess step, and get two Chinese word segmentation result sets of the Chinese webpage got from the same URL.

c. The judgment of the update of the webpage

We will compare the two sets to judge whether the webpage update or not, besides, we will carry out different measure method for different updating pattern of the webpage.

The detailed process of model is showed in Fig. 44.1.

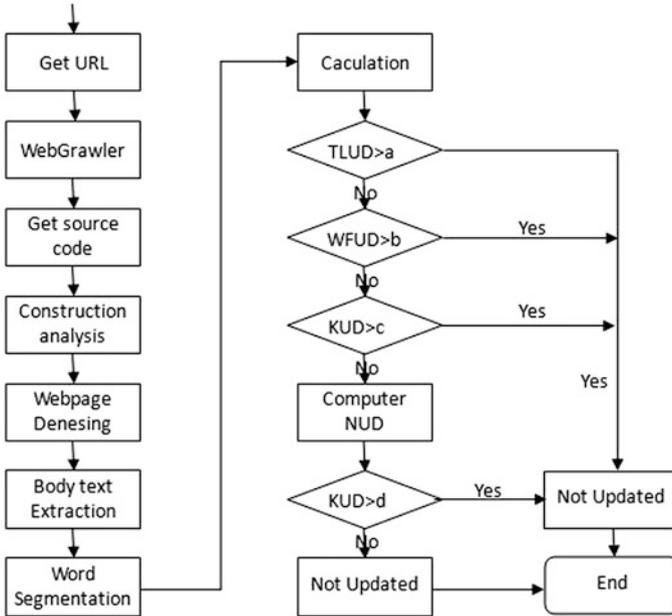


Fig. 44.1 The process of model. *Note* the Fig. 44.1 is the process of a single-process on one webpage. The detailed introduction of the algorithm will be introduced in Sect. 44.3.2

44.3.2 The Algorithm of Webpage Update Detection

This section gives a detailed description about the steps mentioned in Sect. 3.1. At the beginning, some definitions should be given that will be used in the following description.

Body text is defined as the main information of a webpage; it contains the title, keywords, description, and some text in body.

Update degree is defined as the distinction level between two texts.

For the one URL, we get its body text at different times, and what we should do is to detect whether the webpage specified by the URL update or not, the following are the detailed steps of the algorithm.

- (1) Get all source code (html) of the webpage specified by the URL;
- (2) Analysis the construction of source code(html), and denoise the webpage specified by URL, such as navigator text, advertisement, and so on, and extract the body text of webpage, denoted by $T(UR L)$;
- (3) Segments the $T(UR L)$ word by word and put the each word in a set, marked the set as $W(T) = \{w_1, w_2, w_3, \dots, w_n\}$;
- (4) Statistic Word frequency:

For each word in $W(T)$, set a counter to record the number of word's occurrences; if reach the end of the set, remove word in set and start the

second round, at same time, put the value into a new set $W_f(T) = \{\langle w_1, fw_1 \rangle, \langle w_2, fw_2 \rangle, \langle w_3, fw_3 \rangle, \dots, \langle w_n, fw_n \rangle\}$, the element formal of $W_f(T)$ is $\langle w, f \rangle$, f is the word' occurrences.

- (5) Set $L(X)$ as the Symbol of the length of set X , now calculate $L(W(T))$, $L(W_f(T))$;
- (6) Calculate the update degree; we design three dimensions to measure the update degree;
Text's length update degree (TLUD) is the variation of $L(W(T))$;

$$TLUD(URL) = |L(W(T_1)) - L(W(T_2))| \div L(W(T_1)) \quad (44.1)$$

word's frequency update degree(WFUD) is the variation of $L(W_f(T))$;

$$TFUD(URL) = |L(W_f(T_1)) - L(W_f(T_2))| \div L(W_f(T_1)) \quad (44.2)$$

keywords update degree(KUD) is used for weight the change of keywords; we get the top $m = L(W_f(T_1))/3$ as the keywords of the body text,

$$KUD(URL) = \left\{ \sum_{\substack{1 \leq i \leq m \\ 1 \leq j \leq m}} (f_i - f_j), (\langle w_i, f_i \rangle \text{ in } W_f(T_1), \langle w_j, f_j \rangle \text{ in } W_f(T_2), w_i = w_j) \right\} \quad (44.3)$$

Let sub set $s = \{\langle w_i, f_i \rangle, \langle w_j, f_j \rangle \text{ in } W_f(T), W_f(T) \text{ is ordered by } f_i \text{ desc}\}$;

$$r = \sum_{j=0}^{j < L(s)} f_j \quad (44.4)$$

- (7) Judgment rules: if the values of step 6 meet the conditions as follows, $TLUD > a$, $WFUD > b$, $KUD > c$, we can get the result that the webpage was updated; Otherwise, we compute the mixed update degree(MUD), defined as:

$$MUD(URL) = [n_1 \times TLUD(URL) + n_2 \times WFUD(URL) + n_3 \times KUD(URL)] \div L(W(T_1)) \times 2, 0 < n_1, n_2, n_3 < 1, n_1 + n_2 + n_3 = 1 \quad (44.5)$$

If MUD (URL) exceed the threshold (value is d), we are sure that the webpage was updated, or not updated.

Table 44.1 Test results

Scene	Total URLs	Reality	Detection	Precision (%)
Scene 1	1367	134	118	85.07
Scene 2	1254	164	152	92.68
Scene 3	1437	145	133	90.34

44.4 Experiments

44.4.1 Test Results

In our test context, we set $a = 0.1$, $b = 0.08$, $c = 0.12$, $d = 0.073$.

Scene 1: in this scene, we carry out the test on 1367 different URLs, and set 15 days as the time interval. Scene 2: in this scene, we will carry out contrived randomly copy update on the text of some, suppose M, WebPages. Scene 3: in this scene, we will carry out contrived randomly theme replacement and main body text replacement.

Our experiment result is shown in Table 44.1.

44.4.2 Results Analysis

The results show that the length of the body text is a key factor affecting the Precision. The longer the length of the body text, the lower the accuracy. This is attributed to denominator which has much relation to text's length we used. Fortunately, most of webpage's body text is short. If you want to processing longer text, you should use smaller value of thresholds.

44.5 Summary

In this paper, we have proposed an algorithm of webpage update detection based on body text, which uses Chinese word segmentation method; denoise the html data and simple computing method. The results show that it has rapidly response and processing speed, especially applied in short body text update detection.

Acknowledgments Thanks for sponsors of, 2009BAH40B04, CNGI-09-03-15 and NCET-09-0708.

References

1. Elhadi M, Al-Tobi A (2009) Webpage duplicate detection using combined POS and sequence alignment algorithm. In: 2009 WRI world congress on computer science and information engineering, vol 76, pp 630–634
2. Liu KY, Zheng JH (2002) Research of automatic Chinese word segmentation. Proc Int Conf Mach Learn Cybern 55(2):805–809
3. Abudoulikemu Y (2010) The research and application of the Chinese machinery word segmentation algorithm based on improved patricia tree dictionary. In: 2nd international conference on signal processing systems (ICSPS), 2010, vol 54, pp 341–345
4. Wang FL, Yang CC (2007) Mining web data for Chinese segmentation. J Am Soc Inform Sci Technol 58(12):1820–1837
5. Ma WY (2007) Effective analysis of Chinese word-segmentation accuracy. Mod Electron Technol 4(243):108–111

Chapter 45

Research on Enterprise Application System Integration Based on Web Services and Agent

Xin Jin and Xu Zhao

Abstract This paper introduces the requirement of enterprise application system integration, and analyzes the disadvantages of the traditional application integration technologies, then proposes application system integration architecture based on Agent and Web Services. It also introduces the logic hierarchy model, and analyzes the application system integration mechanism, then proposes application system integration processes based on Agent with the services as the core.

Keywords Agent · Application system integration · Services

45.1 Introduction

Due to the influence of information technology, globalization and liberalization of the economy, today's enterprises are faced with unprecedented challenges and changes. In this new economic era, no single company can meet the market demand by their own forces. In order to occupy more market shares, a new mode of economic operation named e-commerce communities came into being. The so-called e-commerce community, basically, can be seen as a group of enterprises based on common strategies, objectives and interests of the formation of the collection. Businesses and individuals in the community are responsible for a specific mechanism, and benefit themselves from businesses and individuals as well. Through the exchange of value sharing mechanism, the basis of enterprise or individual cooperation and community management has been formed. The essence in the trends of community cooperation is structured and spontaneous, which may

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come from the industrial cooperation, or from the face of the common market segment and consumer needs.

In such e-commerce business model, challenges have been brought to information sharing and process integration. However, as a result, enterprise information system integration and collaboration have been motivated [1].

Application system integration is the final rendering of the business process and data flow in the information system. During application integration, issues from the internal logic of the application system changes, interactions between all applications and application data format transforming between systems are often being considered. And commonly, under the process of enterprise development, application systems are varied constantly due to the development, import and modification of different business needs [2, 3].

Traditional application integration is usually invoked by Remote Procedure Call, and Shared Data Files, or the database. However, these modes are far from satisfaction in the performance of efficiency, integrity and system maintenance. When the system has some problem, it is difficult to find out the cause. Sometimes the only solution is to modify, supplement or delete the wrong records through artificial methods. As a result, not only should the technical staff consider the business logic needs at the time of writing a program, one must also take into account operational errors and necessary processing when exceptions happened (in most applications, the part, which handles business logic, is far less than half of all orders).

Using Agent Technologies to address the inadequacy of the traditional methods are hotspots of application integration researching. Agent, generally speaking, is a software entity that completes tasks by active service. It has the features of autonomy, perception, initiative and interactivity, which equals to the general sense of giving humanistic elements to objects. These characteristics have brought new vitality to distributed computing in the Internet environments, such as people cooperate over the network, Network intelligence, and so on. Agent's autonomy enables object service requests more transparent; allowing service requester and interoperability of middleware need only know the service interface. And under the direction of certain conditions, using Agent with active senses to provide services to request, can improve the efficiency of the service and reduce service request expenses [4, 5].

In the process of system integration, when Agent used as a single entity of multiple entities, it always has features of autonomy, sociality, responsiveness and spontaneous, which can give issues, including application integration for heterogeneous application environments required by cooperation communication, effective information sharing service, and personalized service, better implementation solutions.

This paper will discuss application system integration design based on Agent. Agent, as multi-layer entities in the system, mainly accomplishes the top services and the underlying communication, which is sorts of response services or consultation services.

45.2 Traditional Application Integration Models

Traditional application integration strategies are as following:

Use application program interface Application Programming Interface (API). Problems frequently encountered by using API, is that when the number of system continuously increases, API will follow the exponential increase. And data exchanged through API technology must have a fixed format, for this strategy does not support access control and error recovery features.

Pass fixed text fields through a network shared directory. Because it uses batch processing, application of this technology often leads to delays. In addition, it is usually a lack of a management mechanism for sensitive data, which is stored in a shared direction as other data files. Obviously, this technique is unsuitable for online operating environment.

Open the database to other applications. This technology solves the problem of parallel access to data, but also leads to some security concerns because users can't access data at the same time.

Because of the improper of traditional integration technologies, our research on application integration presents opportunities and challenges. The following part will introduce the research of enterprise application based on Agent Technology [6].

45.3 Application Integration Architecture Based on Agent

45.3.1 System Architecture

We want to use AGNET technology to solve the shortcomings brought by the traditional information technology. Their logical systems are shown in Fig. 45.1:

Application systems integrate the content of the application system by integrating the portal Application Integration Portal (AIP). It is worth to noting that AIP organizes the content of an application system according to the relationship of enterprise application rather than simply save all the content in the local. For example, workflow A and workflow B, which belongs to system A and system B respectively, can be used as workflows on a single system after integrating the portal AIP. And this seamless integration of the system is important for the construction of reconfigurable components.

As shown in Fig. 45.1, there is a multiple-level Agent application entity in the system and levels are classified by the application features, such as the business level, consultation level, etc. Detailed Agent level design will be introduced in the next section.

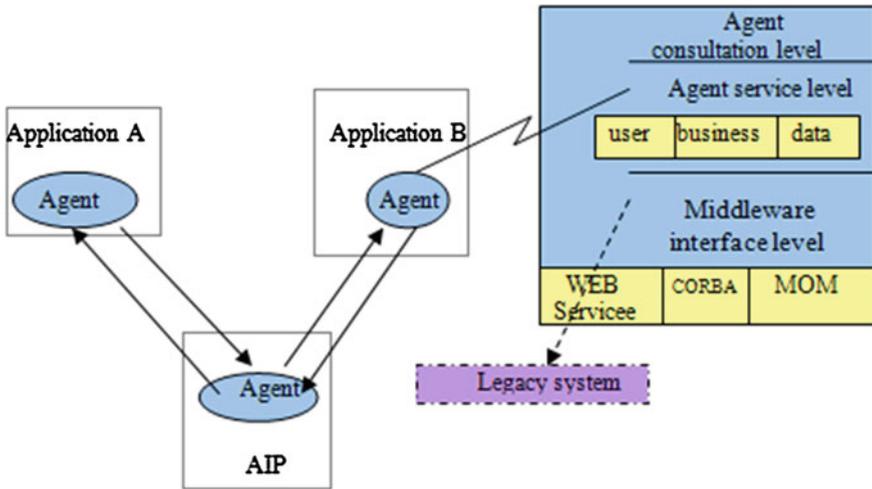


Fig. 45.1 Integration architecture based on agent application

45.3.2 Single-Level Agent Logical Model

Single-level Agent Logical hierarchical model is shown in Fig. 45.1. In the process of application system integration, the main function of negotiation level of Agent is to coordinate activities between different applications. When an application requires additional service from another Agent, it does not access the related Agent directly, but acquire the appropriate service through the integrated Agent between enterprises.

The service level of Agent provides services for application system and Agent consultation level. Services, including user services, business services, and data services are provided. The user service function provides information, functionality and browsers to locate the user interface, ensuring consistency and integrity. Business service provides a shared business policy, generating business information from the data generation to ensure the consistency of information. It also provides the definitions of business workflow activity rule, ensuring the application system internal workflow activity restriction mechanism. Data service: Data definition, data storage and retrieval, ensure the consistency of the data. Using Agent services, application requirements can be broken down into clearly defined service. After defining the service, we need to further create specific physical components to achieve them. And these components are always universal, open interface standards and compliance, so they can be reused, and can be shared within the application as well.

Agent Middleware interface layer provides different solutions to the system integration problems. The best choice for legacy applications and open system integration is the message-oriented middleware (MOM) and ORB. The main

reason to choose MOM is that it supports a number of different communication mechanisms, with which developers can break the limitation brought by legacy systems in a wide range of methods. And the object-oriented middleware (CORBA or COM/DCOM) presents a strong potential in the Integration of legacy systems as well. Having advantages like advanced software bus and object-oriented technology, CORBA is easy to achieve the integration of legacy systems. It is also allowed a packaged legacy application to be reused as a component of a structure based part.

Web services also implemented the mechanisms of service requesting, service registration and service delivery, which greatly simplify the integration with distributed legacy systems.

45.4 Service-Oriented Working Mechanisms Based on Agent Integration System

Web service is the mainstream of distributed computing, so the core of Integration system based on Agent is web service. The framework of application integration using Agent is shown in Fig. 45.2. In the framework, application system is central on the service, mainly including the following contents:

Master Matching Agent: the entrance of the application integration system for service requester and implements the master matching function.

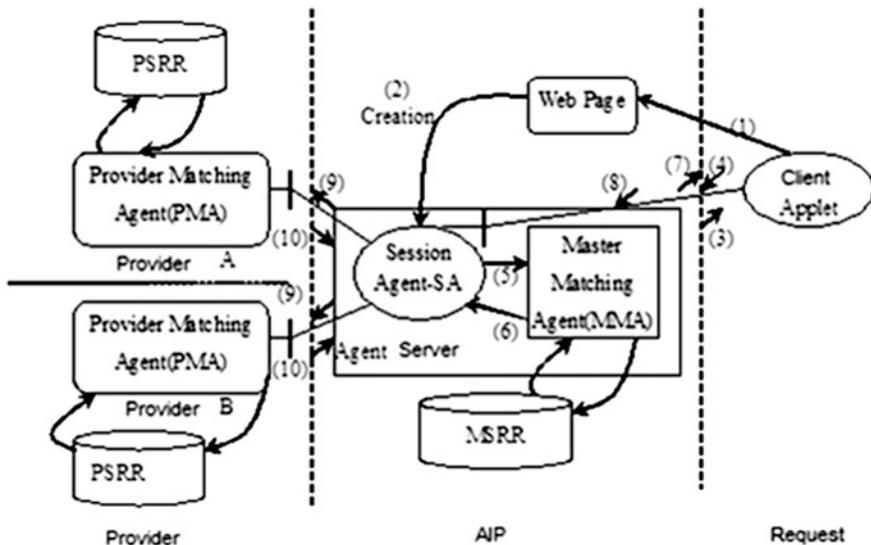


Fig. 45.2 Application of integration working system model based on Agent

Provider Matching Agent: Packaged in each web service provider system, implement the detail matching for each web service request.

Master Service Registry Repository: Store all the information of registered web services in the entire application integration system, and provide web service matches for MMA. The storage of web service is according to the web service description language basing on XML format.

Provider Service Registry Repository: Store the complete register information of web service for providers, and offer detailed matches for PMA. The register information is stored according to the web service description language.

In this application integration model, a service request can finish a series of service matching operations through integrating the platform AIP. The working mechanisms are shown in Fig. 45.2:

- (1) Service requests submitted a web service through the client to a WEB page in the server;
- (2) Agent Manager will stimulate a Session Agent (SA) according to the service request;
- (3) When the SA knows where the demand comes from, it will return the user a Client-Applet, through which guide the user to fill in the basic web service query information;
- (4) Pass the information to SA again;
- (5) SA will extract the necessary data and convert it to XML format query description. Then, this information will be passed to MMA;
- (6) MMA will automatically search the matching web service set in the related MSRR according to the description. And return the result set to SA;
- (7) SA returns the results to users;
- (8) Users on the browser side will select one or more web service providers depending on the result set and then submit again;
- (9) After receiving the specific web service provider information, SA will connect the PMA directly, and implement web service dynamic binding at the same time;
- (10) The appropriate provider's PMA will match the web service request according to PSRR. And the proper service system will establish a connection to the service request through SA in the end.

45.5 Conclusion

Along with the research on the application of artificial and distributed collaborative computing, people have discovered that Agent technology can offer a great solution to address the issue of coordination and integration, which is due to the advantages of Agent system, such as autonomy, self-adaptability. In multi-level Agent system, the restrictions on centralized control, planning control and sequence control are released, and new functions, including distributed control,

emergency and parallel processing are added. Another advantage of Agent system is that it can provide efficient service with low cost. From the discussion, we may acknowledge that Agent technology is a promising technology, and we hope that the research in this paper can offer help to the related researches and applications.

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References

1. Shan X (2005) Complex electronic matching service system based on mobile agent. *Comp Eng* 28(9):35–37
2. Hattori F, Ohguro T (2008) Socialware: multiagent system for supporting network communities. *Commun ACM* 42(3):7–8
3. W3C WebService Architecture Working Group (2004) . Web Service Architecture. <http://www.w3c.org/TR/2004/NOTE-ws-arch-0211>
4. Nguyen XT, Kowalczyk R (2009) WS2JADE: integrating web service with Jade agents. *Proceedings of the 2007 AAMAS international workshop*. vol 11, issue no 9, Springer, Berlin, pp 147–159
5. Greenwood D, Lyell M, Mallya A, Suguri H (2010) The IEEE FIPA approach to integrating software agents and web services. *Proceedings of the 6th international conference on autonomous agents and multiagent systems*, Hawaii, vol 11, issue no 5, pp 12–13
6. Russell S, Peter N (2008) *Artificial intelligence: a modern approach*, 3rd edn. vol 20, issue no 19, Prentice Hall, Upper Saddle River, pp 88–89

Chapter 46

Study of Certainty Factor Model in Attribute Mining

Yanfeng Jin, Yongping Wang, Keming Geng and Baozhu Zhao

Abstract The certainty factor is an inaccuracy inference model used by MYCIN system. It is a reasonable and effective inference model for many practical applications. This paper will focus on the analysis of text messages of magazines and build the audiences' interest, keywords of their careers. Based on the certainty factor, we can calculate the value of the certainty factor with some comprehensive conditions, and then learn the audiences' interest, the level of the certainty factor for their careers with the value in different conditions. This conclusion could be applied to direct mail database marketing to get a better result.

Keywords Certainty factor · Data mining · Keyword database · Comprehensive conditions

46.1 Introduction

Uncertain reasoning is one of the most active research areas in artificial intelligence. It is also the key technology for computer Intelligence System to be practical. The recent 40 years, a group of scientists dedicated to uncertain reasoning, propose a

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number of reasoning methods about uncertainty, such as the uncertainty factor method proposed by Shortliffe and Buchanan, Zadeh suggested that it should be based on fuzzy set, and Dubois and Prade gave the degree of reasoning method. In our country, uncertainty reasoning research has also made important achievements, such as information reasoning and logic belong to the measurement uncertainty reasoning [1, 2].

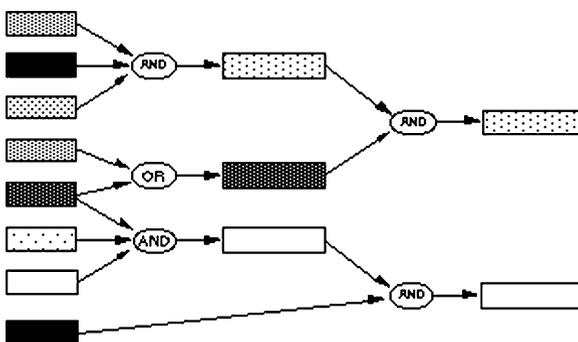
Uncertain reasoning includes qualitative reasoning and quantitative reasoning. Qualitative reasoning can explain the causal relationship by studying the system structure, behaviour and function and their relations. Since Reiter published the first paper in 1977, qualitative reasoning has become an important direction of artificial intelligence. Quantitative uncertainty reasoning method gave the numerical trend of causal relationship by proposition of numerical calculation. Firstly it requires that the uncertainty of information and measurement, methods and different information that constitutes a different measure of uncertainty reasoning. An inexact inference model was proposed by using MYCIN system in this paper, the text information on the basis of data mining, given the interest, industry, quantitative values for the next application provides quantitative indicators [3–6]. Data mining was based on the Information in the text; we can get the interest, industry, quantitative values, providing quantitative indicators for the next application.

46.2 Certainty Factor Method

Sometimes the knowledge in rules is not certain. Rules then may be enhanced by adding information about how certain the conclusions drawn from the rules may be. Our aim in this section is to describe certainty factors and their manipulation (Fig. 46.1).

Certainty Factor method reliability is an imprecise reasoning model used by MYCIN system, it is a reasonable and effective mode of reasoning in many practical applications. According to experience, the believing the degree of a thing

Fig. 46.1 Uncertain reasoning drives the conclusions



or phenomenon is called credibility. Each rule has credibility and each confidence also has its credibility [7–11].

IF E THEN H (CF (H, E)), and CF (H, E) is the certainty factor in this rule.

CF (H, E) means that the support degree of H in case of evidence E, its value is in $[-1, 1]$.

CF (H, E) > 0 means the degree of conclusion is true, the value greater then H greater. If CF (H, E) = 1 then the conclusion is true.

CF (H, E) < 0 means the degree of conclusion is false, the value smaller then more false H is. If CF (H, E) = -1, then the conclusion is false.

CF (H, E) = 0 means that E and H has no relationship.

Definition: CF (H, E) = MB (H, E) - MD (H, E).

MB (H, E) is called degree of confidence in growth. It means the increase confidence level of P at the emergence of evidence E. MD (H, E) is called degree of no-confidence in growth. It means the decrease confidence level of H at the emergence of evidence E.

If MB (H, E) > 0, then $P(H|E) > P(H)$.

If MB (H, E) < 0, then $P(H|E) < P(H)$.

We can get the conclusion:

If $P(H|E) < P(H)$, then: MB = 0, MD = $[P(H) - P(H|E)]/P(H)$, CF = MB - MD.

If $P(H|E) > P(H)$, then: MD = 0, MB = $[P(H|E) - P(H)]/[1 - P(H)]$, CF = MB - MD.

46.3 The Credibility Algorithm in Comprehensive Conditions

Fuzzy data fusion in personalized data base:

Community group: G1, G2...Gn

Personalized data base: L1, L2,...,Lr

Quantity of the personalized data base: S1, S2,...,Sr

Magazines: m1, m2, m3...,mn

Finally, complete content and organizational editing before formatting. Please take note of the following items when proofreading spelling and grammar:

Compute the certification factor of personalized data base Lx under the evidence of community group: CF (Lx|Gy)

Compute the prior probability: $P(Lx) = Sx/(S1 + S2 + \dots + Sr)$

Compute the posterior probability: $P(Lx|Gy) = (\text{Quantity from Lx})/(\text{the sum of elements which come from Gy})$

If $P(Lx|Gy) < P(Lx)$, MB = 0, MD = $[P(Lx) - P(Lx|Gy)]/P(Lx)$, then CF(Lx|Gy) = MB - MD

If $P(Lx|Gy) > P(Lx)$, MD = 0, MB = $[P(Lx|Gy) - P(Lx)]/[1 - P(Lx)]$, then CF(Lx|Gy) = MB - MD.

Compute the certification factor of personalized data base Lx under the evidence of age group: CF(Lx|Ay)

Compute the prior probability: $P(L_x) = S_x / (S_1 + S_2 + \dots + S_r)$.

Compute the posterior probability: $P(L_x|A_y) = (\text{Quantity from } L_x) / (\text{the sum of elements which come from } A_y)$.

If $P(L_x|A_y) < P(L_x)$, $MB = 0$, $MD = [P(L_x) - P(L_x|A_y)] / P(L_x)$, then $CF(L_x|A_y) = MB - MD$.

If $P(L_x|A_y) > P(L_x)$, $MD = 0$, $MB = [P(L_x|A_y) - P(L_x)] / [1 - P(L_x)]$, then $CF(L_x|A_y) = MB - MD$.

Compute the certification factor of personalized data base L_x under the evidence of sex group: $CF(L_x|X_y)$

Compute the prior probability: $P(L_x) = S_x / (S_1 + S_2 + \dots + S_r)$.

Compute the posterior probability: $P(L_x|X_y) = (\text{Quantity from } L_x) / (\text{the sum of elements which come from } X_y)$.

If $P(L_x|X_y) < P(L_x)$, $MB = 0$, $MD = [P(L_x) - P(L_x|X_y)] / P(L_x)$, then $CF(L_x|X_y) = MB - MD$.

If $P(L_x|X_y) > P(L_x)$, $MD = 0$, $MB = [P(L_x|X_y) - P(L_x)] / [1 - P(L_x)]$, then $CF(L_x|X_y) = MB - MD$.

Compute the certification factor of personalized data base L_x under the evidence of magazine group: $CF(L_x|m_y)$

Compute the prior probability: $P(L_x) = S_x / (S_1 + S_2 + \dots + S_r)$.

Compute the posterior probability: $P(L_x|m_y) = (\text{Quantity from } L_x) / (\text{the sum of elements which come from } m_y)$.

If $P(L_x|m_y) < P(L_x)$, $MB = 0$, $MD = [P(L_x) - P(L_x|m_y)] / P(L_x)$, then $CF(L_x|m_y) = MB - MD$.

If $P(L_x|m_y) > P(L_x)$, $MD = 0$, $MB = [P(L_x|m_y) - P(L_x)] / [1 - P(L_x)]$, then $CF(L_x|m_y) = MB - MD$.

Compute the certification factor of personalized data base L_x under the evidence of personalized data base: $CF(L_x|L_y)$

Compute the prior probability: $P(L_x) = S_x / (S_1 + S_2 + \dots + S_r)$

Compute the posterior probability: $P(L_x|L_y) = (\text{Quantity from } L_x) / (\text{the sum of elements which come from } L_y)$

If $P(L_x|L_y) < P(L_x)$, $MB = 0$, $MD = [P(L_x) - P(L_x|L_y)] / P(L_x)$, then $CF(L_x|L_y) = MB - MD$.

If $P(L_x|L_y) > P(L_x)$, $MD = 0$, $MB = [P(L_x|L_y) - P(L_x)] / [1 - P(L_x)]$, then $CF(L_x|L_y) = MB - MD$.

Merge $CF(L_x|G, A, X, m, L)$

$CF(L_x|G, A, X, m, L) = \min [CF(L_x|G_y), CF(L_x|A_y), CF(L_x|X_y), CF(L_x|m_y), CF(L_x|L_y)]$.

46.4 Experimental Results

Select 1,000 kinds of magazines as a source of text messages, according to the algorithm steps, get the quantitative values of the interest and industry from the text information corresponding to the journals. Following the Table 46.1:

Table 46.1 Sample of experimental results

Source of text information	Comprehensive conditions				CF
	G district	L Personalized database	A age division	X Gender selection	
Peking University education review	0.7	0.65	0.49	0.81	0.8
Financial sector	0.45	0.58	0.60	0.73	0.7
Yangtze River Delta	0.82	0.76	0.50	0.60	0.7

According to the results, it is easy to see that, for data mining of text messages, the system can be used to calculate uncertainty to arrive at quantitative values, and then applied to the actual production.

46.5 Conclusion

In this paper, the MYCIN system uses imprecise reasoning model in-depth study of the reliability of the method is applied to text data mining, infer from the text of interest magazines and industry conditions, and calculate the corresponding confidence values to solve the current applications rely on the lack of quantitative analysis. Text algorithm can also be applied to direct mail, database marketing, direct marketing and other areas, very broad application prospects.

References

1. Lucas P (2001) Certainty-factor-like structures in Bayesian belief networks. *Knowl-Based Syst* 14(7):327–335
2. Cohen A et al (2008) Spatial decision support system for Med fly control in citrus. *Comp Electron Agric* 62(2):107–117
3. Nasiri JH, Mashinchi M (2009) Rough set and data analysis in decision tables. *J Uncertain Syst* 3(3):232–240
4. Binaghi E, Luzzi L, Madella P, Pergalani F, Rampini A (1998) A comparison between certainty factor and Fuzzy Dempster—Shafer approaches. *Nat Hazards* 3(1984):77–97
5. Liu LJ, Wang YD, Guo MZ (2005) The research and application of the self-learning expert system based on BP network. *International conference on machine learning and cybernetics*, vol 7, IEEE, pp 4153–4157
6. Jalayer F, Elefante L, Iervolino I, Manfredi G (2009) Confidence factors and structural reliability. *Euro code 8 perspectives from the Italian standpoint Workshop* 33:39–52
7. Martínez-Espiñeira R, Lyssenko N (2012) Alternative approaches to dealing with respondent uncertainty in contingent valuation: a comparative analysis. *J Environ Manage* 93(1):130–139
8. Wang HQ, Chen P (2011) Intelligent diagnosis method for rolling element bearing faults using possibility theory and neural network. *Comput Ind Eng* 60(4):511–518

9. Li DS, Xu KL (2011) Research on the subjective weight of the risk assessment in the coal mine system based on GSPA-IAHP. *Procedia Eng* 26:1956–1963
10. Lughofer E (2012) Hybrid active learning for reducing the annotation effort of operators in classification systems. *Pattern Recogn* 45(2):884–896
11. Behera HS, Dash PK, Biswal B (2010) Power quality time series data mining using S-transform and fuzzy expert system. *Appl Soft Comput* 10(3):945–955

Chapter 47

Structured Dictionary Learning Based on Composite Absolute Penalties

Jiawen Wang and Hongbin Zhang

Abstract In this paper, we focus on the problem of learning dictionaries with structural features for the sparse representations of natural images. Dictionaries learned by traditional techniques such as MOD, K-SVD lack structure. Each atom of them is treated independently and the possible relationships are not fully explored, which is insufficient for some cases. We propose a framework for structured dictionary learning by integrating the Composite Absolute Penalties (CAP) into the K-SVD algorithm. Atoms of the learned dictionary are laid out in a predefined fashion, i.e., group or tree structure. Such a setting is more appropriate to exploit the latent relationships existing between the patches of natural images. Experiments show that dictionaries learned by our method achieve better results for image restoration tasks. Our approach can also be integrated into other sparse representation-based applications of image processing.

Keywords Sparse representation · Dictionary learning · Structured sparsity · Denoising

47.1 Introduction

Recent years have witnessed a growing interest in the study of sparse representations of signals. Consider a signal $x \in R^m$ with m dimension, we say that it admits a sparse representation over a dictionary matrix $D = [d^1, \dots, d^K] \in R^{m \times K}$,

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with K columns referred to as atoms, if one can find a linear combination of atoms from D that is close to the signal x , which can be formulated as follows:

$$\min_a \|\alpha\|_0 \quad \text{subject to } x = da \quad (47.1)$$

where $a \in R^K$ contains the representation coefficients of the signal x . $\|\alpha\|_0$ is the ℓ_0 norm, counting the nonzero elements of a . This so-called Sparseland model has been applied in many fields, including image processing, machine learning and statistics, and leads to the state-of-the-art performances in several applications.

It can be seen from (47.1) that the choice of the dictionary to sparsify the signal is crucial to the success of the above model. In general, a dictionary D can either be chosen as a pre-specified set of functions, such as the wavelet, curvelet [1], contourlet [2], wedgelet [3], bandlet [4] and steerable wavelet [5], or trained by adapting it to fit a given set of signal examples. In this paper, we focus on the latter. Let us consider a set of n training examples $X = [x_1, \dots, x_n] \in R^{m \times n}$. Dictionary learning is a matrix factorization problem that aims to represent these signals as linear combinations of dictionary atoms. Denote by $A = [a_1, \dots, a_n] \in R^{K \times n}$ the representation coefficients matrix, when A is obtained by employing sparse coding techniques, the dictionary D is updated in accordance with it, so that $x_i \approx Da_i$ for every signal x_i , satisfying $\|x_i - Da_i\|_p \leq \epsilon$. The deviation can be measured by any convex loss. In this paper, we concentrate on the square loss, i.e., $p = 2$.

To address this issue, a sequence of works have been published under various assumptions, including maximum likelihood methods [6], method of optimal directions (MOD) [7], maximum a posteriori probability methods [8] and K-SVD [9]. However, dictionaries learned by all those methods are flat, which lack structure, referred to as traditional approaches. In many practical applications of image processing, the structure of the problem, e.g., the overlap of the patches in an image induces relationships between atoms. It is appropriate to exploit such a priori knowledge by constraining the possible sparsity patterns. For instance, dictionary atoms representing different objects in the image can naturally be considered to belong to different groups. Then, one can enforce a predefined grouped structure in the sparsity pattern, i.e., select or remove simultaneously all the variables in the same group. Particularly, if an atom is excluded to represent an image patch, a set of atoms that are close to it should not be considered. This can be viewed as a tree-structured instance of structured sparsity, which has been intensively investigated by recent studies [10]. To learn a structured dictionary, sparse coding techniques that impose structural relationships on atoms are important. Zhao et al. [11], put forward a model selection framework via regularization methods using CAP penalties. It provided a mechanism for expressing grouped and hierarchical relationships between the features. In this paper, we incorporate the CAP penalties into the K-SVD algorithm to learn a structured dictionary.

The main contribution of this paper is proposing a framework to learn structured dictionaries for the sparse representations of natural images. Grouped or tree-structured relationships are imposed on atoms by the structural regularization using CAP penalties. Sequential dictionary updating technique is employed to accelerate convergence. It is worth noting that the proposed approach can be easily integrated into other sparse representation-based applications.

47.2 Composite Absolute Penalty

Before describing the proposed framework, we give a brief overview of the CAP family of penalties, and show that under particular settings, they can express structural relationships between the features, which are also referred to as atoms in dictionary learning.

Denote by \mathcal{G}_i , $i = 1, \dots, k$, groups that reflect the structure among the features, which is known a priori. A new vector N is then obtained by collecting the ℓ_{r_i} norm of the coefficients $a_{\mathcal{G}_i}$ related with the features within each of the groups. Coefficient vectors and their respective norms are defined as:

$$a_{\mathcal{G}_i} = (a_j)_{j \in \mathcal{G}_i}, \quad i = 1, \dots, k$$

$$N_i = \|a_{\mathcal{G}_i}\|_{r_i}$$

Note that the group norms can differ from each other. The CAP penalty is then defined to be the ℓ_{r_0} norm of this new vector N :

$$\Omega(a) = \|N\|_{r_0}^{r_0} = \sum_i \|N_i\|^{r_0} \quad (47.2)$$

It can be seen from (47.2) that the CAP penalty operates on two levels, i.e., a within-group level and an across-group level. By properly selecting the group-norms ℓ_{r_i} and the overall norm ℓ_{r_0} , the features can be selected in a grouped fashion. In addition, when the groups are overlapped, hierarchical relationships are imposed on the features.

47.2.1 Grouped Selection

Assuming that the coefficient vector a is partitioned into several groups, it is natural to select or remove simultaneously all variables in the same groups. To achieve group sparsity, the overall norm should be chosen as ℓ_1 norm, i.e., $r_0 = 1$. In most cases, the group-norms can be chosen as ℓ_2 or ℓ_∞ norm. In this paper, we choose ℓ_2 norm for each group, i.e., $r_i = 2$, $i = 1, \dots, k$. Then, (47.2) is known as a mixed ℓ_1/ℓ_2 norm, behaving like a ℓ_1 norm on the vector $\|a_{\mathcal{G}_i}\|_2$. The CAP penalty for grouped selection is defined as follows:

$$\Omega(a) = \sum_i \|a_{\mathcal{G}_i}\|_2, \quad i = 1, \dots, k \tag{47.3}$$

47.2.2 Hierarchical Selection

To better explore the possible relationships between features, hierarchical structure can be imposed by letting groups overlap, which means a given coefficient could belong to different groups. Given a tree structure \mathcal{T} with p nodes indexed by j in $\{1, \dots, p\}$, we want to embed coefficients into \mathcal{T} , obeying the following rule:

$$a_j = 0 \Rightarrow a_{dj} = 0, \forall dj \in \text{desc}(j) \tag{47.4}$$

where $\text{desc}(j) \subseteq \{1, \dots, p\}$ denotes the set of indices corresponding to the descendants of the node j (including j) in \mathcal{T} . (47.4) indicates that if a feature is excluded from the model, then its descendants in the tree should not be involved. Then, the group set \mathcal{G} is defined as follows:

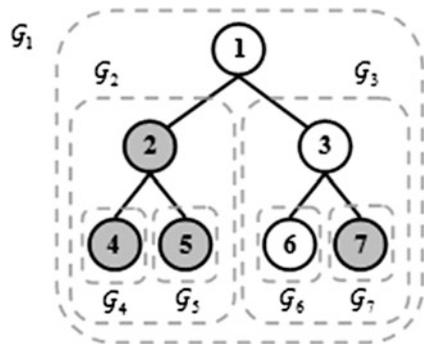
$$\mathcal{G} \triangleq \{\text{desc}(j), j \in \{1, \dots, p\}\} \tag{47.5}$$

Similar to (47.3), we choose ℓ_1 and ℓ_2 norm for the overall norm and the group-norms respectively. When penalized by Ω defined in (47.2) on the above group set (47.5), some of the vectors $a_{\mathcal{G}_i}$ are regularized to zero. Therefore, coefficients corresponding to some complete sub-trees of \mathcal{T} are set to zero, which satisfies (47.4), as illustrated in Fig. 47.1.

47.3 Proposed Algorithm

This section presents our structured dictionary learning algorithm. In general, dictionary learning consists of sparse coding and dictionary updating. We describe these two processes respectively.

Fig. 47.1 Illustration of the tree-structured set of groups \mathcal{G} (dashed contours in gray), corresponding to a tree \mathcal{T} with $p = 7$ nodes represented by black circles. Group $\{2\ 4\ 5\}$, $\{4\}$, $\{5\}$ and $\{7\}$ are set to zero, so that the corresponding nodes with gray color are excluded



47.3.1 Structured Sparse Coding

We propose two schemes to perform sparse coding in grouped and hierarchical fashion based on different assumptions.

Assumption 1. If any atom in \mathcal{G}_i participates in the decomposition, then all its group members are inclined to be chosen.

Assumption 1 indicates that atoms in \mathcal{G}_i should be selected or removed simultaneously. This is intuitive because dictionary atoms representing different objects in the image naturally form groups. This grouped structure can be imposed by regularizing the coefficient vector with the group sparsity norm, as described in Sect. 1.2.1. Defining the group set \mathcal{G}^1 as $\mathcal{G}^1 \triangleq \{\mathcal{G}_i, 1 \leq i \leq k\}$, group sparse coding can be performed by solving such a regularized problem:

$$\min_{\alpha} \frac{1}{2} \|x - Da\|_2^2 + \lambda \sum_i \|a_{\mathcal{G}_i^1}\|_2 \quad (47.6)$$

Assumption 2. If an atom is excluded to represent an image patch, a set of atoms that are close to it should not be considered.

Under Assumption 2, hierarchical relationship is imposed on dictionary atoms, which can be achieved by regularizing with the hierarchical sparsity norm, as described in Sect. 1.2.2. Given a tree structure \mathcal{T} with p nodes indexed by j in $\{1, \dots, p\}$ for each group \mathcal{G}_i , its correspondent group set \mathcal{G}_i^2 is built following (47.5), i.e., $\mathcal{G}_i^2 \triangleq \{\text{desc}(j), j \in \{1, \dots, p\}\}$. Then group set \mathcal{G}^2 is obtained by $\mathcal{G}^2 = \bigcup_i \mathcal{G}_i^2$. Hierarchical sparse coding can be performed by solving such a regularized problem:

$$\min_{\alpha} \frac{1}{2} \|x - Da\|_2^2 + \lambda \sum_i \|a_{\mathcal{G}_i^2}\|_2 \quad (47.7)$$

47.3.2 Sequential Dictionary Updating

We update D in a sequential way, i.e., one atom at a time, which is similar to K-SVD. This setting can accelerate convergence [9]. A full description of our algorithm is shown in Fig. 47.2.

Initialization: Set the dictionary $D^{(0)}$ with ℓ_2 normalized columns.

Loop: Repeat J times

- **Structured sparse coding:** compute the coefficient vector α_i for each signal x_i , by solving

$$\min_{\alpha_i} \frac{1}{2} \|x_i - D\alpha_i\|_2^2 + \lambda\Omega(\alpha_i)$$
- **Sequential dictionary updating:** for each atom d_i in $D^{(j-1)}$, update it by
 - Select the set of signals that use this atom

$$w_i = \{j | 1 \leq j \leq n, \alpha_i^T(j) \neq 0\}$$
 - Compute the overall representation error matrix E_i by

$$E_i = X - DA + d_i\alpha_i^T$$
 - Restrict E_i by choosing only the columns corresponding to w_i .
 - Update d_i and $\alpha_i^T(j)$, $j \in w_i$, using SVD decomposition

$$(d_i, \alpha_i^T(j)) = \arg \min \|E_i - d\alpha^T\|_F^2$$

Where $\|\cdot\|_F$ is the Frobenius norm.

Fig. 47.2 The full description of our proposed algorithm

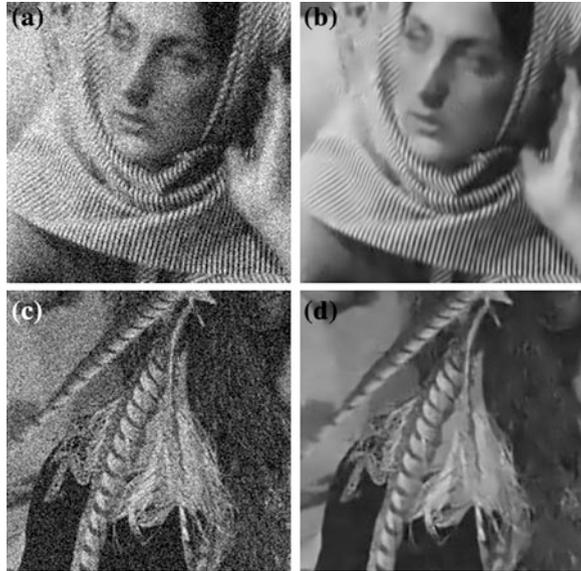
47.4 Experimental Results

We incorporate our dictionary learning algorithm into the framework of image denoising based on sparse representation [12]. Experiments have carried out with five standard benchmark images. The patch size is 8×8 . Peak signal-to-noise ratio (PSNR) is used to measure performances in quantitative evaluation. Table 47.1 shows the results obtained on each image for our methods with standard deviation $\sigma = 25$, and the comparison with top performers, FoE [13], BLS-GSM [14], and BM3D [15]. Part of denoising results is quoted from [16]. It can be seen from Table 47.1 that our proposed algorithms outperform FoE with an improvement in PSNR of 0.8–2.6 dB. In most cases, our methods are compatible

Table 47.1 PSNR results of algorithms (dB), $\sigma = 25$

Method	Group	Tree	FoE	BLS-GSM	BM3D
Barbara	29.51	29.49	26.84	29.15	30.72
Boat	29.33	29.40	28.57	29.39	29.91
Living	28.93	29.96	28.17	29.09	29.72
Lena	31.33	31.39	30.57	31.71	32.08
Pirate	29.11	29.17	28.31	29.29	29.62

Fig. 47.3 Qualitative evaluation of our method. **a, c** noisy sub-images, **b, d** denoised results



with BLS-GSM and BM3D. Figure 47.3 shows qualitative examples. It can be seen that some fine textures, e.g. stripes and feathers, are recovered very well by our approaches.

47.5 Conclusions

This paper introduced a framework to learn structured dictionaries for the sparse representations of natural images. Grouped and hierarchical relationships are imposed on atoms by the structural regularization using CAP penalties. Experimental results show the effectiveness of our method for restoration tasks. Future work includes investigating alternative techniques to accelerate the structured sparse coding process, and integrating structured dictionary learning into other applications.

References

1. Candès EJ, Donoho DL (2002) Recovering edges in ill-posed inverse problems: optimality of curvelet frames. *Ann Statist* 30:784–842
2. Do MN, Vetterli M (2003) Contourlets. In: Stoeckler J, Welland GV (eds) *Beyond wavelets*. Academic Press, New York
3. Donoho DL (1998) Wedgelets: nearly minimax estimation of edges. *Ann Statist* 27:859–897

4. Mallat S, LePennec E (2005) Sparse geometric image representation with bandelets. *IEEE Trans Image Process* 14:423–438
5. Freeman WT, Adelson EH (1991) The design and use of steerable filters. *IEEE Pattern Anal Mach Intell* 13:891–906
6. Olshausen BA, Field DJ (1997) Sparse coding with an overcomplete basis set: a strategy employed by v1. *Vis Res* 37:3311–3325
7. Engan K, Aase SO, Hakon-Husoy JH (1999) Method of optimal directions for frame design. *IEEE Int Conf Acoust, Speech, Signal Process* 5:2443–2446
8. Kreutz-Delgado K, Rao BD (2000) FOCUSS-based dictionary learning algorithms. *Wavelet Appl Signal Image Process* 8:4119–4153
9. Aharon M, Elad M, Bruckstein AM (2006) K-SVD: an algorithm for designing of overcomplete dictionaries for sparse representation. *IEEE Trans Signal Process* 54:4311–4322
10. Jenatton R, Mairal J, Obozinski G, Bach F (2011) Proximal methods for hierarchical sparse coding. *J Mach Learn Res* 12:2297–2334
11. Zhao P, Rocha G, Yu B (2009) The composite absolute penalties family for grouped and hierarchical variable selection. *Ann Stat* 37:3468–3497
12. Elad M, Aharon M (2006) Image denoising via sparse and redundant representations over learned dictionaries. *IEEE Trans Image Process* 15:3736–3745
13. Roth R, Black MJ (2005) Fields of experts: a framework for learning image priors. *IEEE Conf CVPR* 2:860–867
14. Portilla J, Simoncelli EP (2003) Image restoration using gaussian scale mixtures in the wavelet domain. In: 9th IEEE international conference on image processing vol 34. pp 965–968
15. Dabov K, Foi A, Katkovnik V, Egiazarian K (2007) Image denoising by sparse 3-D transform-domain collaborative filtering. *IEEE Trans IP* 16:2080–2095
16. Katkovnik V, Foi A, Egiazarian K, Astola J (2010) From local kernel to nonlocal multiple-model image denoising. *Int J Comput Vis* 86:1–32

Chapter 48

Research of College English Teaching Based on Computer Network Technology

Qing-hua Yang

Abstract College English teaching under the computer network environment can be presently considered as the orientation of national college English teaching reform. Based on the constructivism theory, this paper discussed the feasibility and necessity of network application on college English teaching and analyzed some related problems which are about the theoretical basis of present network and multimedia technology assisting teaching, English teaching practice in network information age and network English teaching. We combine the technology of multimedia teaching, Web serviceman and network resource sharing with modern English teaching, and improve the English teaching mode based on computer and network technology. The practical effect of program on enhancing students' English learning ability is proved through practice.

Keywords Network technology · English teaching · Database · Multimedia · CAI

48.1 Introduction

At present, the information technology symbolized as computer and network communication technology has been increasingly influencing in contemporary society. In college English teaching field, utilizing information technology to change teaching method has become a new breakthrough point in college English teaching reform. Taking advantage of network resource and carrying out autonomous learning have become an inevitable requirement of in-depth development of college English teaching reform. However, making use of network technology

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in college English teaching is superior to traditional teaching method on pronunciation, personalization, operability, etc. [1, 2]. Meanwhile, the application of computer technology which is developing so rapid in the second language acquisition has penetrated into language teaching, language test, language research, etc. Therefore, the combination between education and information technology will be more effective comparing to traditional teaching method.

48.2 The Importance Analysis of Network Technology on College English Teaching

Constructivism learning theory considers that production process, the basic cognitive process during learning, is the positive construction of each partial relation in learning materials and learning contents, knowledge as well as experience [3, 4]. However, it is not acquired through teachers' interpretation but acquired by students' depending on other people's help, applying necessary learning materials and getting through the method of meaning construction under the specific environment [5]. Situation creating in learning environment should promote students' meaning construction of learning contents and teachers should bring in or create the specific circumstances which exist emotion, image and vividness. Meanwhile, in order to make meaning construction more effective, mutual cooperation between teachers and students during learning should be strongly emphasized. Since it is significant for collaboration between teachers and students to collect and analyze learning materials, present and confirm the hypothesis, assess learning outcomes and finally establish meaning construction, it should be emphasized that some important factors of meaning construction will play an important and helpful role in students' study during their learning [6, 7]. Teaching mode based on computer technology requires that teachers should convert knowledge interpreters into helpers as well as promoters of students' initiative constructing sense and producers as well as designers of teaching resources. Constructivism theory has not only become the theoretical basis making use of modern information technology to carry out foreign language teaching but it also offers theoretical support of network to change college English teaching method [8–10].

48.3 English Teaching Based on Computer and Network Technology

48.3.1 College English Teaching Mode Based on Network and Multimedia Technology

Multimedia and network technology can provide interactive learning environment with the feature of fresh view and intuitive image, can offer visual materials of

various sensory stimuli and total prominence and illustration of image, text, audio as well as video and can supply the world's largest and broadest knowledge base which is established by hypertext and hyperlink techniques. All these functions will play a positive role in forming and developing students' cognitive structure and promoting meaning construction of students' knowledge mastering and they also provide favorable conditions for changing college English teaching methods. Since English belongs to common and global language, students can acquire a large amount of English information and resources through network which can also provide more available resources for transforming college English teaching methods. Foreign language teaching is not only the language education, more importantly, it is also the comparative education between British and American culture. Therefore, the information resources provided by network will be favorable for students to obtain more knowledge and information about British and American culture which cannot be acquired in the classroom. Network technology can render students abundant English information as well as interactive approach and help them create college English teaching's need situation which will be helpful to cultivate and improve these students' English application capability in practice. Under the network environment, students will become learning initiatives who can completely design and arrange their studying activities according to their individually practical condition. Besides, network technology can also provide space as well as devices of expressing and transmitting information for students who can deliver and transmit results and achievements so that students can consequently consolidate their learning autonomy quality to improve their autonomous learning ability.

48.3.2 The Evaluation Mode of New-Pattern English Courses Based on CAI

During the process of college English teaching, computer-aided Instruction (CAI) sets up an interactive learning environment with visualized image for students' language study and creates each vivid learning situation so as to guarantee the interaction and cooperation among learners, teachers and other types of learners. On the basis of the teaching mode of CAI, the process of college English teaching evaluation will attach more importance to the application of the newly-typed evaluation mode. Under this newly-typed evaluation mode, students will become the main part and teachers will become learning organizers, coordinators, helpers of students' meaning construction, promoters and providers of information feedback whose task is to work out evaluations on students' daily performance, achievements and the development of reflected emotions, attitudes, strategies and other aspects. The teaching mode of CAI establishes an interactive learning environment for language studying and guarantees the interaction and cooperation among learners, teachers and other type of learners. Under the teaching mode of

CAI, the application of this new evaluation mode will become more efficient during college English teaching evaluation while its application effect will become more prominent and students will genuinely become main part in evaluation process. Mutual evaluation between students, interviews between teachers, learning efficiency evaluation in multi-dimensions and other activities create diversified diagnosis and it provides students multi-channel feedback information and helps students evaluate their learning effects more accurately.

Multimedia network technology platform provides reliable technological support for the implementation of new evaluation mode. Hardware capacities of platform, software platform, English resources, etc. provide guarantee for informatization of evaluation mode. The interaction of multimedia network platform assists students to play a role in cognitive subject, breaks through the space obstacles of traditional evaluation mode and provide technical guarantee for effective feedback and direct information achievements during evaluation.

48.3.3 The Teaching Platform Based on Network Service

The design of online English teaching System is mostly based on B/S structure. Clients are composed of teachers, students and administrators. They access the English teaching server machine of internet or intranet by use of some kind of browser, commonly under HTTP protocol. Servers include two parts. One is composed of four modules: the teacher management, the student management, the CAI management and the system resource management. The other is the database machine which contains kinds of resource information. The web technology is integrated into the work mode of B/S, which divides the server machines into web servers and database servers.

This kind of three layer structure is advanced network information. When the browser sends data request, Web servers send request retrieval to database by middleware. The retrieval data returns to Web servers as HTML pages, and then back to the browsers. The system structure is shown in Fig. 48.1.

48.4 Rational Utilization of Network Resources During the Process of Teaching

During college English teaching, teachers could actively encourage students to look up and select materials making use of literature retrieval system in library and network materials search methods so as to broaden college students' English learning horizon and stir up their English learning interests. Due to the present advanced information technology and great information amount, it deserves attentions for teachers to encourage college students to look up with specific

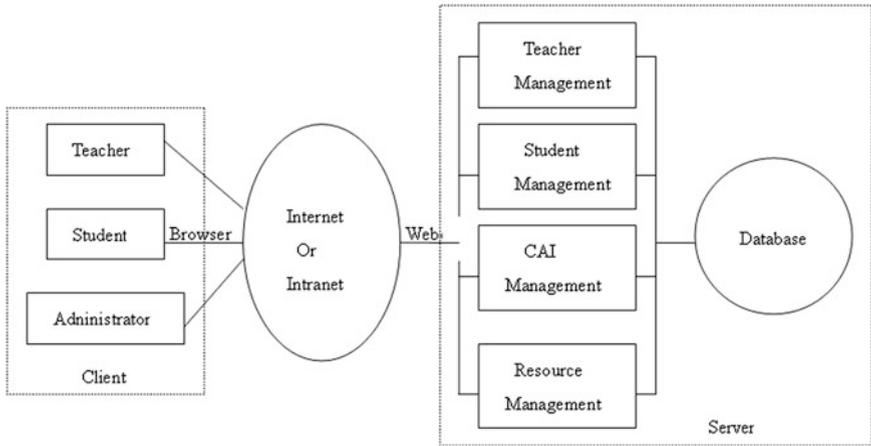


Fig. 48.1 Structure of Web-based English learning system

purpose rather than surf the web without an aim while looking up materials especially searching the Internet. Students will be advised to classify and look up materials according to materials' qualities and classifications. Besides, they can look up and classify materials while carrying out statistics and taking notes (Fig. 48.2).

Since there are abundant network resources and the materials selected by students may have some kind of deviations, teachers can offer websites in advance to direct students to pay their attentions to the relative information of problems solution. Each group can deal with selected materials to strengthen the understanding of problems. During the process of materials collection, students might have troubles and they can return them back to teachers through "electronic

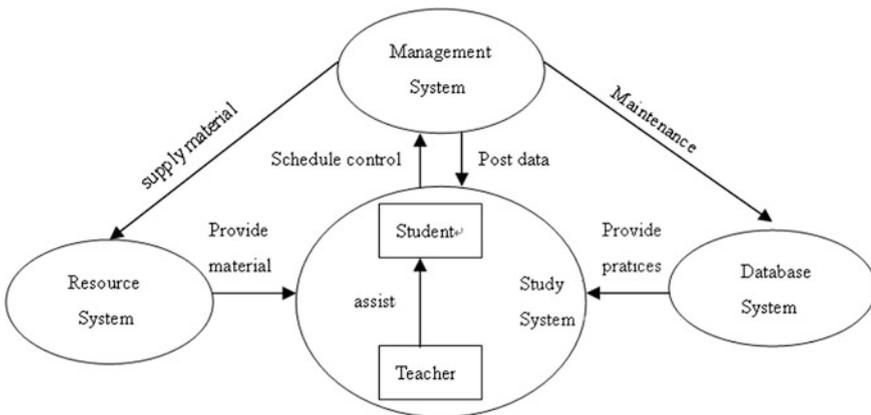


Fig. 48.2 Network resource sharing architecture of teacher-student interaction

assistance” while teachers can provide individualized help for students by means of network, answer their questions and overcome their learning difficulties. After students gather materials through network, they can mutually carry out group discussion, group interaction to produce a written statement and oral materials about problems research with gathering materials and academic instructors can check and approve to further realize resource sharing.

48.5 Collection and Analysis of Experimental Data

Our research target is to carry out three-term tests among randomly selected 100 students in grade 2011 from a university. Although the investigation has the limitations, students’ current learning situation under the present teaching mode can also be reflected to some extent. The data adopt the software SPSS to implement statistics. The data from Table 48.1 shows independent sample test of students’ data and the test results will be applied to analyze whether their English ability has the significant difference between experimental group and general group.

From Table 48.1, the initial situation between these two groups is that there exists no significant difference in English ability. Their t value is $0.26 < 1.645$, while their p value which is $0.97 > 0.05$ indicates that the English ability did not exist no significant difference before experiment since Sig. is 0.000.

From Table 48.2, we can see that the final term examination scores between two groups are not very different ($t = 0.97$, $p = 0.33$) after one term experiment. The reason is that students have not completely adjusted to this new teaching mode due to short-time experiment. However, after one year or one and a half year, there exist significant difference between experiment group and general group on the final exam scores of the second and the third semester ($t = 2.864$, $p = 0.005$; $t = 2.971$, $p = 0.033$).It indicates that the advantages have appeared progressively on the basis of network teaching mode and teachers find that students’ interest of learning English has improved during courses interpretation so as to promote their scores to be obviously superior to the general group’s students.

Figure 48.1 shows the passing rate of CET-4 in two groups’ students in the third term. Comparing between experimental group and general group on CET-4 passing rate, it is shown that teaching mode based on computer network will not influence but instead promote students to improve their comprehensive English

Table 48.1 Model for the modern distance education

	Highest score	Lowest score	Average score	Standard deviation	Sig
Experimental group	115	70	85.18	8.1144	0.000
General group	109	74	86.21	8.2126	0.000
T value	$t = 0.26 < 1.645$				
P value	$P = 0.97 > 0.05$				

Table 48.2 English ability analysis after experiment

	First term		Second term		Third term		Sig
	Avg	S.D.	Avg	S.D.	Avg	S.D.	
Exp	70.11	4.862	73.89	6.719	76.12	4.578	0.001
Gen	68.01	6.603	70.21	8.505	72.14	6.228	0.000
T value	t = 0.97		t = 2.864		t = 2.971		
P value	P = 0.33 < 0.05		P = 0.005 < 0.01		P = 0.033 < 0.05		

Avg = Average score; S.D. = Standard deviation

scores. Finally, we carried out the satisfactory degree investigation on experiment students and it shows that 87.9 % students preferred this teaching approach (Fig. 48.3).

On the basis of above investigation and analysis, we can conclude that: During the present college English teaching, the development of students' autonomous learning ability is very imbalanced. Based on the questionnaire, we put forward the purpose which is to cultivate students' overall qualities applying network materials to effectively merge with college English teaching according to the practical situation of college English teaching in universities. During the afterward experiment, through scores analysis of pre-experiment test and pro-experiment test as well as results analysis of questionnaire, we can obviously find that experimental groups' students have largely improved their learning interest, learning habits, learning attitudes, learning methods, autonomous learning, etc. under the guidance of new teaching mode comparing to general group's students. Therefore, effectively merging computer network technology especially multimedia teaching with college English teaching is a very efficient and feasible teaching mode.

College English teaching mode and courses evaluation mode based on network technology will not only play a greatly facilitating role in students' listening, speaking, reading, writing and translating capabilities and cultivating creative thinking capability, but also promote university English teachers to improve their teaching abilities so as to adjust modern educational development and satisfy the

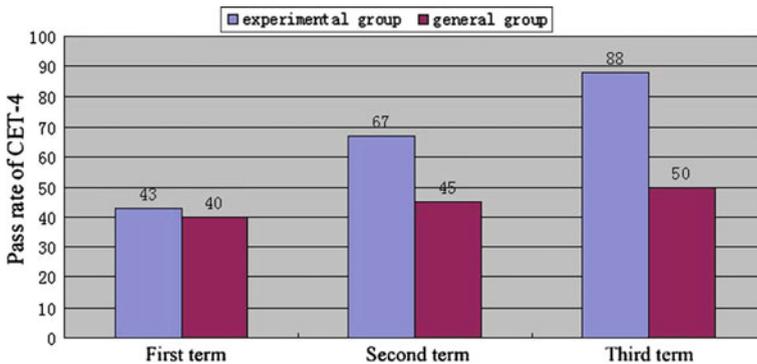


Fig. 48.3 The passing rate of CET-4

requirement of students' personal development. Network technological development and application provide us broader space of autonomous learning. It can assist learners to master the skills of language knowledge and English study and offer students more opportunities to contact the real English materials, understand the real life in English world all around, broaden their horizon and finally improve their English learning interest and achievement sense.

References

1. Ma J (2004) Multimedia college english teaching mode from the constructivist perspective. *Tangshan Normal Univ* 34(5):14-17
2. He K (1997) Constructivist teaching models, teaching methods and instructional design. *Beijing Normal Univ (Soc Sci Ed)* 41(5):501-506
3. Sun D (2006) Use the network information resources to improve the language. Proficiency of English learners in college *Modern intelligence* 4(12):389-393
4. Xiang L (2011) The advantages & disadvantages of multimedia assisted college english teaching. *J Huanggang Polytech* 3(2):38-42
5. Sun Y, Wang C, Wang Chunhong (2001) Design and realization of web-based college english listening teaching system. *J Tianjin Inst Technol* 3(17):98-101
6. Shi B (2011) Research on college english learning resources construction online. *J Heilongjiang Coll Educ* 1(5):101-104
7. Qin X (2011) Research on multi-media and self-taught mode based on network of college english in ethnic universities. *J Honghe Univ* 2(40):83-87
8. Deng Y (2007) Task-based online teaching of english viewing, listening and speaking—a case analysis of the national elite course of english viewing, listening and speaking. *Foreign Lang Educ* 3(5):45-52
9. Shi L, Ling J (2008) The practice of blocks mode under the guidance of the whole language approach. *Comput Assist Foreign Lang Educ* 8(2):62-63
10. Luo R (2007) The application of english movies in college english listening-speaking teaching. *J Inner Mongolia Agric Univ (Soc Sci Ed)* 2(6):343-348

Part III
Sports Management and Application I

Chapter 49

Research on Arms Kinetics in Basketball Penalty of Chinese Wheelchair Athlete

Bin Gao, Weimin Sun and Zhilong Zhao

Abstract Wheel chair basketball (WCB) is a team to compete vehemence degree one of sport with the most rapid growths in sport, Chinese wheel chair basketball arms kinetics has never reported. Understanding arms sport is worthy, because the its in aid of improvement pitches ball of performance. Therefore, the textual purpose lies in arms sport for studying excellent wheel chair basketball athlete's penalty. Adopt Mann–Whitney U test especially examination with make sure each one of the statistics of learn meaning. Suggest as a result that the sport scope with a better shoulder department and elbow department of the low group of high group B, the angle discovers that two sets are in the P from the arms kinetics < 0.05 times didn't show obvious difference, but the amount of sample is small, so the survey of big sample from now on is necessary.

Keywords Kinematics · Wheelchair basketball · The hit rate of basketball penalty

49.1 Introduction

Athletics and amusement not only is the important tools that disable and sick person's individual recovers from illness, but also is the important tool of social association. Many disable and sick person athletes participate in an international competition for example from 1960 established in Rome has already had been

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being continuously increasing of the Olympic Games for the disabled. In the Olympic Games for the disabled for the first time, represent 23 nations to take part in at only 400 athletes of that time, till 2008 when Peking destroyed an A meeting 4000 near athletes represented 146 nations to take part in 20 sport.

Wheel chair basketball (WCB) is a team to compete vehemence degree one of sport with the most rapid growths in sport. This may be because of the rule and regular basketball game very alike fact of wheel chair basketball, in addition to the player's classification; this is owing to the angle of the athlete's function technical ability. It is one of the basic technical ability of importance to in the clout in wheel chair basketball technical ability, because it provides an opportunity to get a goal a point for a team. The penalty in the clout a rate performance usually in the middle of ordering ball and in the clout a competition, because it is to beyond disputely in the clout a point to easily get a goal.

The previous research investigated a quadriplegia wheel chair basketball the player in the clout with the penalty of sound basketball athlete to shoot the basket a technique. Show a quadriplegia wheel chair as a result basketball the player release the perpendicular speed of ball than the sound basketball athlete and show obvious slowly and shorter of release height. In addition, quadriplegia wheel chair basketball player's biggest wrist joint the crooked angle is smaller than the sound player's. Have the scholar the penalty for comparing wheel chair basketball different classification of athlete to in the clout a rate. The angle expressed that the lower set another player (1 set and 2 sets) usually compares the ball that higher Class (3 classes and 4 sets) releases from a lower height to have larger speed and releases as a result. And, then express smaller shoulder joint to release crooked angle in the much lower set, but the speed of a better shoulder department and the elbow biggest department. There is also reporting of similar result. For all that, still lack relevant exercise in Chinese wheel chair biomechanical research. Therefore, the purpose of this research is more China excellent wheel chair basketball the athlete is tall, low successful wheel chair basketball between the sets in the clout the kinetics difference of rate.

49.2 Research Method

49.2.1 Test Objects

Male wheel chair basketball of the selection athlete, the age scope is 18–35 years old; enlist from the wheel chair basketball team in China nation. This research includes to test community at these, if they (1) according to international wheel chair basketball unite meeting (IWBF) classification from 3 classes arrive 4.5 not etc., (2) for more than a year of wheel chair basketball experience, (3) once competed national and international level. Be expelled in the experiment

community out of the research BE, if they (1) experience the arms injury of (2) condition, forbid a sit on the wheel chair or influence wheel chair of control. Test community to is divided into two types: High group (4–4.5) and low group (3.0–3.5) [1–3].

49.2.2 Test Process

Test community to allow warming up for 10–15 min. Seven spheroid markings adhere to below the arm of predominating the position of dissection position: The shoulder locks a joint, seamy side and outside side, path to and the Chinese foot bone caulis Tu process, the second and the fifth Palm point a joint [4].

Make use of three high-speed figures cameras to collect a 3D dynamic state data. Obtain penalty to in the clout sport under the sample rate of 30 Hz [5]. All these three cameras pass the electric light switch that moveses synchronously carry on. Obtain data before set a size as $100 \times s 200 \times$ the mark of 100 Li rices settle. This 12 control points are been used to make sure to pass quasi-physical volume space in the DLT method school. The originality sits to mark data at fourth ranks carried on percolation while expecting fertile Si one to close the frequency as 4 Hz especially. All experiment communities have an opportunity to shoot the basket 10 times. Two success of a little bit clear will be turned by the number and analyze. Obtain is an arms angle, including shoulder, elbow and wrist. Adopt Mann–Whitney U test especially examination to make sure that the statistics of each one learns meaning. ($P < 0.05$).

49.3 The Concrete Steps of Mann–Whitney U Test

The height is two sets of to random change to measure for the continuous type of independence, establishing a height two sets of samples is $X(x_1, \dots, x_m)$ and $Y.(y_1, \dots, y_n)$. Height two sets of samples prognosticate a value to carry on analysis to relatively record for WXY and prognosticate to be worth Y is bigger than X piece, namely.

$$W_{XY} = \#\{(x_i, y_i) : x_i < y_i, i = 1, 2, \dots, m; j = 1, 2, \dots, n\} \tag{49.1}$$

W_{XY} presents symmetry distribute, therefore prognosticate a value to the two sets of height rate and accumulation a little bit analytically and all lead a difference for:

$$P(W_{XY} = d) = t_{m,n} \left(d + \frac{n(n+1)}{2} \right) / \binom{N}{n}, (d = 0, 1, \dots, mn) \tag{49.2}$$

49.4 Test Result

- H0 The arms kinetics in the clout to there is no difference on rate in athlete's penalty of the height two sets of wheel chairs basketball. (Table 49.1).
- H1 The arms kinetics in the clout in athlete's penalty of the height two sets of wheel chairs basketball rate up have already shown obvious difference.

In order to simplify a description, the value of prognosticating of wheel chair basketball athlete of high group records for the x_1, \dots, x_m , among them $m = 4$; Low group wheel chair basketball the athlete prognosticate a value to record for the y_1, \dots, y_n , among them $n = 5$.

The certain p value makes to predict:

If number $k = 2$, each example's counting is smaller than to equal 5, check form, H boundary value form.

If the number of minimum sample is bigger than 5, the H then distributes to look like χ^2 distribute, check χ^2 boundary value form, $H = 14.95$, check form to get $p < 0.005$. Namely satisfy H0, meant that the arms kinetics in the clout in athlete's penalty of the height two sets of wheel chairs basketball to don't show Obvious difference in the rate.

The arms in the clout the Fang value angle of rate to see table in the penalty 2. Adopt Mann-Whitney U test especially examination, two sets of in the clout to lead the angle that the arms body exercises to contain certain number difference in the penalty, the sport scope with a better shoulder department and elbow department of the low group of high group B_i , the low group can use a larger usage scope, but don't show the statistics difference of obvious than high group. (Table 49.2).

Wheel chair basketball (WCB) is a team to compete vehemence degree one of sport with the most rapid growths in sport. From got a goal to speak, penalty's in the clout a rate (FTS) was a to understand order, so it is to order most in brief. Although before there has been the kinetics of FTS to aim at carrying on a survey research, Chinese wheel chair basketball arms kinetics has never reported.

Table 49.1 The physical characteristic in one experiment objects

Objects	Age (years)	Weight (kg)	Level
1	30	55	4.5
2	24	61	4.5
3	29	67	4.5
4	31	67	4.5
5	25	58	3.0
6	28	65	3.0
7	29	69	3.0
8	22	53	3.0
9	27	60	3.0

Table 49.2 The peak value of rate angle in the clout in the penalty

Groups	Shoulder peak F/E (o)	Shoulder peak Abd (o)	Abd/add	The peak F/E (o)	Wrist peak F/E (o)
High group	130.5	5.8		140	10.2
Low group	128.2	4.9		135	19.2

Understanding arms sport is worthy, because the its in aid of improvement pitches ball of performance. Therefore, the textual purpose lies in arms sport for studying excellent wheel chair basketball athlete’s penalty. Male wheel chair basketball that voluntarily participates in a research here athlete, average age = 27 ± 2.9 years old, average weight = $61 \pm 4,200$ g. The participant is been divided into two types: high group (4–4.5 cent) and low group (3–3.5 cent). Seven reflection markings put in the right side second Palm to point a joint, the fifth Palm points a joint, path to and the Chinese foot bone caulis Tu process, seamy side and outside side and shoulder Feng process. Three cameras at the same time the record is in 30 Hz and only sample the FTS proposal of frequency under the synchronous switch. The originality sits to mark data fourth ranks to expect fertile Si to filter the closing of wave’s frequency as 4 Hz especially. Each participant carries on 10 FTS experiments, average and analytical experiment in two success of a little bit clear. Get arms angle to include shoulder, elbow and wrist. Adopt Mann–Whitney U test especially examination with make sure each one of the statistics of learn meaning. Suggest as a result that the sport scope with a better shoulder department and elbow department of the low group of high group Bi, however the low group uses a larger usage scope than high group. Because the low group is as smaller as the sport scope of elbow joint with the shoulder, they can use wrist joint as repair. However, the angle discovers that two sets of are in the P from the arms kinetics < the 0.05 times didn’t show obvious difference, but the amount of sample is small, so the survey of big sample from now on is necessary.

49.5 Conclusion

The purpose of this research inquires into the arms kinetics ining the clout a rate on Chinese wheel chair basketball penalty of athlete. The discovering height is two sets of have certain difference, but didn’t show obvious difference. This may be because 2 sets be thought is high time wheel chair basketball athlete, have a better torso control and arms muscle. Dissimilarity of BE, such as the low group athlete of 1 or 2 classes don’t have torso control and arms muscle have no dint. But the sport scope with a better shoulder department and elbow department of the low group of high group Bi, however the low group uses a larger usage scope than high group. Because the low group is as smaller as the sport scope of elbow joint with

the shoulder, they can use wrist joint as repair. However, this research is the initial research of a small sample of wheel chair basketball. Therefore, the survey lieutenant general in future needs larger amount of sample.

References

1. High W (2000) The research on kinetics and dynamics of human body arms imitates based on five freedom degrees. *Tienjin Light Ind Univ* 7:45–47
2. WeiYe (1991) The analysis on rms action the kinetic in badminton kills ball, flat-high ball. In: *The 7th national meeting of sport biomechanics academic thesis*, vol 7, pp 3–12
3. Palm S, Qiu T, Palm A (2011) Research on the present condition of Athlete's physiology. *Exercise* 7:20–23
4. Palm S (2011) Research on wheel chair basketball athlete's appearance and the change of blood. Beijing: *Beijing Sport Univ* 7:101–107
5. IPC http://www.paralympic.org/Paralympic_Games

Chapter 50

Fosbury Flop Technology Based on Mechanical Analysis Method

Sufei Yang, Peng Pu and Chao Fan

Abstract By using computers and other modern means of science and technology, this paper introduced modern sports development characteristics combined with the mechanical analysis method. Based on the mechanical analysis of fosberry flop, it is useful for athletes to improve motor skills with the best motion attitude, which plays an important role in the training. The purpose of this paper is two main reason: the one is to do some scientific analysis on the fosberry flop based on the mechanics analysis, the other is to provide scientific theoretical basis for athletes scientific training in order to promote the development of sports.

Keywords Sports mechanics · Fosbury flop technology · Mechanical analysis

50.1 Introduction

Fosberry flop is a very complex system, which is mainly a series of actions, including running, jumping, vacated the movement process, and the landing of a series of movement process is complete. In addition to run-up speed and take-off angle, elevation angle, size, weight control, ground tilt degree, slope angle of some techniques and related. Mechanics analysis method is mainly for the player to build models, thus the model for mechanical analysis. Establishing, model to

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biomechanical analysis based on. Whereas the biomechanical motion analysis is mainly based on digital video and infrared camera system [1–4]. Digital camera range from ordinary DV camera, to a high speed video system operation. Video analysis of the high precision of 10,000 Hz. By increasing the camera lens resolution quality, working frequency and the number of the camera, at the same time from different angles to capture movement. In addition to the subjects' body mounted on the skin signs reflective markers, are commonly used to improve the measurement accuracy. Especially the high speed video system, it not only need to use high and homogeneous photometric facilities. Computer based biomechanical simulation model can better describe the motion variables. Based on the mechanics analysis model, using the mathematical analysis method of fosberry flop of the analysis can better promote the athlete technology improved, thereby also promoted our country sports technology development, but also to the biomechanical development provided academic research platform [5–9].

50.2 The Research Object and Method

This paper is through biomechanical perspective to the study of back style fosberry flop, and through biomechanical analysis of back style fosberry flop key points [10].

50.2.1 Research Object

The research object of this paper is the Wuhan Sports Institute in track and field competition in elite athletes of six people. The related data are shown in (Table 50.1).

Table 50.1 The high jump athletes technical data

Full name	The last step height of center of gravity	On the jump height of the center of gravity at	A lower center of gravity	Vertical acceleration distance	Step size	Height
A	0.91 m	0.86 m	0.05 m	0.57 m	2.16 m	2.37 m
B	0.96 m	0.99 m	−0.03 m	0.42 m	2.00 m	2.35 m
C	0.98 m	0.93 m	0.05 m	0.39 m	1.93 m	2.35 m
D	0.85 m	0.85 m	0.00 m	0.44 m	1.99 m	2.32 m
E	0.83 m	0.88 m	−0.05 m	0.44 m	2.00 m	2.32 m
F	0.90 m	0.90 m	0.00 m	0.45 m	2.01 m	2.34 m
Average value	0.90 m	0.90 m	0.00 m	0.45 m	2.01 m	2.45 m
Standard deviation	±0.06	±0.05	±0.04	±0.06	±0.08	±0.02

50.2.2 The Research Method

In this paper, using the method of literature and video analysis method on the fosberry flop analysis. The method is accomplished by looking up the fosberry flop of elite athletes at home and abroad to establish mathematical model system for the analysis of mathematical model [11–13]. Video shooting method is mainly by the high-speed camera for fixed-point shooting. The shooting position as shown in Fig. 50.1.

In order to better establish the mathematics model, we put stress on the coordinate system. The coordinate resolution diagram as shown in Fig. 50.2.

50.3 The Mechanical Analysis

High jump athletes in the takeoff of gravity center position of mathematical analysis as shown in Fig. 50.3.

In the high jump, the trajectory can be regarded as a parabola. The parabolic mathematical decomposition we can get the direction of vertical speed: $v_t = \sqrt{2gh}$. When the body is in the highest point in the resting state, its speed is zero. So;

$$F = -\frac{mv_t}{\Delta t} \tag{50.1}$$

The $v_t = \sqrt{2gh}$ into (50.1) formula, we get

$$F = -\frac{m\sqrt{2gh}}{\Delta t} \tag{50.2}$$

Fig. 50.1 Shoot location of the videotape

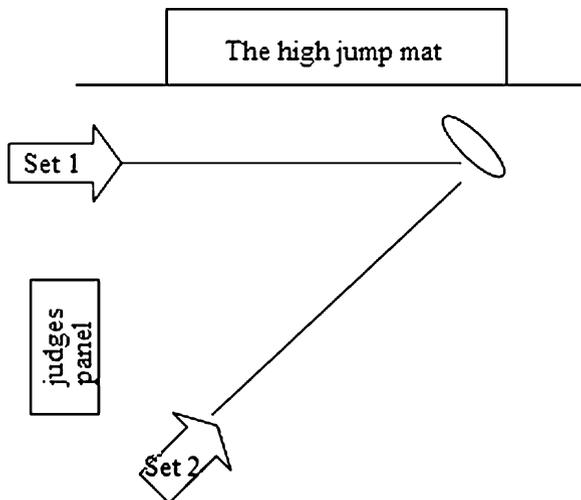


Fig. 50.2 Schematic diagram of coordinate analysis

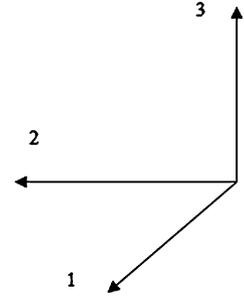
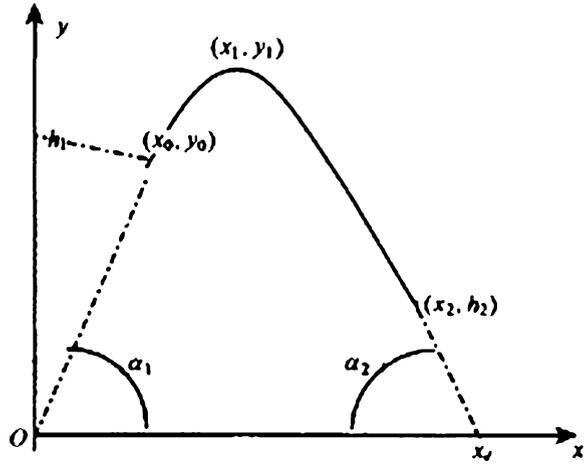


Fig. 50.3 The athletes's take-off position in the center of gravity



In this equation we can see that the force is applied by gravity to the highest point of the distance h mat, and buffer time of decision.

The body and the cushion between the pressure for:

$$P = \frac{F}{A} = \frac{m\sqrt{2gh}}{A \cdot \Delta t} \leq 1.9678\text{kg/cm}^2 \tag{50.3}$$

Know by theorem of kinetic energy

$$F \cdot \Delta h = \frac{1}{2}mgh \quad \text{So} \quad \frac{F}{A} = \frac{mgh}{24 \cdot \Delta h} = P \tag{50.4}$$

From this we get the buffer distance relationships are as follows:

$$P = \frac{mgh}{A \cdot \Delta h} \tag{50.5}$$

50.4 The Model Analysis of Fosbury Flop

Fosbury flop is a very complex system, this system is mainly a series of actions, including running, jumping, vacated the movement process, and the landing of a series of movement process is complete. Kinematics index system mainly includes the following several points, first is we developed according to the expert questionnaire screening, determine the measurement index. Along with along with the development of figures camera, Gao pixel photographs a technique and spreads the development of feeling machine application and makes the biomechanics get into a modern technical diagraph stage, the establishment of 3D lay figure, pushed a 3D mechanics technical development. The muscle gives or gets an electric shock synchronous diagraph technique of with Gao accuracy, the high intelligent degree spreads a feeling machine technique can already with carry dynamics, the athletics learns, the biology builds up 3D space model. Although the modern measures a stage have already consumedly promoted athletics biomechanical development, exist, Gao budget, experiment research of time long, the place restriction wait a disadvantageous factor, is an athletics biomechanical further development exist very big of limit character, so get into calculator emulation to imitate a true

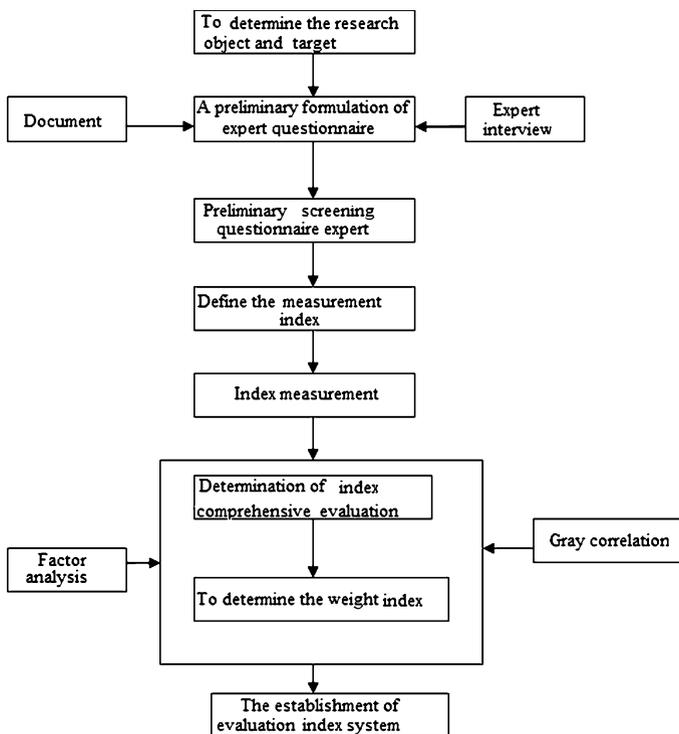


Fig. 50.4 The quota system of the kinematics

research. Imitating true model by the biomechanics that the calculator builds up can better description sport change to measure. Promote an athletics biomechanical development. Although test technical development for sport the biomechanical research provided important foundation, also existed to definitely limit character such as experiment expenses big, research the period grow a disadvantageous factor of etc. Got into make use of calculator to carry on building up mathematics model towards exercising biomechanics and solve the stage of emulation along with the rapid development of calculator technique, mechanics. If Kane will describe sitting of human body sport mark to classified into inside change to measure and outside change to measure, the former describes opposite sport of body, for can control to change to measure; The latter describes whole sport of human body, is made sure by the dynamics equation. The kind of simplification research method makes the mechanics principle directly used for a human body and physically exercise of imitate and really make possible with theory analysis. According to our video identify measurement index, according to the measurement index determined by measuring the weight, then according to the measured weights to establish evaluation system. Its evaluation system flow diagram as shown in Fig. 50.4.

50.5 Conclusion

Using the arc forms, we verified that the performance of the fosberry flop can be greatly improved through mechanical analysis, which can help athletes reduce the take-off pressure and increase take-off impulse, further more improve sports performance. In addition, the experiments has certain scientific character through mechanical analysis principle.

References

1. Huang W, Zheng D (2003) The theory and practice of Fosbury flop arc approach technology. *J Beijing Sport Univ* 26(1):120–122
2. Liu J (2003) The effect of biomechanical research mechanism of different run-up speed of take-off effect. *J Shenyang Sport Univ* 2:90–92
3. Yan Z (2005) The biomechanical research on the conversion ratio of jump run-up speed. *J Shandong Sports Inst* 21(6):72–74
4. Du X (2006) Research on curving approach in Fosbury flop technique. *J Taiyuan Norm Univ (Nat Sci Edn)* 5(2):141–142
5. Huang J (2004) The comparative study of kinematics in the Fosbury flop technique. *J Beijing Sport Univ* 27(3):408–410
6. Zhang J et al (1998) The biomechanical analysis on high jump movement in three-dimensional. *Sports Sci Tech China* 34(4):45–47
7. Song G (2005) The analysis of take-off technique in excellent male high jumpers in China the three-dimensional kinematic. *J Phys Educ* 12(6):115–119

8. Fan Qin H, Wu J, He T (2005) Three-dimensional kinematic analysis on take-off phase of swing leg technique. *J Hebei Norm Univ* 29(1):106–108
9. Zhang L (2002) Research method of sports science. Higher Education Press Beijing p 577
10. Sleivert G (1997) Training and competing in the my steryzone. *Sport Sci* 5:701–704
11. Depenna J (1997) A Closer looking at the shape of high jump run-up. *Track Coach Winter* 138:4406–4411
12. Jones T (1990) Flop high jump. *Track Field Coach Rev* 3:14–17
13. Yu Y (1999) The structure and function of take-off phase of Fosbury flop of swinging leg movement. *Chinese sports coaches* 2

Chapter 51

Experimental Study on Influence on University Male Students Psychological Health by Playing Basketball

Jianliang Wang

Abstract Through the research and findings, the college students in different degrees of mental disorder and mental illness, and the existence of psychological problems of college students the proportion is increasing. College students mental health problem has social and school, cannot be neglected and the urgent need to resolve important issues. In this paper, through a combination of the basketball movement the oneself characteristic analysis of basketball exercise on mental health of college students the positive impact, focuses on the study of influence factors between mutual coupling between the relations, and in the specific experiment verification.

Keywords Basketball · Influence factor · Coupling mechanism · Psychology · Experimental psychology

51.1 Introduction

Through this study, explore new program under the guidance of basketball training course, compared with other sports curriculum of sports on College Students' physical quality acquired role, as well as the psychological health factors of college students is active guide, stimulate on physical education interest, fosters the lifelong physical education habits, so that the students' physical health, personality, mental state is good, in the basketball training to achieve certain positive to promote physical and mental health purposes. In this paper, according to the

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characteristic of basketball sports, from the train body stress ability, alleviate the psychological tension, improve emotional self-control, exercise a strong will and improve interpersonal relationship and other aspects, demonstration of basketball exercise on mental health of college students role in promoting [1–3]. The basketball movement to develop physical stress ability. The basketball movement is smooth, the need for strong physique, quick to judge and quick response, so it can cultivate students ability to stress, conducive to cope with the emergency events come unexpectedly. Basketball can alleviate the psychological tension [4].

The basketball movement to increase the emotional self-control. Mood and emotion is the human to the objective things whether conforms to the subjective and psychological experience, is accompanied by specific physiological responses and the external manifestation of a psychological process. They will directly affect the body's physical and mental health. The mood and emotion, human psychology can crab and physical energy exchange, formed a significant interaction between. In basketball, the outcome of the game will give participants or spectators to produce strong, rich and varied emotion. Against the complexity, diversity and strong, easy to make college students often appear a variety of emotional state. Therefore, the basketball movement process must know how to control their emotions, to overcome the various internal and external factors of the interference field [5].

This paper firstly analyzes the students' existing mental health problems, these problems are mainly anxiety, loneliness, weak-willed, communication ability and low self-esteem and other aspects; then, from the training of physical stress ability, alleviate the psychological tension, improve emotional self-control, exercise a strong will and improve interpersonal relationship in five aspects, discusses basketball exercise can effectively promote the development of College Students' psychological health; finally, according to the Hunan province Xiangtan county first middle school teaching cases show the effectiveness of the method. Conclusion: basketball in college students' psychological health has a good role in promoting [6].

51.2 Research Method

In order to make the results more significantly, randomly sampled in order to make the results more significantly, a random sample of Agricultural University of Hebei 09, 10 level management professional students are divided into two groups as the experimental object, randomly selected from a class as the basketball training experiment group, another class for the control group. The experimental group used to understand the game teaching and based on the concept of physical education curriculum model of basketball teaching. The control group in addition to the daily school opened sports curriculum activities, has not participated in other sports training.

51.2.1 Research Framework

The experimental study of identifying, collecting the relevant domestic university students' physical and mental quality status and basketball training on College Students' physical and mental quality of the data, analysis of basketball training course on College Students' physical and mental quality and comprehensive quality and academic performance of active meaning, combination of teaching evaluation and students' self exercise after evaluation of College Students' physical exercise interest, stimulate raise, train lifelong sports consciousness, through the basketball training "to help students build fitness", and then based on the results, conclusions and recommendations, in order to achieve the objective. Study of architecture, as shown in Fig. 51.1.

51.2.2 Experimental Group

The experimental group is as shown in Table 51.1.

Ensure that students are grouped randomly, the experimental group a total of 208 people, 210 people in control group, let the experimental factors are basically the same, there is no difference, which belongs to the same class (see Table 51.2) by the school sports teachers.

From Table 51.2, $P > 0.05$, has no significant difference. This shows that the experimental group and the control group before the experiment of physical quality level had no significant difference.

51.2.3 Experimental Scheme

From Table 51.2 that the experimental group and the control group before the experiment of physical quality level had no significant difference. Then take on the students in the experimental group 3 times a week, 2 h per time basketball practice, content can be arranged to basketball games, basketball basic skill and tactics, teaching competitions, experimental time is 6 months. Finally, the

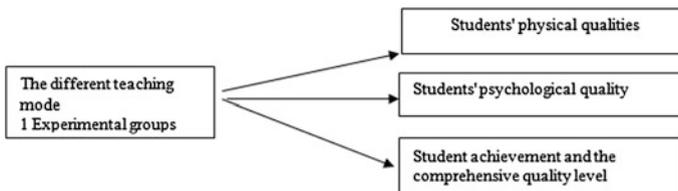


Fig. 51.1 Research framework

Table 51.1 Test object grouping and number distribution

Grade	Basketball training experimental group		Contrast group	
	Female	Male	Female	Male
Class1, 2011	19	16	20	15
Class2, 2011	17	18	19	20
Class3, 2011	16	20	15	19
Class4, 2011	27	34	30	33
Class5, 2011	16	25	13	28
Total	95	113	95	115

Table 51.2 The experiment taught by the school sports teachers

	Number N	Sum Σ	Average X	Standard deviation S
Experimental group	208	15641.6	75.20	7.54
Contrast group	210	17101.42	75.67	7.07
Difference		1459.82	0.47	
Statistics P	0.850			

experimental group and the control group in terms of psychological factor scores contrast analysis conclusion.

51.2.4 Data Processing

Adopt Mathematical Statistics method to carry on a data processing to the acquisition data (Show Zhao level with $P < 0.05$ is standard)

Analyze with the list factor hair to before the experiment of the experiment set and the matched control set difference the adoption is on the average worth the method (T examination method) of comparison, Carry on 3 times weekly after the student to the experiment set, basketball practice in every time 2 h, the contents can arrange basketball game, basketball basic skill military tactics, and teaching game...etc., it of experiment is 6 months. Finally carry on a test with the amount of SCL-90 form, get experiment set and the mental index sign factor of matched control get a goal of contrast analysis the form experiment result enunciation, the relationship factor has already descend, such as Table 51.3 show.

51.2.5 The Result Analysis

There is sport of regulation toughenning ability the Yu circumstance of suppressing of effective improvement university student, ease to suppress Yu degree. Have research to express, sport toughen can increase the content (its function is

Table 51.3 The data used for result analysis

Factor	Contrast group		Experimental group	
	Factor score	Factor total score	Factor score	Factor total score
Somatization	0.5326	4.2608	0.4586	4.856
Obsessive compulsive symptoms	0.8837	7.9857	0.5266	4.2128
Interpersonal sensitivity	1.1876	15.4388	1.0357	16.5712
Depression	1.0972	18.6524	0.9251	12.7541
Anxiety	0.9873	13.8222	0.8238	12.357
Hostile	0.9258	6.4806	0.7328	6.1024
Horror	0.7358	3.679	0.5301	3.1806
Paranoid	0.9875	7.900	0.5128	3.6274
Psychotic	0.5288	1.5864	0.3283	0.6566
Miscellaneous	0.7253	2.1759	0.5862	0.5682
Total score		81.9618		65.0836

moderate unified should arouse status bottom whole body the function of each system) of Fei Tai inside the human body, the content change exercises medium emotion variety and the increment of association, make strain suppress ease, raised the student's Xin pleasant sensation. Formerly form result also suggest, after experimenting of force getting a goal of symptom factor have to have a competition have been already descended before checking, make to force symptom to ease after expressing to pass to have sport of the regulation to toughen, force symptom to mainly point those know perfectly well to have no necessity misgiving but again cannot get away from of nonsense thought impulses and behavior, because sport toughen can be 1 kind to vent, various annoyance, uneasy of the emotion vent and make thus the mental state can be equilibrium.

51.2.5.1 Toughens with Athletics Aspect

This aspect explains to have something to do with collectively exercising and toughening, the compulsive sex ground increased the machine that they associate mutually and exercised and toughened and asked for taking part in body and mental state activity of to be placed in the exciting status of certain degree on the other hand, this was advantageous to emotion and communicated to reach agreement in addition to ego the You shut and usually take part in and toughens more and easily relate to with the formation intimacy of others, the way that university student can ask for help of an exercise and toughen to know, adjustment and change mental quality and behavior method.

51.2.5.2 Toughens with Educate Teaching

Contemporary athletics education should adopt a superior quality educational guideline and educate athletics to healthily plan to systematically bring into an university student athletics education teaching of reform project. The traditional athletics educates mode already not the student in suitable contemporary, should combine individual difference and student to know the unbalance of technical ability. Therefore this text emphasizes how strengthen the student's corpus, raised mental character of student and body character to put forward the research of experiment completely. Take basketball teaching as to guide thought on the other hand, build up taking student as origin of principle. The teaching method and means of "take student as origin" has to adapt to the student's actual circumstance differentiation to treat, cannot let to think the student has resentment and strengthen the student's competition consciousness and raise basketball technique and strengthen physical endowment further.

51.2.5.3 Healthily Influence Aspect with Mental State

Mental state health is the important sign of sounds character, passes sport to toughen, raising of body character and the inside motive toughenning is an inseparable, sport toughen of level and spirit the healthy exist a kind of just related.

51.3 Conclusion

Mental health is the important symbol of perfect personality, by exercise, fitness and exercise motivation is not divided, exercise level and mental health between the existence of a positive correlation (Slephens 1988). Once upon a time table can be seen, the subjects of anxiety factor is reduced considerably, and several of the students physical quality, low exercise capacity, low exercise capacity of students in general anxiety level rises apparently, through exercise, healthy feeling led to positive changes in heart function, exercise students' anxiety, students mental disorders were significantly decreased after exercise, self-concept has significantly strengthened, the exercise level, mental health level in the presence of strong interaction

College students, depression, anxiety, hostility, learning pressure, psychological balance, emotional balance, mental health, and academic performance and comprehensive quality through 6 months of basketball games, are a significant change has occurred, that basketball training and the improvement of students' learning promote each other, basketball training to promote the mental health of the students and improve the comprehensive qualities.

Through the teaching of basketball skills and knowledge, change to teach skills oriented teaching mode, cultivate more knowledge

Identification and adaptive sports participants, so that students can be more widely understood basketball knowledge, and in the pursuit of the process of this kind of understanding is applied to the system of basketball training, stimulate students' sports interest, promote the intelligence development and comprehensive quality, and cultivate students' consciousness of lifelong sports.

References

1. Wang S, Zhang J (2003) Left from the present; physical and mental health of college students and physical exercise related study. *Sports Sci* 02:23–27
2. Xiushu B, Yan-chun P (2003) Physical exercise on mental health of college students. *China Sport Sci Technol* 03:348–352
3. Xu B, Ni J (2008) Experimental research on college students mental health. *Wuhan Sports Inst J* 2:23–25
4. Beili Z (1987) *Sports psychology*. Higher education press, Beijing 2000:412–413
5. Shi Z (2011) *Mental health*. vol 34, Chengdu University of Science and Technology Press, Chengdu pp 445–448
6. Ding Q, Fan F (2009) Exercise prescription for the correction of College Students' mental barriers effect. *Beijing: Beijing Sport Univ J* 04:45–52

Chapter 52

Research of Role and Practice in Pulse-Measuring in Sports Train

Yu Jiang

Abstract In order to assess the heart function, the level of training and athletic intensity of physiological indexes, this paper choose pulse measurement as the research object, the pulse and other physiological indexes because compared with simple, easy to measure is more practical and the characteristics of no wound. Through the years related to scholars on pulse measurement in training use situation analysis, and further study of sports training and measuring pulse game player body function condition, sports strength and fatigue recovery situation and psychological regulation, and other aspects of the measured value and meaning.

Keywords Pulse-measuring · Survey · Physiological · Sports training · Monitoring

52.1 Introduction

Pulse, is the number of heart beat per minute, but in essence, it is the comprehensive reflection of physiological changes in the body of a “window”, through it, can more accurately describe the body function to exercise stimulates the immediate reaction or chronic adapt. Pulse are able to act as “the window” role, is from its change and exercise load changes between causality [1].

For decades, pulse in the domestic and international measurement sports training and competition process has played a very important role, not only use the

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pulse to process monitoring process training and competition, will also be used for measuring pulse in athletes fatigue degree definition, the movement [2].

After recovering and fatigue motor function injury rehab status, etc., pulse measurement has become the most convenient coaches and athletes side of one of the measurement methods [3]. And in sports training and competition due to economic, instruments and teachers ability, etc. A variety of factors, couldnot get any more high-tech sports measuring instruments and methods applied to practical training and competition [4]. In view of this, this article aims to previous research foundation, discuss pulse measurement in sports training and competition to the important role and operation leaning [5, 6].

52.2 The Role Pulse Measurement in Sports Training

52.2.1 The Role Pulse Measurement in the Determination of the Sport Intensity and Assessment of the Body Function

Pulse and athletic intensity in a linear relationship and can be reliably reflect human body function condition, in all aspects of the sports training could be used as measurement indexes [7, 8]. For pulse and athletic intensity of the research, the domestic and foreign scholars study the result is consistent, and, when the speed of the pulse is a sport on the strength and movement [9]. For example: Yu Qi research thinks, pulse is aerobic exercise intensity evaluation of the effective index. In the study, in a certain range, the pulse of the athletes with athletic intensity increased. It is not hard to see, in a certain range, the greater the strength, pulse will be quicker. When the same in sports load, the slower the pulse of the athletes rise, says athletes body function condition, the better. For the same strength after the biggest sports training athletes pulse value lower, indicates that the athletes' physical function enhanced [10].

When the pulse muscle activity increase and movement on the strength, and increasing range still and duration, fitness level, the level of training. Wang Yong Quan in the our country football the physical strength of the excellent players load que "in the article points out that when pulse change range between 110 and 180/ between division, pulse and exercise intensity, oxygen energy metabolism and taken between the linear relationship there are significant. This article proved, in a certain range, the discretion of the pulse index to a direct reaction to the size of the exercise intensity, pulse index measure of athletic intensity evaluation to have the important meaning [11]. Because of the differences between individual athletes pulse is larger, the maximum pulse not completely the same, so in training practice, the pulse of the movement monitoring strength should be considered when the individual difference, the longitudinal comparison is more reasonable [12].

A lot of research using pulse as evaluation index of the physiological load strength, are based on studies confirm that the ultimate tensile strength of the pulse and external load movement of the linear relationship. However, with further thorough, the pulse and movement of the relationship between the strength of some new understanding. 1992 h. TANAKA of the results of the study show that, pulse and external load of the linear relationship between the different forms of exercise performance under different, pulse depends more on the body for this kind of movement form Type the extent to, not this movement form of external load strength. The research suggests we, pulse index reflects is not limited to the movement of the external load strength, it may be affected by the movement of the specific form, rhythm changes and athletes of the emotional, to luck. The move to the influence of various factors such as degree [13]. Therefore, in sports training, not only simple pulse index as the only exercise intensity evaluation monitoring index, want to combine other physiological and biochemical indicators of the exercise intensity and athletes body function Monitoring.

52.2.2 The Rolepulse in Sports Fatigue Judgment and Recovery

Many researches show that pulse is the most simple and easy fatigue evaluation index. General common basis of pulse, sports pulse application “in the article points out that, in the badminton sports training, changes reflect the pulse of the movement function level, energy metabolism, the training load strength and body function recovery degree. Not only using pulse control on training for the whole process real-time monitoring based on the implementation method of accurate training, and also use of physical injury and pulse the recovery of the comprehensive monitoring. Through the pulse change will be monitoring exercise intensity, promote the sports injury recovery process, ensure training effect and prevent excessive training. In sports training pulse index is master athletes training session recovery of the good index, also will help athletes from sports injury to recover as soon as possible. In the absence of pulse measurement, coaches and athletes are often hard to perceive to athletes due to injury caused by stopped training the body function of decline. To be able to use pulse monitor, gradually returning to fitness exercises, will help the athletes’ physical skills to get fast recovery, and gradually transition to the normal training.

Pulse in mental relaxation of the training research shows that the psychological meditate on the method of immediate movement relax girl after the pulse has significant effect. The study results show that run the 800 m after the 2 min of the language that psychological meditate on the pulse of the subjects. Numerical recovery is far better than the normal recovery means of control; and after 5 min of the subjects that psychological meditate on pulse recovery than 2 min and numerical methodological low; after restoring pulse with quiet state group compared with the numerical values have differences. Do not have a statistically significant ($P > 0.05$), whereas the control subjects are far higher than pulse

numerical quiet level ($P < 0.01$), indicating that 5 min of mental relaxation more conducive to meditate on the recovery of the pulse. The experiment proved mental relaxation method used to meditate on training and competition stage student physical recovery, practice 2 min to pulse recovery have certain effect, practice 5 min can achieve significant effect, make the pulse numerical basic reach quiet level. In sports training or competition, the coach should master some simple mental relaxation technology or suggest that language, to help athletes in the meet emergencies, maintain the stability of the pulse, so that in sports training or competition quickly adjust the psychological state.

A simulated game the training of the pulse is only a simulated game on one hand of many aspects. It is through the creation and game similar load stimulation, provides higher than the density and intensity sports game, forcing pulse rise to match level, and reflects the pulse of the game is Training process. In many collective ball games, the athletes are standing position is different, the task of different, he decided to have the sport ability of different, accordingly, in training or competition required levels of the pulse and pulse is a reflection of the functional status also different. So the pulse of the simulated game appears very important, because only the players have a different stance assume its position of the sports ability, to make the team sports level, play gives better competitive ability. Because the essence of the training is to make the human body adapt to what they engaged in activities, and competition is the final purpose of any sport, so training must be from the actual needs, in strict accordance to the pulse of the game for training.

Zhao LiHua (1996) “in football simulation game of the preliminary discussion pulse training session” in the article points out: the great physiological load of exercise training session cannot reach the level of the pulse of the game many reasons. The author analyzed from sports load training cannot reach the pulse than” The cause of the pulse, and lack of competition in psychological factors influence the great physiological load of exercise training, can try to match or pulse. This will match as the training goal of the pulse of the pulse method helps to improve the quality of sports training and effect. To choose and determine the right training means play an important role.

52.3 The Practice of the Pulse Measurement in Games

52.3.1 Pulse Index Measure of Exercise Intensity and Function in the Monitoring of the Situation

Wang Yan Qiong on basketball player in the before and after exercise in the research of the pulse change, from its the experiment result, in sports immediately after the pulse up to (189.40 ± 10.71) times/min, and pulse before has very significant difference in sexual meaning ($P < 0.01$), and the test of the object

visible pulse reserves more fully. After the game 2 h already basically to restore quiet when level. It also hints for the times the strength of the game is to adapt, athletes in the game can quick recovery, also suggests athletes about the game load ability and function fairly well. The experiment proved the pulse index measure of sport intensity and the evaluation of the body function status is important. Guo Li in national fencing championships during, determined and England athletes pulse, and found: the pulse can reflect fencing competition fierce strength. Related research shows that the pulse in the game can be used as a simple, easy to operate, more intuitive index reaction in the game players exercise intensity. Therefore, in the hardware devices allow, sports team coach should master the measurement index, and it is advantageous to athletes in the process monitoring implementation, help the athletes to adjust in time the game with tactics.

Peng Guo Xiong to tennis options class of students man research shows that the heart rate in the college students' tennis teaching the course of a game features change, to reflect the game change of load strength, can be as college students tennis load strength monitoring of the effective physiological indexes. Tennis is the current development of more hot sports fitness project, their sports strength, load characteristics for the determination of tennis players get good competition results have important value, so need to College students' tennis sports to the implementation of scientific exercise intensity and function condition of measurement, facilitate the coaches in the game to realize the athlete's body function condition and accurate adjustment of the tactics. Only the comprehensive and timely master athletes in the race. Athletic intensity and the condition of the body function, can faster and more effective to improve the competitive level of tennis player.

52.3.2 The Role Pulse Measure of Psychological State in the Game

Before an appeared nervous, pressure, excitement and mood swings wait for a phenomenon, can affect the training and the pulse of the normal before the game. Research shows that most of the players in a few days before the pulse is on a daily basis at ordinary times faster, this can be considered as the central for the match in advance of stress and mobilization; the pulse before rising and the level of play, the importance of places his opponent's strength, and the directly related. In addition, the study also found that the pulse and increase before the game about the distance of the project: the longer distance before the smaller increase in pulse. Such as measured in men 50 m freestyle, 200 and 400 m players, a day before the pulse 130 times/min respectively, 120 and 105/min; the same player in different games and different distance of the measuring also have similarities.

Similar data. For the first time in the game's new players, unless necessary, we usually arrange the register of long distance swim additional project, try to reduce the psychological pressure disturbance. All this suggests that pulse in a psychological pressure when disturbance to physical activity levels reflect deviation. We,

therefore, a week before the game with pulse assess training load, will be very careful not to overestimate players load strength, and appropriate cut back and psychological counseling.

Zhang LuFei of shooting athletes of the study show that, due to the emotional, thinking, attention athletes psychological factors by environment and various factors, with different mental load stimulation, pulse will produce corresponding change. Therefore, in the shooting attack [14]. In the process of hair, striker pulse keep in “good” (best psychological state pulse) range, it will be possible to show the best technical movement, obtain the success of the games. Conversely, too high or low pulse (bad psychological state pulse), will directly influence the shipment. Mobilize technology play. For non-professional athletes, the game is the psychological regulation is very important, because they did not receive the professional training, the game experience, to appear in the game of some of the incident dealing sometimes is in. This needs the coaches is able to control the game except when athletes exercise intensity change the influence of the pulse change other factors of pulse change, in order to help the athletes to adjust in time to play their psychological state.

52.4 The Significance of Pulse Measurement in Sports Training

52.4.1 The Role Pulse Monitoring in Sports Training

In a certain range, the discretion of the pulse index to a direct reaction to the size of the exercise intensity, pulse index measure of the strength of the movement of the evaluation is of great significance. But because of the differences between individual athletes pulse is larger, the maximum pulse not completely the same, so in training practice, the pulse of the movement monitoring strength should be considered when the individual difference, the longitudinal comparison is more reasonable.

In sports or athletes after the body appeared fatigue or injury pulse index will be when coaches and players to send out a warning message, in order to improve the coaches and athletes increased attention to this, will help athletes from sports fatigue or injury problems found as soon as possible, adjustable. The whole plan, make the body get quickly restored. Through the determination of the pulse of the game, to determine the best athletes in the competition when the pulse of the competition ability, events will be applied to the pulse sports training, training goal of the pulse as method helps to improve the quality of sports training and effect. To choose and determine the right training means play an important role.

52.4.2 The Important Meaning of Pulse Index on Athletes Physiological Monitoring

In the process of training before the game, the coach should be able to easily control the influence factors of heart rate changes, accurately grasp the pulse of the pre-match increase is due to the influence of the psychological state or exercise too much intensity or body function recovery by the incomplete, and thus more help to help the athletes to adjust psychology or training program, and in the game better sports competitive sports level. Through the game for the monitoring of the pulse of the athletes, coaches accurately grasp as soon as possible to the psychological situation changes athletes, coaches is more effective to help athletes overcome game of all kinds of bad mood influence, make its obtain more excellent sports results.

52.5 Conclusions

Pulse is exercise physiology to assess the heart function, the level of training and athletic intensity of one of the most common and most simple easy to measure of physiology, in sports has been widely used in practice. Pulse and other physiological indexes have more practical than simple, easy to measure and the characteristics of no wound. This article through to the years related to measuring pulse scholars in training use literature review, and further discussion of sports training and measuring pulse game player body function condition, sports strength and fatigue recovery situation and psychological regulation, and other aspects of the measured value and meaning.

References

1. Su Z, Hao X (2002) Pulse measurement in sports training the role and influence factors. *J Chengdu Sports Coll* 2:89-91
2. Yang Q (2002) Using pulse control sports training intensity in 2 cases reported. *China J Sports Med* 2:219-220
3. Wang Y, Yumeng X (1998) Our country football outstanding athletes physical que load. *J Shenyang Inst Phys Edu* 1:10-13
4. Tanaka H, Fukumoto S et al (1991) Distinctive effects of three different modes of exercise on oxygen uptake, heart rate, blood lactate and pyruvate. *Int J Sports Med* 12:433
5. Coen B, Zieres C, Lieblangoo Alf S et al (1993) Lactate and heartrate patterns in endurance runs of leisure-time athletes. *Int J Sports Med* 14:176
6. Zhuang GJ, Hroma T, Suttun JR et al (2010) Autonomic regulation of heart response to exercise in tibetan and Han residents of Lhasa. *Am J Cardiol* 28:37-44
7. Yao H (2006) Sports health care learning. Higher Education Press, Beijing

8. Yang Y, Li B (2008) Pulse measurement in badminton sports training practice application of sports world. *Br J Sports Med* 7:88–91
9. Sun G (2000) Psychological meditate on relaxation methods for girls gym class the role of pulse recovery. *Shandong Sports Sci Technol* 1:71–72
10. Lin G, Yang YL (2008) Creatine kinase and vital capacity index in basketball pulse before and after exercise. *Changes China Tissue Eng Res Clin Rehabil* 11:2120–2124
11. Guo L (2009) For fencing athletes pulse, blood lactic acid and serum CK after. *J Beijing Sport Univ* 5:190–194
12. Peng G, Hu B (2007) College students before and after games tennis teaching pulse and systolic blood pressure, diastolic pressure change characteristics of the experimental study. *J Guangzhou Inst Physical Educ* 5:67–69
13. Ma X (2008) Sports pulse in school swimming team training game measurement of the application. *J Jingmen Inst Technol* 3:89–92
14. Zhang L (1996) Shooting athletes and the results of the competition of the relationship between pulses. *Shandong Sports Sci Technol* 1:41–43

Chapter 53

Research on Biomechanics Technology Based on the Tennis Sports

Fengling Li, Kelei Li and Jingjing Lv

Abstract Sports biomechanics research is human body movement mechanics regular a applied science. The main task is to use mechanics method makes the complex system of mathematics, and human movement phenomenon and the objective quantitative description and explanation. In the teaching of sports biomechanics use knowledge, to research action technology, establish action technology principle, establish action technology model and optimized sports teaching has an important role. This paper starting from the actual teaching, the biological mechanics knowledge and ball games teaching, combining the article tried to sports biomechanics in the sports teaching the application of the methods play a guiding role from.

Keywords Biomechanics · Sports · Tennis technology

53.1 Introduction

53.1.1 Development Stage of Sports Biomechanics

Sports biomechanics it with the sports action as the core, the use of biology and mechanics theory and method, human body movement of the study the biomechanical characteristics of the human body movement and movement law, and

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according to affect human body movement of the internal and external conditions, seek the rationality of the human body movement technology and optimization four 1. Sports biomechanics ultimate purpose is: to expound various sports mechanics principle, to improve sports technology to provide the theory basis [1].

53.1.2 Research and Application Status of Sports Biomechanics

Sports biomechanics analysis and research of the technology level depends on the development of the research instrument, need to synchronization, and computerized and action technology optimization, etc. development, theory research will focus on the calculation method of accurate and simple. About muscle function, the domestic use of test system dynamic started late, so it is difficult to and exercise combined with practice; for muscle model research less, so about the muscles mechanics study was limited. All in all, a variety of methods in combination, the comprehensive research of is the trend of the development of sports biomechanics [2–6]. Sports biomechanics is a applied strong marginal subject, the theory framework is not perfect, the experimental method and maturity, the new problems emerge in endlessly, which requires innovation theory and method to solve the new problems, and continuously improve the discipline theory. Because of the discipline of marginal characteristics, the new theory, new methods and new technology into the transplantation of sports biomechanics of innovation is a very important way [7].

53.2 Research Purpose

This research mainly through the domestic and international good weightlifter video material analysis and game site investigation results, both at home and abroad of good players serve the characteristics of the technology, from the biomechanics angle to serve as a technical analysis. Provide technical training to improve the scientific basis, promote the tennis player technical level and improve athletic performance [8]. With two a SONY camera 3D camera in accordance with the requirements of the measurement of athletes' service for technology for 3D fixed-point shooting, participants in the bottom line to the central station respectively outside of an internal angle and two goals each hair two times. Using the analytic system for love video serve athletes action technology data analytical and analysis. Get the human body and the ball, took the kinematics of data, to the human body key points of 5 according to interval analysis, to the ball, took the picture by using the analytic. The digital filtering method smooth raw data [9].

Table 53.1 Characteristic parameters of ball

Statistics	The ball hit the point-level the distance		A ball point height		Hitting some highly		Hit the high-point gap	
	Woman	Man	Woman	Man	Woman	Man	Woman	Man
Average	0.52	0.83	1.49	1.51	2.43	2.76	0.87	0.64
Is than	0.31	0.45	0.88	0.83	1.45	1.51	0.52	0.35
Standard deviation	0.0	0.30	0.13	0.18	0.06	0.05	0.21	0.25
Big value the most	0.11	0.43	1.27	1.32	2.30	2.66	0.49	0.20
Minimum value	0.79	1.35	1.72	1.91	2.49	2.82	1.12	1.08

Table 53.2 Statistical results of closely maximum speed and velocity before hitting dot

Statistics	Hold some maximum speed (m/s)		Wrist maximum speed (m/s)		Velocity (km/h)	
	Woman	Man	Woman	Man	Woman	Man
Average	16.70	22.02	11.12	12.67	154.86	183.28
Standard deviation	3.15	2.90	1.08	1.40	18.86	19.96
Minimum	10.92	18.39	9.24	10.74	120.96	144.68
Maximum	22.85	26.89	12.83	15.32	186.88	206.53

53.3 The Experimental Results and Analysis

See Tables 53.1 and 53.2.

53.4 Analysis of Serve Technical

The traditional service technical movement is: “a ball swing arm, and the arm and downward motion, up at the same time movement”. Now most outstanding athletes used to serve technology: the ball up in arms, move forward until a ball from hand instantly, swing arm moving slowly, take to the body after pointed below. The differences between the two technologies are: new technology ball swing arm action amplitude, the movement and coherent, without ceasing; and old technology is just the opposite, because the swing arm had previously lifted, and the shorter the swing by action, in the same ball height below, old technology swing among action pause. The new technology can make to participate in the continuity of the action in advance to stretch muscles from fast to the heart contraction, the muscle can play the outbreak of the biggest strength, large activities range increased muscle working distance, also added to accelerate the process of the racket. The end result is hitting new technology powerful, send out the ball speed.

53.4.1 Analysis of Ball Technical

53.4.1.1 Ball Position

Is the body should be above the right. When the ball to each joint upper fully straighten, a ball completely by relative to the upper position shoulder axis and the trunk position decision. The ball to the right position is to ensure that swing arm (the right upper limbs) swinging forward hit in the vertical turn of arc can hit just above; A ball to because the human body in the bottom position in the process of swinging forward, forming a motion inertia, body weight and beat a horizontal displacement, therefore only a little ball forward to ensure that hit points in the body is just above.

53.4.1.2 The Way of the Ball

A ball fully unbend arm, holding the ball up to a ball from hand ball after position, the ball from palm platform leave, don't bend ancon a ball with your fingers or accelerate the ball out of orbit ball % should be relatively stable. A ball shall be of high accuracy and stability a ball, the arm don't rush to put down the left arm, keep up the attitude of the stretch forward to hit point judgment (in the air to form a reference).

53.4.1.3 The Division of the Ball

From the principle of speaking, a ball high rise-hitting some distance is remote, the ball falling speed is big, the same time error caused by the judge ball hit points is big deviation (set shot opportunity judgement error for Δt , then shot some distance error for $\Delta s = v \times \Delta t$), shot accuracy is poor. At the same time the ball from the highest point of the ball drops to time is too long, affects hair force effect; above two aspects that as far as possible in the ball reached a high place or whereabouts smaller distance shot. According to the relevant research material is introduced, the excellent athletes ball around 50 cm in fall, some even in 20 cm range.

53.4.2 Analysis of Hitting Technical

53.4.2.1 High Ball Point

From Table 53.1 data can see: the man hit point relative height of athletes than women's high. The advantage of the differences between the main source is stamped out powerful man lower limbs, the height of the jump higher. Another is

an important reason for the jump shot the ball high drops to hit from the point of time with master, when focus to the highest level rise just hit the ball, hit the point is high.

53.4.2.2 The Elbow Flexion and Shaking Wrist

From the experiment the statistical results can be seen! Our country male, female athletes' service of low accuracy, serve in the target position placement 1.5 m outside the perimeter of the number of times the test data from Table 53.2 66.8 % can see: man ride the acceleration of wrist than women's obvious, therefore male athletes after hitting, ball flight from the point of view of face downward level than female athletes hit the ball out of the large angle. But because the man hit the high point for the direction of the ball from the effect, therefore male, female athletes hitting accuracy difference is not big. Single technically: female athletes than male athletes.

53.4.2.3 Analysis of the Arms of the Action in Swing Spin

When fully using the trunk and shoulder, hip axis twisting send force hit, athletes have a clear trunk and shoulder axis rotation. Greatly rotation will make upper limbs and racket games direction deviation. In order to eliminate this kind of action on the direction of deviation, can use many link chain of relative movement reach this goal. In the shot instantly, human body and shoulder axis is turning to the left, and the swing arm in action and trunk spin turn opposite direction, which can eliminate the moment to hit the ball the human body rotation direction negative influence. In today's tennis technology, trunk and shoulder axis has obviously rotation movement, so swing arm in the moments before hitting the spin action has become indispensable in the technology link.

53.4.2.4 Analysis of Velocity and Speed

Due to the special arrangement is serve, before each experiment to athletes explains "to the target position to own biggest power serve". Therefore the experiment result can reflect the Chinese men. Female athlete's biggest strength and serve speeds. From Table 53.2 data can see: female athletes of the average velocity is 154.8 km/h, while the men averaged 183.8 km/h fastball, far more than people think high speeds, than before to our country women players of high velocity measurement (110 km/h) causes the difference has two reasons: (1) we measure is the biggest velocity, athletes in the competition rarely used to serve (control the ball placement is an important game service, improve the precision technology is bound to increase muscle placement proprioception sensitivity, close to the limit when muscle proprioception sensitivity low); (2) we filmed speed is

high (500 squares/SEC) and the low speed before shooting (50–100 squares/SEC). The tennis ball time only 4/1000 of s around, the velocity change quickly, according to the spectrum analysis theory, the ball and displacement signal frequency of the racket, the frequency of the signal and the main period the average frequency to the high-end mobile, in signal smoothing, shooting at low speed, because shooting speed limits, smooth truncation frequency is also low, so make signal loss, the introduction of the error.

53.5 Conclusion

After the experimental results and analysis that new technology to serve can exert systemic muscle force, our athletes should actively adopted. In addition, the ball too high against the trunk and the lower extremity play hitting power, also suitable for their own quality should serve movement rhythm, especially have to pay attention to the ball hitting the cooperation among action with training, to achieve the accuracy and stability. Strengthen special explosive quality training and lumbar back flexibility training, improve the maximum speed capacity. Pay attention to tennis player the exact time, and space consciousness training.

References

1. Fang X (2009) Tennis movement technology power serve the evaluation of the quality of basis and index of the research and reveal. Ninth Natl Sports Biomech Semin Nanjing 3(4):47–54
2. Yan B (1988) Image measurement error processing and feasibility of the method of inspection. Sports Sci 2:44–49
3. Xin D (2006) Research methods development and gazing at sports biomechanics. Sports Sci 3(6):95–99
4. Zeng F, Li Q (2006) Excellent professional tennis player game scoring analysis. Hubei Sports Sci Technol 23(1):09–14
5. Liu Y, Liu Q, Zheng M (2008) On improving the quality of tennis the paper discusses the problems. Anhui Sports Sci Technol 22(5):73–79
6. Wu S, He W (2008) Tennis ball beginners' que stability. Guangdong Technol Norm Coll J 30(9):482–488
7. Wang Z, Zhang S (2009) Tennis serve the motion of lower limbs kinematical analysis. Ningbo Eng Coll J 3(3):190–198
8. Guo P, Wang X (2010) Tennis technology and training. Norm Sch J 2(2):480–484
9. Pan S, Zhang H (2002) Two tennis ball technical characteristics and bottom line biomechanical characteristics comparative analysis. J suzhou univ (Nat Sci edn) 12(4):388–392

Chapter 54

Analysis of Tai Chi on Pulse Wave Velocity

Chuanguo Li

Abstract Fifty persons aged 45–65 years old, of whom 25 persons have been practicing Tai chi for more than 36 months, and the others didn't practice Tai chi, voluntarily participated in this study. All had a PWV test. By analyzing the data of PWV, the study came to some findings that (a) Tai chi has a significant effect on PWV, it can make the PWV of the elderly decrease, and namely, it can improve the cardiovascular function of the elderly, and (b) it seemed that the Tai chi have more significant effect on male than female. Therefore, this study suggested that Tai chi can be used as an exercise on preventing cardiovascular conditions.

Keywords Tai chi · Pulse wave velocity · Cardiovascular

54.1 Introduction

Tai chi (also called Taijiquan, T'ai chi, T'ai chi ch'uan, etc.), originated in China over 1,200 years ago and began as a form of martial arts like boxing [1]. It has constantly been evolving from being originally used as a combative and self-defense form to a health-enhancing exercise, practiced by individuals of all ages to maintain health and prevent disease. In much literature, as we have known, Tai chi is a type of internal Chinese martial art practiced for both its defense training and its health benefits [2]. It is also typically practiced for a variety of other personal reasons. It can provided evidence of the beneficial effects of Tai chi exercise on health, fitness, and prevention of falls. As a consequence, a multitude of training

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forms exist, both traditional and modern, which correspond to those aims, and nowadays Tai chi is a popular exercise all over the world. Therefore, the function of Tai chi attracted many researchers.

In recent years, a number of researches have been carried out and existing evidence that Tai chi generates various health benefits for individuals of varying age groups and patient populations. But, the experiment has not yet done by pulse wave velocity (PWV) assessment. The study of the basic scientific principles of the velocity of the pulse wave through the arterial branch dates back to 1808 with the research of Thomas Young. The relationship between pulse wave velocity and arterial wall stiffness can be calculated from first principles from Newton's second law of motion, $F = ma$. Using some simplifying assumptions, the Moens-Korteweg equation can be derived; an equation that directly relates PWV and artery wall stiffness. PWV is a measure method and assessment of arterial stiffness. It is easy to measure invasively and non-invasively in humans, is highly reproducible [3], has a strong correlation between PWV and cardiovascular events and all-cause mortality [4], and was recognized by the European Society of Hypertension as integral to the diagnosis and treatment of hypertension [5]. In this study, the purposes were to explore the effect of Tai chi on PWV and confirm the role of Tai chi on cardiovascular system of the elderly.

54.2 Subjects and Methods

54.2.1 Subjects

Fifty healthy adults aged above 45 years old, of whom 25 Tai chi practitioners who practice years more than 36 months, and 25 common people, participated in this study. A written consent protocol was acquired from each participant.

54.2.2 Methods

54.2.2.1 PWV Test Procedure

PWV were measured by the COLIN VP-1000 automatic atherosclerosis tester (Colin Co. Ltd, Komaki, Japan). PWV were measured and recorded automatically by this instrument, and cuffs were wrapped on both arms and ankles. The cuff was connected to a plethysmographic sensor that determines volume pulse form and to an oscillometric pressure sensor that measures blood pressure. PWV is expressed as the ratio of the distance between two sites to pulse wave transit time. In this study, PWV was measured from the brachial artery and ankle (baPWV). The distance of each segment was measured manually in each subject.

Table 54.1 Basics characteristic of subjects

Group	Samples	Weight (kg)	Height (cm)	Age (years)
Tai chi	24	54.4 ± 10.1*	163.2 ± 8.6	56.2 ± 5.5
Control	26	63.1 ± 10.3	161.2 ± 8.8	57.9 ± 6.1

Data are means ± standard deviations. *:p < 0.05

Table 54.2 Difference of PWV between Tai chi and control group

Category	PWV (cm/s)	t	p
Tai chi	1318.8 ± 160.8	-2.058	0.046
Control	1437.1 ± 238.3		

Data are means ± standard deviations

54.2.2.2 Statistics Analysis

Statistical analyses were performed using SPSS 16.0 for Windows. Independent sample t test was used in this study. All significant levels were set at 0.05.

54.3 Result

54.3.1 Basics Characteristic of Subjects

The basics characteristics of subjects are listed in Table 54.1. From Table 54.1 we knew the body weight of control and Tai chi group had significant different. It showed that Tai chi can prevent the obesity and make people more wellness.

54.3.2 PWV Comparison between Tai Chi and Control Group

A independent sample t test has been done on the PWV comparison between Tai chi and control group, the result was listed in Table 54.2. The table showed that the Tai chi and control group's PWV were 1318.8 ± 160.8 cm/s and 1437.1 ± 238.3 cm/s respectively. $T = -2.058$, $p = 0.046 < 0.05$, therefore, the PWV between Tai chi and control group was significant difference. It demonstrated that the Tai chi exercise can make the arterial wall stiffness softer and make the people slowly old.

Table 54.3 Gender difference of PWV between Tai chi and control group

Category	Female			Male		
	PWV (cm/s)	t	p	PWV (cm/s)	t	p
Tai chi	1310.7 ± 176.5	- 0.750	0.462	1326.2 ± 151.7	- 2.203	0.037
Control	1375.9 ± 243.5			1493.6 ± 228.0		

Data are means ± standard deviations

54.3.3 Effect of Sex on PWV between Tai Chi and Control Group

According to female and male division, independent sample t test has been done on PWV comparison between Tai chi and control. The result of test was listed in Table 54.3. The table showed that Tai chi and control group's PWV in female were 1310.7 ± 176.5 cm/s and 1375.9 ± 243.5 cm/s respectively, $T = -0.750$, $p = 0.462 > 0.05$, and PWV in male were 1326.2 ± 151.7 cm/s and 1493.6 ± 228.0 cm/s respectively, $T = -2.203$, $p = 0.037 < 0.05$.

54.4 Discussion

The pulse wave is a physiological phenomenon, observable and measurable in the arterial system during blood circulation. During one heart systole a certain blood volume is expelled. This propagates through the arteries due to the reciprocal transformation between kinetic energy of a segment of the expelled blood volume and the potential energy of a stretched segment of the resilient vascular wall. We can observe the changes in pressure, blood flow, velocity and profile throughout the whole pulse wave. It can be used for classification of the artery elasticity. Pulse wave velocity assessment is a classic index of aortic stiffness and is a predictor of cardiovascular mortality in hypertensive cases. Since aortic pulse wave velocity is dominantly influenced by age, this study was to explore the effect of Tai chi on the evaluation of cardiovascular risk in the elderly.

Aortic PWV nowadays is considered as a marker of CV risk independently of blood pressure level. Since PWV is increased particularly in the elderly, PWV index may be considered as important for geriatric populations. Researchers have found that intensive tai chi practice shows some favorable effects on the promotion of balance control, flexibility, cardiovascular fitness, and has shown to reduce the risk of falls in both healthy elderly patients [6], and those recovering from chronic stroke [7], heart failure, high blood pressure, heart attacks, multiple sclerosis, Parkinson's, Alzheimer's and fibromyalgia [8], Tai chi's gentle, low impact movements burn more calories than surfing and nearly as many as downhill skiing [9].

This present study showed that the pulse wave velocity of Tai chi group was slower than control group. According to literature, the pulse wave velocity increase when the age increases, in this study the Tai chi group pulse wave velocity was less than the control group, so the Tai chi can benefit the cardiovascular.

According to the discussion mentioned, the present study suggested that Tai chi exercise may have beneficial effects for the elderly with cardiovascular conditions and some cardiovascular risk factors, although the literature to date was limited. Very few studies specifically examine patients with pulse wave velocity, although the available studies report positive results in both functional and physiological parameters. In investigations of patients with cardiovascular risk factors, most information is available on blood pressure effects and hypertension. The data on Tai chi's effect on PWV are unclear. The further study will be carried out on the factor of Tai chi on pulse wave velocity.

54.5 Conclusion

- a. The Tai chi has a significant effect on PWV, it can make the PWV of the elderly decrease, and namely, it can improve the cardiovascular function of the elderly.
- b. It seemed that the Tai chi have more significant effect on male than female. The author think it may produce owing to the ages of samples was limited.
- c. The data showed that practicing Tai chi regularly may delay the decline of cardiovascular function in older individuals. In addition, Tai chi may be prescribed as a suitable aerobics exercise for older adults. The further research should be done on larger samples and wider age range.

References

1. China Sports (1980) Simplified Taijiquan. Foreign Language Printing House, Beijing
2. Wilkinson IB, Cockcroft JR, Webb DJ (1998) Pulse wave analysis and arterial stiffness. *J Cardiovasc Pharmacol* 32(suppl 3):S33–S37
3. Wilkinson IB, Fuchs SA, Jansen IM et al (1998) Reproducibility of pulse wave velocity and augmentation index measured by pulse wave analysis. *J Hypertens* 16(12Pt2):2079–2084
4. Cruickshank K, Riste L, Anderson SG, Wright JS, Dunn G, Gosling RG (2002) Aortic pulse-wave velocity and its relationship to mortality in diabetes and glucose intolerance: an integrated index of vascular function? *Circulation* 106(16):2085–2090
5. Laurent S, Boutouyrie P, Asmar R et al (2001) Aortic stiffness is an independent predictor of all-cause and cardiovascular mortality in hypertensive patients. *Hypertension* 37(5):1236–1241
6. Wolf SL, Sattin RW, Kutner M (2003) Intense Tai chi exercise training and fall occurrences in older, transitionally frail adults: a randomized, controlled trial. *J Am Geriatr Soc* 51(12):1693–1701
7. Au-Yeung SSY, Hui-Chan CWY, Tang JCS, (2009) Short-form Tai chi improves standing balance of people with chronic stroke. *Neurorehabilitation Neural Repair* 23(5):515–522
8. Taggart HM, Arslanian CL, Bae S, Singh K (2003) Effects of T'ai chi exercise on fibromyalgia symptoms and health-related quality of life. *Orthop Nurs* 22(5):353–360
9. McAlindon T, Wang C, Schmid CH, Roncs R, Kalish R, Yin J, Goldenberg DL, Lee Y, McAlindon T (2010) A randomized trial of Tai chi for fibromyalgia. *N Engl J Med* 363(8):743–754

Chapter 55

Research of Jumping Ability and Explosive Power Based on Plyometric Training

Xiaocheng Zhang

Abstract Jumping ability and explosive power are crucial to basketball players. The purpose of this study is to examine the effects of a four week plyometric training on basketball players' jumping ability and explosiveness. The testing aspects include single-leg and two-leg vertical jump height, 40-m dash, 10-m dash, as well as the anaerobic power test. The participants were 17 healthy male CUBA (Chinese University Basketball Association) basketball players, aging at 18–24. All participants were tested both before and after the four week training. The outcome showed that there were big differences existing in the statistics of anaerobic power and jumping height: the anaerobic peak power reached the level of significance at ($p = 0.02$), relative power at ($p = 0.046$), left leg vertical jump height at ($p = 0$), right leg vertical jump height at ($p = 0.046$). These show that the four week plyometric training can improve single-leg vertical jumping ability and overall power endurance ability. However, it does not greatly improve the athletes' sprinting ability in 40-m dash, 10-m dash as well as their two-leg vertical jumping ability.

Keywords Plyometric training · CUBA · Jumping ability · Explosive power

55.1 Introduction

Plyometrics is the contraction of muscles, it is also known as a method of training muscle elastic strength and explosiveness to improve and enhance athletic performances [1]. Scholars in Hong Kong and Tai Wan translated it into muscle

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strength training [2]. Strength training is based on muscular contraction. These fast and powerful movements of contraction will stimulate stretch–shortening cycle. Training in which the concentric contraction of muscle occurs and then followed by an eccentric contraction can be called Plyometric Training. There are three mechanical models: (1) Mechanism of muscle elasticity. (2) Stretch reflex process. In the muscle strengthen training, muscle concentric contraction happens, when muscle lengthens, muscle spindle is stretched due to stimulation, then stretch reflex happens. (3) Working of neuromuscular system. No matter how strong the muscle is, the nervous system will play a role in plyometric training, when a muscle is stretched, the neuromuscular system starts to work, it will detect it and give it a protective response, which means that the neuromuscular system will control the movements to a proper rate, and make the muscle movements more effective [3].

Basketball demands good physical fitness in athletes, especially focusing on their jumping and sprinting ability, this can be proved from certain movements in basket ball such as pass on and go, power drive/stop, standing jump and reach, block etc. All these moves are quite challenging in terms of explosiveness and jumping ability. And the muscle moves are concentric contraction followed by eccentric contraction, which are same as the moves in plyometric training. Plyometric training has been popular for many years, but the study of its effects on CUBA players of China is rare. This paper aims at analyzing the effects of plyometric training on jumping ability and explosive power of male CUBA basketball players, the main purpose is to further benefit basketball training for CUBA players by improving their jumping ability as well as explosive power.

55.2 Participants

Participants are 19 players from one of the CUBA group A basketball teams, 17 out of 19 players finished the whole training and test, listed below are their basic information (Table 55.1):

55.2.1 Documentation Method

In order to get a basic theoretical idea of plyometric training, reading documentary information related to plyometric training is the first studying step.

Table 55.1 Participants basic information

Variables	Average \pm Standard deviation	Range
Age (old)	20.94 \pm 1.98	18–24
Height (cm)	188.4 \pm 5.2	178–195
Weight (kg)	85.3 \pm 8.1	67.3–95.5
PBF (%)	10.19 \pm 1.49	6.1–18.4

Research method

55.2.2 Experiment Method

55.2.2.1 Basic Structure of Experiment

A four week plyometric training was given to participants during their off-season period, the training included three sessions (one hour for each session) per week, altogether there are twelve sessions. The session combined 10 min warm-up exercise, 40 min basic exercise then followed by 10 min relax exercise. There were 3 min break among exercises, and there were also 2 min break in the same exercise. These exercises in training program were based on the advices of Dr. Donald Chu's "Jumping into Plyometric" idea [4] (Table 55.2).

55.2.2.2 Testing Procedure

Every participant was tested before and after the training. Testing place was in Sports Science Research Institute and the track and field venue. Testing order of the participants was random. The test was finished in a day. The last test was given three days after the final training. We used "Taina" height weight scale for height and wight measurement, and analyzed body composition by using body composition analyzer made by company of China Sports and Tongfang.

In 40-m dash, participants were asked to perform one by one. Stopwatches were allocated at 10 and 40-m points, as the participants' performing averages would be recorded. Monark ergomedic 894 E peak bike was used for anaerobic power test. The computer would calculate all the figures and show the index of anaerobic peak power (W), anaerobic relative power (W/kg), and anaerobic minimum power (W) (Table 55.3).

Table 55.2 Training arrangement

Week	Exercise	(training intensity)	Strength
Week 1	Side to side ankle hops	(3 × 15)	Low
	Squat jumping	(3 × 15)	Low
	Jumping and reaching	(5 × 6)	Low
Week 2	Stationary long jump	(3 × 15)	Low
	Front barrier hops	(5 × 6)	Middle
	Double-leg tuck hops	(5 × 10)	High
	Squat jumping	(3 × 15)	Low
	Depth jump sequence	(3 × 15)	High
Week 3	Jumping and reaching	(5 × 6)	Low
	Lateral jump over barriers	(2 × 15)	Middle
	Single leg hops	(4 × 8)	High
	Stationary long jump	(3 × 10)	Low
Week 4	Side to side ankle hops	(3 × 15)	Low
	Double-legs front barrier hops)	(4 × 6)	Middle
	Single- leg lateral jump over barriers)	(4 × 8)	High
	Alternate-leg push off	(3 × 8)	Middle

Table 55.3 Outcomes and analysis

Variables	Before training	After training	Mean range	P
Left leg vertical jump				
Height (cm)	49.5 ± 5.3	52.6 ± 5.9	3.1 ± 0.6	P < 0.05
Right leg vertical jump				
Height (cm)	47.2 ± 4.8	55.9 ± 6.4	8.7 ± 1.6	P < 0.05
Two-leg vertical jump				
Height (cm)	53.7 ± 6.1	59.6 ± 7.2	5.9 ± 1.1	P > 0.05
First 10 m result in				
40-m dash (s)	1.66 ± 0.05	1.65 ± 0.08	0.01 ± 0.03	P > 0.05
40-m dash result (s)	5.17 ± 0.20	5.16 ± 0.23	0.01 ± 0.03	P > 0.05
Anaerobic peak power (W)	1111.85 ± 139.02	1165.23 ± 126.34	53.38 ± 12.68	P < 0.05
Anaerobic relative peak				
Power (W/kg)	13.09 ± 1.67			P > 0.05
Anaerobic minimum peak		13.45 ± 1.49	0.36 ± 0.18	
Power (W)	608.15 ± 85.24			P < 0.05
Anaerobic relative		595.07 ± 80.29	13.34 ± 4.95	
Minimum peak	7.14 ± 0.84			P < 0.05
Power (W/kg)		6.84 ± 0.69	0.3 ± 0.15	

55.2.3 Statistical Processing

SPSS13.0 was applied for statistical processing. Averages, variance, and significance level were got from paired *T* test. The independent variable was plyometric training program itself. Variables were single-leg vertical jumping height (cm), two-leg vertical jumping height (cm), 40-m dash time (s), 10-m dash time(s), the anaerobic peak power, anaerobic relative peak power, anaerobic minimum power. We found that the figure of significance level was $P < 0.05$ (Figs. 55.1, 55.2, 55.3).

55.2.4 Outcome

17 out of 19 participants finished the whole tests. Tests held both before and after the training were very successful. The charts above were descriptions of the outcomes of related measurements for participants. From chart 3, we can find the differences before and after training. The significance level in two-leg vertical jumping height and 40-m dash time was $p > 0.05$, but it was $p < 0.05$ in single-leg vertical jumping height, anaerobic peak power and anaerobic relative peak power test.

55.2.5 Analysis and Discussion

The outcome shows that CUBA players' four aspects have been improved after the training: the figure for single-leg vertical jump height—from (49.5 ± 5.3 cm and

Fig. 55.1 The anaerobic peak power: averages

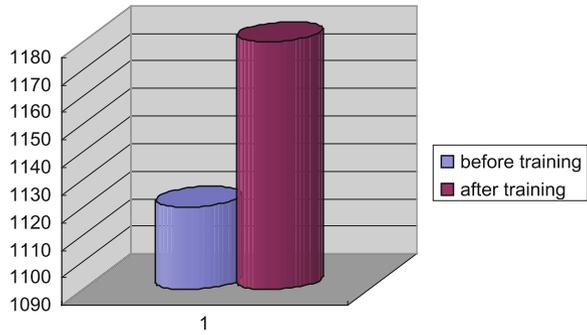


Fig. 55.2 The anaerobic relative peak power (averages)

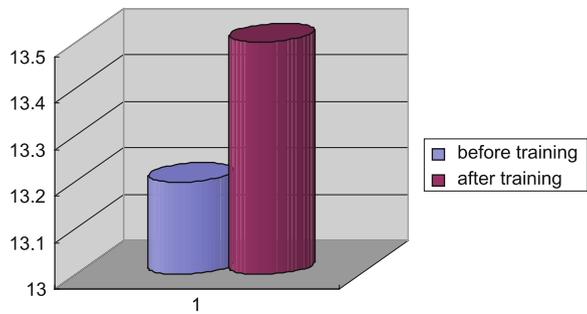
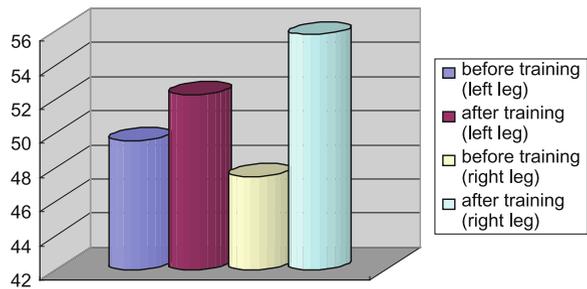


Fig. 55.3 Single-leg vertical jump in height: (averages)



52.6 ± 5.9 cm) to (52.6 ± 5.9 cm and 55.9 ± 6.4 cm); for anaerobic peak power—from (1111.85 ± 139.02 W) to (1165.23 ± 126.34 W); for anaerobic relative peak power—from (13.09 ± 1.67 W/kg) to (13.45 ± 1.49 W/kg). Paired *T* test shows the figure of significant difference level is ($p < 0.05$) Based on stretch–shortening cycle (SSC) theory, the results has been improved. According to SSC theory, there are three periods: (1) eccentric contraction periods. (2) Coupling period. (3) Concentric contraction period. In concentric contraction, muscle produces more power due to the process of storing and releasing energy, which means that neuromuscular system plays a role in controlling. However, the outcome cannot prove the improvement that plyometric training may bring to two-leg vertical jump height [5], 10-m and 40-m dash. This outcome did not agree with

Rimmer [6] and Brophy's [7] studies. In their studies, they claimed that participants' performances in 10-m and 40-m dash can be improved with eight week plyometric training. Thus, it showed that four week plyometric training is not enough to improve players sprinting ability, more time in training is needed. The outcome of two-leg vertical jump height experiment agreed with the study of Luebbers [8]. In Luebbers's study, participants were university students fancying sports, a four week plyometric training was given, showing that the two-leg vertical height figure went down—from $(67.8 \pm 7.9 \text{ cm})$ to $(65.4 \pm 7.8 \text{ cm})$, but when they were tested again after a four week rest, the figure raised to $(69.7 \pm 7.6 \text{ cm})$. But there were no significant changes in anaerobic power test. So this showed that plyometric training can improve players jumping ability, the evidence may not be found immediately after the training; instead, it may occur after a period of rest. In Polhemius' study, the participants were university students majoring in sports [9]. They were given basic physical training companied with plyometric training (6 weeks training with 3 sessions per week), the outcome showed that the performance jumping and 40-m dash became worse, which did not agree with this study. This difference in outcome may due to different training arrangement and training intensity. So, all these findings remind us that in order to get the expected results, we need to adjust some exercises and their intensity when doing plyometric training.

In conclusion, the plyometric training is an effective way to improve CUBA basketball players' jumping ability and explosive power. The outcome proves that the four week training with three sessions per week can improve players' single-leg vertical jump height and leg anaerobic power. However, to improve 10-m dash, 40 m dash and two feet jumping ability, this four week training is not enough. The suggestions are to increase training time and add physiological and biochemical index test. Besides, basic physical power training should be added before plyometric training, as in many exercises body power endurance should be 20 times higher than its own weight. Thus, in order to handle the power, players need to become very strong to avoid injury.

References

1. Michael Yessis, Fred Hatfield Plyometric training (2003) Achieving explosive power in sports. Human Kinetics , Champaign pp 19–29
2. Chang Hui-yin, Lin Peo-Cheng (2005) The effect of plyometric training for jumping performance in high-school female basketball players. Taiwan Sports J 05:11–18
3. Lin Z-C (2002) Sports science and training 3rd edn. Yinhe Culture Industry Company, Taibei 02:01–04
4. Chu DA (1998) Jumping into plyometrics, 2nd edn. Human Kinetics, Champaign 10:270–277
5. Cavanagh PR, Komi PV (1979) Electromechanical delay in human skeletal muscle under concentric and eccentric contractions. Eur J Appl Physiol 42(3):159–163
6. Rimmer E, Sleiver G (2000) Effects of a plyometrics intervention program on sprint performance. J Strength Cond 14:295–301

7. Brophey Patrick (2004) Kelly L. Lockwood. The Effect of a plyometrics program intervention on skating speed in junior hockey players. *The Sport Journal* 7:10–17
8. Luebbers Paul E et al (2003) Effects of plyometric training and recovery on vertical jump performance and anaerobic power. *J Strength Cond Res* 17:704–710
9. Mai-jiu T (2006) *Sports training science Beijing*. High Education Press 06:10–18

Chapter 56

Research on Sun Sports and Relationship between Physical and Mental Health

Changjun Tian

Abstract Sun sports to carry out the status quo, the use of document analysis, questionnaires, psychological scale test method and mathematical statistical method to explore the behavior of college students participate in physical characteristics of the sun, the sun reveals the physical and mental health of college sports and the promotion of relations, colleges and universities provide the basis for the sun to carry out sports.

Keywords Sun sports · Constitution · Health · Attitude toward physical education · Physical exercise

56.1 Introduction

The physical quality of the last 20 years, our young students, vital capacity, and strength continued to decline, student obesity rates increased constantly, eyes high myopia, urgent need to improve the nutritional status of some rural young people [1, 2]. The start of Sunny Sports is that the types of schools at all levels to promote the formation of a strong campus atmosphere of physical exercise and full participation in mass sports in the atmosphere, to attract the majority of young students to the playground, into nature, come under the sun, positive active participation in physical exercise, training interests and habits of physical exercise, and improve the Health of University Students [3]. Private education is charged with the important task of culture in the twenty-first century application of highly

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skilled personnel, its sports mission first is to get students trained to have a healthy body, has a good life skills and way of life, capable of performing talent of the future work of the physical and mental health [4, 5]. Private college physical education not only according to the new curriculum standards a good physical education, should also adhere to the “healthy, happy sports, life-long sports, focus on cultivating students’ sports sense of competition, teamwork, and lifelong exercise habits, emphasis on the students took to the work positions after the needs of sports, sports and future career and lifestyle combine.

Current Developments for Private Universities in Shaanxi Province Sunshine Sports, through questionnaires and physical fitness of students of classes on the behavior of private college students Sunshine Fitness and health testing and statistical analysis to explore the relationship of the Sunshine Fitness and health of students [6].

56.2 Subjects and Methods

56.2.1 Study Subjects

Foreign Affairs Institute, Xijing University, Eurasia Institute, Siyuan College six private universities.

56.2.2 Research Methods

The literature analysis: retrieval, query and analysis of relevant literature

The questionnaire survey method: take a random stratified sampling survey, and to verify their reliability and validity.

56.3 Results and Analysis

56.3.1 Private Universities in Shaanxi Province to the Implementation of the Status of the Sunshine Sports

56.3.1.1 Unity of Thinking, the Full Implementation of the Sunshine Sports

According to the survey showed that private colleges recognize the importance of the implementation of the “sunshine sports, sports work can be included in the school year, semester work plan, the urge to develop the relevant details of the implementation; all private universities have this sports work as an essential

element of school examination achievements. In functional departments and the sports department with five institutions (86.7 %) in close coordination with the Office of Academic Affairs, Student Affairs Office, Communist Youth League and other functional departments and coordinated [7, 8]. Most institutions student union and sports federations, to organizing school, the Department of mass sports activities, in the big games to help the sports department (room) to jointly promote the implementation of students' "sunshine sports". For example: the tug of Xi'an Foreign Affairs College Sports Ministry and school unions for the faculty organization, skipping game, with external organizations, civil Football League and so actively promote the development and implementation of the sports of the sun.

On the one hand, equipment, venue construction, sports facilities and capital investment in the physical education curriculum objectives and the smooth development of the "sunshine sports" material security, physical education, extracurricular sports activities and after-school sports teams, training and other normal working premise. On the other hand, the construction of teachers, physical education teachers is a major force in school sports, school sports executor, is the "sunshine sports" participants and instructors. The author believes that physical education teachers with students "sunshine sports" implementation effect, teacher qualifications structure, age, etc. will impact in varying degrees.

Through visits to some colleges and universities in Shaanxi Province found that college students know is still very weak, more than 85 % of the students do not understand or do not know what the term, let alone understanding and awareness of the "sunshine sports". We can see that propaganda is doing is not enough. We did not let students have a clear understanding of this problem will lead to action on the slack, students cannot participate actively affect the implementation of the "sunshine sports" [9]. Therefore, the majority of private colleges physical education teachers also had to do this work, publicity work, so that students truly understand the significance of carrying out the movement and encourage them to actively participate in, around the concept of "healthy", so that they raise into active participation in the habit of physical exercise, grasp the scientific training methods, the formation of a healthy lifestyle.

56.3.2 Sunshine Sports Factor Analysis

Affect university students' participation sun sports factors can be divided into 5 "internal factors": (1) sports interest and sport-loving, (2) Sports attitudes and exercise habits, (3) to acquire new skills and exercise levels, (4) course load and academic pressure, of (5) sports expenditure and consumption capacity. Five of the external factors: (1) campus culture and sports atmosphere, (2) movement guidance and forms of organization, (3) the social environment with friends and family, the (4) seasonal changes and climate impact, (5) sports venues and conditions. Sunshine Sports factors contrast sort and the number of weighted average "handle to the size of the weights of each factor to distinguish between primary and

secondary data statistical comparison. Survey from the internal and external influencing factors can be seen on the sports of the sun directly affected by the impact of students 'interests and teachers' professional interests and hobbies, followed by the constraints of the site conditions, other factors are ranked in the follow-up position.

As can be seen from Table 56.1, the table tennis ball games, badminton welcomed by students, aerobics bodybuilding class project is relatively good, the proportion of tai chi in the martial arts project, which make Sunshine Sports carried out, we must first solve the students 'interest in sports and hobbies, reasonable arrangements for physical education, according to students' interests and to enable students to grasp the technology and skills of physical exercise in the sports class, prompting students to participate in physical exercise. The second is to improve the site conditions of the schools, to create a good atmosphere for movement to create good conditions for the implementation of the Sunshine Sports in order to improve students' physical and mental health.

56.3.3 Private College Students' Physical Condition (Table 56.1)

The test scores of students involved in the Sunshine Sports grouped as follows: normal group, the mild group, moderate group and severe group, and statistical analysis. As can be seen from Table 3, in addition to weight for height, the rest of the index score differences (Sig < 0.05).

56.3.4 Students' Mental Health and Its Correlation Analysis between Body Mass Indexs (Table 56.2)

Table 4 shows the difference between the nine factors of different physical grade students both statistically significant (P are 0.0001), which the constitution does not pass the group of nine psychological factor to the title than the excellent physique and good group to be much more serious, more prominent especially paranoid, somatization, hostility and psychotic four factors; physical passing group relationships, forcing the four factors of the paranoia and anxiety is more serious than the physical outstanding group, the difference of the two groups in the other five factors not statistically significant. Physical good group and physical outstanding group, in addition to differences in the three factors of interpersonal sensitivity, anxiety, and paranoia, the differences between the remaining six factors is not obvious. Thus, relationships, anxiety and paranoia three factors affect the physical condition of college students, obsession, depression, somatization and hostility of four factors, followed by two factors of the terror and psychosis on college students' physique extent relatively small.

Table 56.1 Health test results status of student physical

	Normal group	Mild group	Moderate group	Severe group	F	Sig
Total physical score						
Weight for height score 800 m/1000 m of						
Points of vital capacity weight	77.4 ± 4.747 10.47 ± 2.71	7.1 ± 7.12 10.55 ± 2.92	74.7 ± 6.17 10.43 ± 2.65	72.4 ± 8.89 9.23 ± 2.22	3.49 1.65	0.018 0.181
Standing long jump sub	16.87 ± 1.97 12.23 ± 2.11	16.50 ± 2.31 11.26 ± 1.79	16.16 ± 1.82 11.06 ± 1.74	15.23 ± 2.29 10.80 ± 2.04	3.28 3.14	0.023 0.028
Solid ball points	21.30 ± 2.94 18.67 ± 2.08	19.83 ± 2.37 18.63 ± 1.77	18.63 ± 1.77 17.20 ± 2.42	17.20 ± 2.42 17.96 ± 2.48	15.60 2.93	0.000 0.037

Table 56.2 Mental Health factor different students' physical condition

	Physique excellent group	Physical good group	Physical passing group	Physical not passing group	F	P
Somatization	1.38 ± 0.41	1.42 ± 0.47	1.53 ± 0.47	1.82 ± 0.46	16.71	0.0001
Forced to	1.79 ± 0.59	1.84 ± 0.64	1.89 ± 0.60	2.10 ± 0.63	15.16	0.0001
Interpersonal	1.65 ± 0.67	1.89 ± 0.62	1.92 ± 0.67	2.08 ± 0.68	16.06	0.0001
Depression	1.68 ± 0.63	1.74 ± 0.61	1.79 ± 0.61	1.92 ± 0.66	16.91	0.0001
Anxiety and Hostile	1.58 ± 0.52	1.73 ± 0.54	1.75 ± 0.57	1.91 ± 0.65	18.34	0.0001
Terror	1.66 ± 0.58	1.71 ± 0.62	1.77 ± 0.70	1.98 ± 0.69	20.25	0.0001
Paranoia	1.43 ± 0.51	1.45 ± 0.53	1.45 ± 0.48	1.61 ± 0.66	12.53	0.0001
Psychotic	1.49 ± 0.47	1.62 ± 0.62	1.67 ± 0.63	1.90 ± 0.54	14.81	0.0001
	1.48 ± 0.48	1.47 ± 0.55	1.63 ± 0.51	1.94 ± 0.36	15.37	0.0001

56.4 Conclusions and Recommendations

56.4.1 Conclusions

Students involved in acts of Sunshine Sports, outstanding performance in the campaign aims to project selectivity involved in a number of times, weekends and holidays the number of activities, objectively reflects the characteristics of college students participate in the Sunshine Sports acts tend.

Students involved in the influencing factors of the sun sports can be divided into internal and external factors. Students and teachers of research and analysis of cognitive orientation and various influencing factors of the right value for the guide and mobilize college students to participate in the sunshine sports activities, improve and improve the management level and the implementation effect of the private universities sun sports has a practical significance.

Health Testing and sports interest survey clearly demonstrated by the SCL-90 scale tests, the influence of the sun sports modern university students of physical and mental. From the analysis show that the implementation of the effect of the sun sports and college students physical and mental health.

56.4.2 Strategies and Recommendations

Schools to organize the various departments to seriously study the Ministry of Education on the study and implementation of the opinions "of the CPC Central Committee and State Council on strengthening the youth sports to enhance young people's health, the State Sports General Administration of the Ministry of Education, the Communist Youth League Central to carry out hundreds of millions of students sunshine sports movement decided to "file, and further raise awareness, changing concepts, a fundamental understanding of the importance to improve the students' physical health, with particular emphasis on health education for

students, to enable students to correctly recognize the importance of health in terms of ideology, culture They voluntarily participate in the awareness of physical exercise.

Increase school sports propaganda, to create an atmosphere conducive to the schools to implement quality education, sunshine sports activities. To formulate a detailed promotional plan, schools should make full use of the school radio station, bulletin boards, campus network, and other promotional tools and instruments, creation of thematic sections, vigorously publicize the sun sport, the wide dissemination of “health first” ideology and the concept of health concept deeply rooted, so that the “one hour of exercise a day, health, work for 50 years, happy live life”, to arouse concern for the health of teachers and students, a highly publicized “sunshine sports, guide the majority of students consciously toward the playground, went to under the sun, come to nature, and actively participate in sports. Pay attention to the publicity and popularization of scientific fitness, scientific eye, scientific nutrition and other scientific knowledge for students to participate in physical training, the establishment of a civilized and healthy way of life to provide scientific guidance.

Adhere to the Law to teach, regulate school behavior, and strictly enforce the provisions of relevant state physical education courses, open enough to open the Qi and athletic class, do not squeeze the gym class. Deepening teaching reform, and constantly improve the quality of teaching, physical education, educate and guide students to actively participate in the “sunshine sports”.

With the physical education teaching, to ensure that students have one hour of exercise time. Extensively carried out with a clear theme, with local characteristics and ethnic characteristics of the student collective sports activities and competitions, and constantly enrich students’ extracurricular sports activities in the form and content, and actively create a happy garden of extra-curricular sports. And to pay more attention to strengthen the cultivation of health knowledge of education and scientific fitness concept “for students, extra-curricular activities into the school education program, and arrange for physical education teachers for extra-curricular activities counseling, training, physical education teachers to participate in extra-curricular activities counseling according to the corresponding time to calculate the workload to ensure the legitimate rights and interests of the physical education teachers.

Use of large-scale sporting events and recreational activities for the effective carrier, training students to sports and fitness ideas, inspire their outdoor activities and interest in physical exercise, sports teaching and research, class, and Student Union Culture and Sports Department to develop a practical program of activities and strive to achieve that “everyone projects, arrangement classes in the month competition, so that more students to join the sun sports.

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References

1. Art of Education and Culture (2007) Ministry of Education on studying and implementing the “CPC Central Committee and State Council on Youth Sports and enhance their physical fitness to enhance the views of” notice 14:93–98
2. To teach Ti (2006) 6 Man: Ministry of education, the state sports general administration of the CYL central committee regarding the development of the country hundreds of millions of students sunshine sports decision
3. National Institute of Physical Education Textbook Committee (1998) “Sports Medicine”. People’s sports publishing house 6:72
4. State Sports General Administration Division group code (2002) “2000 National Physical Fitness test report” Beijing Sports University Press 5:98–104
5. Xiangdong W etc. (1999) “Mental Health Assessment Scale Manual”. Chin Ment Health J Club 12:72–74
6. Weixiong Z etc. (2007) “College Students and Health”. Wuhan University Press p 98
7. Xiuli M etc. (2008) “To carry out the sun college sports to improve the physical health of the experimental study.” Harbin Institute of Physical Education 10:87–92
8. Lihai S (2007) “Mental health and their physical condition-related research.” China Sports Science and Technology 5:14–18
9. Fengcai T etc. (2006) “Capital Normal University Students Health Situation and Countermeasures.” Capital Normal University 8:38–44

Chapter 57

Cultivating Pattern of Managerial and Administrative Personnel in Sport Industry

Pan Li

Abstract Sport has become a dominant feature of societies around the world, sport industry, therefore, is of noticeable significance on both macro and micro levels, specifically the catalyst in economy and an active ingredient in personal identity formation. By reviewing the existing data and investigating the sport industry in Sichuan province, this paper analyzed the history and present of sport industry, and pointed out the cultivating pattern of managerial and administrative personnel in sport industry. The paper finally came to the findings that the future of sport Industry has unlimited potential but it depends a great deal on the quality of managerial and administrative personnel and the different fields which can cooperate with each other in the development of sport industry, and in the cultivating managerial and administrative personnel, the school plays an important role.

Keywords Sport industry · Managerial and administrative personnel · Sichuan

57.1 Introduction

As many literature mentioned, sport industry is the industry of manufacturing of sport related goods, services, and ideas through the combination of sport activities with business, mass media, and politics [1]. Unlike sport, which emphasizes participation of both players and spectators, sport industry aims at maximizing its

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economic profits and social effects [2]. To achieve these goals, business, media, and politics cooperate on the basis of interdependence. Due to its wide involvement in society, sport industry, therefore, is of noticeable significance on both macro and micro levels. Specifically, sport industry is the catalyst in economy and an active ingredient in personal identity formation [3].

As it was known, while the impact of sport at the social and cultural leaves is significant, its economic impact has emerged as one of the dominant topics of discussion among scholars [4]. At the same time, any industry needs a great number of trained managerial and administrative personnel. The sport industry is the same as other industries, and the quality of managerial and administrative personnel decided the sustainable, healthy and sound development of sport industry. For these reasons mentioned above, this paper explored the development of China's sport industry, the categories of sport industry in China, and finally the author gives some suggestion on how to training the managerial and administrative personnel met the requirement of the China's market in colleges and universities.

57.2 Basis of Managerial and Administrative Personnel in Sport Industry

57.2.1 Development of China's Sport Industry

According to related literature and actual conditions, there are three development phases of China's sport industry, it is listed as follows:

Enlightening phase (1978–1992)

Starting phase (1992–1997)

Developing phase (1997 up to present)

According to the data issued by related government, the cost of national sport consumption in China was around \$17 billion USD in 1998 (sport goods were not included) and the average growth was 5.1 % (1992–1997).

For spectator sport markets, the average each game attendance of National Soccer Major League A has reached 21,300 and the total ticket sale was around \$12.12 million USD. For National Male Basketball Major League A, the average each game attendance was around 3,700 and the total ticket sales was around \$1.7 million USD; for National Volleyball League, the total attendance has reached around 500,000 and the total ticket sales was around \$1.45 million USD (China's Yearly Sport Business Statistics, 1998).

For sport goods markets, the capital size of sport goods markets has arrived around \$ 17 billion USD in 1998 (National Council of Physical Education and Sport, 1998). Besides of the basic daily living consumptions, sport good has been rated the top 6 of people's primary expenditures (12 categories and 3,300 manufactures). Regarding to the professional management service markets, there are

IMG (USA), IDEA (Italy), ELITE (HK) and local PR agencies in Beijing and other big cities. Sport lottery markets were opened in 1994 and the revenues have reached \$800 million USD. High competition, unbalance development, quantity and quality of industry construction, national policies and regulations, and R&D are threatening China's sport industry in terms of future development.

According to the description mentioned above, we can come to the result, the sport industry in China was ever-increasing development, the managerial and administrative personnel, therefore, are need a great deal.

57.2.2 Categories of Sport Industry

According to the related literature, in order to understand the components of the sport industry, the author classified the sport industry into 6 segments as follows:

Fitness
 Sport entertainment
 Sport training and consulting
 Sport tourism
 Sport agency
 Sport lottery

As we known, common choices for sports science graduates include working as a personal trainer, fitness instructor, sports psychologist, health promotion specialist or leisure centre manager [5].

But, of course, there's plenty more careers to choose from in the sport industry. Options range from becoming a sports massage therapist to an extreme sports instructor, teaching everything from kite surfing to sky diving. We could also aim to be centre of the action by becoming a referee or coach [6].

Therefore, the cultivation of managerial and administrative personnel in sport industry should meet the sections' requirement.

57.3 Cultivating Pattern Exploration

57.3.1 Investigation and Analysis of Requirement of Managerial and Administrative Personnel in Sport Industry

This study carried out an investigation on the requirement on managerial and administrative personnel in sport industry in Sichuan.

These units which need the managerial and administrative personnel in sport industry are as follows: [7]

Physical fitness centers
 Professional sports teams or clubs
 Sports goods manufactories
 Stadium
 Sports associations and federations
 Sports department of administration
 Service centers for Sports tourism
 Sports personnel exchange centers
 Sports lottery management centers
 Sports equipments R&D centers

The results of investigation (see Table 57.1) showed that requirement of sports personnel was complex: they should master not only popular sports events but also complicated skills, managerial ability, interdependent plan and design abilities. They should understand the selling skill, account management concept, sales administration process, and has the experience of service and certain regular customer contact and certain business sources [8].

57.3.2 Curriculum Setting on Managerial and Administrative Personnel in Sport Industry

57.3.2.1 Approaches, Goals and Size of Cultivating Managerial and Administrative Personnel in Sport Industry

Nowadays, the focus on managerial and administrative personnel is to cultivate interdisciplinary talents who possess both sports and physical and economics knowledge. To doing so, the following approaches can be used:

Table 57.1 Ratio of personnel requirement in sport industry

Categories	%
Design fitness plan for individual	62.4
Management and communication and co-ordination skills	57.6
Design and arrangement for fitness halls or sports fields	51.1
Marketing abilities	46.2
Communication skills with foreign language	45.7
Maintenance and repair facilities abilities	37.5
Related management abilities	24.2

To introduce a number of high-level management personnel, to extend economic exchanges and cooperation in international sports, and to learn from foreign advanced management experience and sports economical approach.

To further cultivate the existing managerial and administrative personnel in sport industry.

To rely on universities to cultivate sport industry personnel.

To rely on sports colleges with cooperative education or training methods to develop sports management professionals [9].

To cooperate with the sports departments to cultivate sports features, sports marketing personnel. Those personnel focusing on practical skills training for the individual sport associations or sports clubs to develop practical talents.

The managerial and administrative personnel in sport industry aims at cultivating talents who will orient market, world, and future, they should, therefore, have some exercise experiences, the basis of managerial and administrative knowledge and skills, scientific research ability, and adapted creative ability. Therefore, the personnel should possess both professional and comprehensive quality.

The professional qualities which the managerial and administrative personnel in sport industry should own are as follows:

To understand the basis knowledge of sports economics major and its practice systemically.

To learn some sports skills and know some rules sports events.

To understand some sports laws and regulation.

To understand at least one foreign language.

To understand operating computer.

To understand personal network.

To understand sports tourism knowledge.

The comprehensive qualities which the managerial and administrative personnel in sport industry should own are as follows:

Mental quality

Personal network

Good inter-culture background

Team spirit and cooperate spirit

Adaptability and creative ability

57.3.2.2 Curriculum Setting

According to the discussion above, curriculum setting of the managerial and administrative personnel should be around the sport industry management professional model and talent training objectives, and build the political theory, basic theory, professional education, management education, humane education,

Table 57.2 Curriculum setting of managerial and administrative personnel in sport industry

Basics knowledge	Professional education	Vocational skills	Activities and practice
Politics	Administrative course	Mass sports	Social practice
Computer	Humane education	Pedagogy	Educational practice
Laws	Marketing	Psychology	Career and club training
Mathematics	Professional basics course	Vocational education	Social investigation
Foreign language		Team spirit	Professional lectures
		Self-promotion	

marketing education, practice, education and employment and education programs combine to create a complex sports industry management curriculum. In this system, the political education is the premise of educating people, management courses is to adapt to the trend of social development, cultural education is to educate people of sublimation, the marketing education curriculum is to adapt to the needs of social development, expansion of practical course is the key to educating people, school education and society is the connection point.

So the cultivating pattern of managerial and administrative personnel in sport industry was listed in Table 57.2.

The Curriculum setting of managerial and administrative personnel in sport industry in colleges and universities should adapt to the needs of the marketing. In doing so, the goal of sound and sustainable personal training will be reached.

57.4 Conclusion

The future of sport Industry has unlimited potential but it depends very much on the quality of managerial and administrative personnel and the different fields which can cooperate with each other in the development of this industry. The cultivating pattern of managerial and administrative personnel will cover a wide range from investment, new technology and economic personnel.

The uncertainty of future is like the result of sport game that the requirement of managerial and administrative personnel in sport industry is too difficult to predict. However, what is imperative to minimize the impact of uncertain factors in preventing the development of sport industry is to cultivate elite managerial and administrative personnel of the future. For the best result of sport industry in the future, schools should be like a coach of a sport team who has to train hard, collect necessary information and plan the strategy in order to win the game.

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References

1. http://en.wikipedia.org/wiki/Sport_industry
2. Huan SC (2010) The development of Asian sport industry. *Asian J Phys Educ Recreat* 17(1):37–46
3. Milano M, Chelladurai P (2011) Gross domestic sport product: the size of the sport industry in the United States. *J Sport Manag* 25:24–35
4. Chelladurai P (2005) *Managing organizations for sport and physical activity: a systems perspective* 2nd edn. Holcomb Hathaway, Scottsdale 2:09–16
5. Chelladurai P (2006) *Human resource management in sport and recreation* 2nd edn. Human Kinetics. eMarketer Inc., Champaign 8:26–31
6. *China's Yearly Sport Business Statistics* (1998)
7. Pao MS (2000) *Sport industry*. People's Physical Education, Beijing
8. Ashton C (2002) *China: opportunities in the business of sport*. Sport Business Group, London
9. Cheng ST (2002) *Introduction of sport management*. Whang-Tai Publishing, Taipei

Chapter 58

Research on Effects on Women's Breast in Sports Bra

Kun Jiang and Yanxiang Ni

Abstract Sports bra is designed for female breast of athletes in moderate to severe competition, which can provide some protection. The comfort level of sports bra is particularly important for female athletes. In the fierce sports competition, if the female athletes were in the absence of external protection, her breast may be subjected to serious injury, especially the plump breast. So comfortable sports bras will certainly become the popular selling products in the clothing market. In this paper, we analyzed the protection function of female breast from the bodice fabric and other aspects by using three-dimensional dynamic simulation, which was based on the innovation mechanism of biomedical theory.

Keywords Sports Bra · Breast · 3D Dynamic Simulation

58.1 Introduction

In the game, exercising the Sports bra can provide an effective protection for breast. In other words, more vigorous game, May is particularly bosomy to the female athlete; result in more serious breast's hurting. If have never exercised the protection function of Sports bra, even if being those too fat male athletes cannot also succeed in escaping this kind of painful embarrassed. Sport the Sports bra

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undertakes the function of protecting the breast to some extent, regardless in the level and the perpendicular direction, in order to prevent exercise to hurt. Much sport Sports bra manufacturer the basic physical structure from the Sports bra, the mammary glands biomechanics, dynamics, the machine behavior of the breast, the breast moves and the Sports bra transform, pressure and the dynamic state distributing in response to the dint imitates to wait aspect, analysis sport text the influence of the chest upon the breast, thus for take part in an athlete who contest the game to create more comfortable function of product, like well ventilated, stability, the anti- presses characteristics like sex, etc. [1]. This text outlined the research achievement that obtains currently, and from innovate the biomedical science theory of mechanism, the 3D dynamic state imitates really, and the noo- dles from the chest dress anticipates waiting aspect, the analysis exercises Sports bra is how the function is at the breast.

58.2 The Creation Background of Sports Bra

Generally speaking, we very difficult fixed breast, let it cans not keep, because the inner part of breast doesn't have good structure and prop up, secondly the propping up of breast only depends the skin tension of the breast outward appearance. So after training or game carried on continuously, its skin tension extends very easily, if again and again add to carry function dint, this may cause breast the bottom hang and get hurt. According to be up to all 56 % females because of sport result in for a long time trembling of the breast, arouse breast ache. Therefore, exercising the emergence of chest dress is for lowering the breast ache that exercises to bring for a long time and can not the ligaments conversing pull to stretch.

Exercise chest dress and common of the bra carry on contrast experiment, discover to be more opposite than to wear the athlete of common chest dress as a result, its ache lowered 50 %.The expert whom the mankind healthily organize suggests becoming adult a female while exercising, should wearing to match the sport bra of the body to tremble because of exercising by soothing ache and decrease the breast bringing. However, statistics research suggests, being up to 75 % females didn't find out suitable bra, or is don't know how to choose a suitable sport chest dress. In this case, many researchers and involve the related organization of mankind's health and athletics product to start studying this item, look for a better solution, thus creation submit sport chest dress product of having the good protection and comfort.

58.3 Research on the Effect of Sports Bra

The first sport chest dress from originally two American female the second prize put forward of, protect 2 body bandage to stitch in T-shirt but make into. Moxa Lun Bo Ge Man invents of minimum rebound bra, is be him to see his girl friend to

fasten tight he with the hands chest dress, he had lately to inspire, thus creation come out. Bulge along with the problem afterwards, namely the ache of breast with unwell, also for betterly support athletics exercise the development of chest dress, more and more of the research start paying attention to this realm. Learn such as the human body engineering, dynamics, biomechanics, acrossing of calculator science and esthetics science academics chemical element combines together of research. Is again like Amazon, Berlin, return in triumph to etc. some famous companies to have already developed to submit sport chest dress of having a great achievement the ability, it has good comfort. Finally, the product learns according to the human body engineering of research and biomechanics is analytical to anticipate through a special function noodles as a result and finally, material and structure mode, exercise the chest dress can be born.

Exercise Sports bra product but speech, greatly parts of products try the structure of passing change sport Sports bra, so that it can provide enough support and control abilities and raise the problem of its comfort thus, so the second floor skin of their actually equal to athlete. Has already been slowly accepted by a lot of factory houses in the current reform innovation, in the method of Anne mat layer inside the chest dress. The researcher of the plum west university creates "cool bodyguard" of to exercise bra, can reduce the breast within 20 mms to move. This product secret conceals in the Sports bra of in, namely a pair of plastics cup that can dismantle to unload, this is the light and very vivid one material-gather ethylene. Moreover "cool bodyguard" exercises brain of can move a plastics cup, can provide enough space to hide breast, can't cause the distortion of breast and nipple because the breast descends.

A headquarters establishes in the company of London to produce a kind of underwear that is called a living creature form. This company owns the forerunner's technique group, the member includes a calculator expert, underwear designer, engineer. They pass the underwear that the calculator model software of using the forerunner develops this kind of living creature form. First, they hard analyzed the effect of the chest dress and the sport characteristic of the breast. Then, the computer engineer uses a dynamic state line not limited dollar technical analysis the structure function of Sports bra, see figure as a result. The analysis suggests that from on foot the mode arrive mightiness to exercise pressure mode, the chest dress inner part suffered pulsation in response to the dint [2]. They put forward this kind of flat surface form to satisfy the request in the 3D structure, hence established the chest dress of living creature form-large plastics molding tool, it can provide enough support, can't let the breast encounter distortion.

The biologist exploitation of Australia is spread feeling machine to follow the female's breast to exercise process, for finding out a kind of better way to prop up breast. They adopted the chest dress of special design for matching with an experiment. The shoulder top that places to spread feeling machine to measure them under the shoulder bears much pressure, and places electrode to inspect muscle the influence of the activity upon the breast at the upper part torso and the neck. Again is give out light diode to place in the front of breastbone to measure

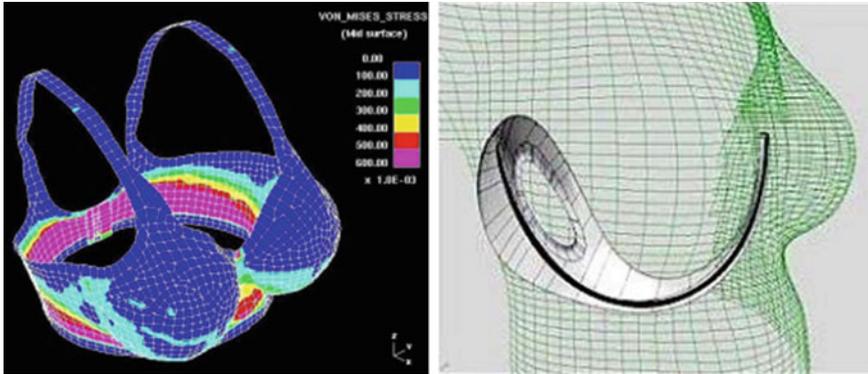
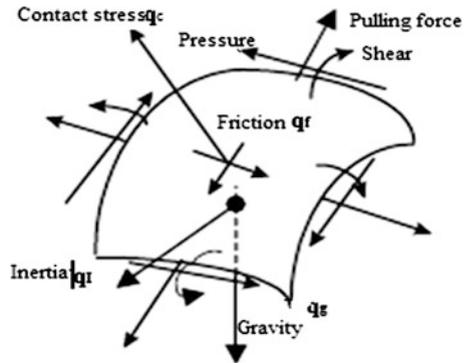


Fig. 58.1 The analysis technology of dynamic nonlinear finite element

Fig. 58.2 The mechanical mechanism analysis of bra



breast and torso sport of corpus, investigate the mechanics relation between chest dress and of breast in detail thus Fig. 58.1.

For the sake of excellent the dress turning chest goodly prop up ability and comfort index, the researcher of Tech University in Hong Kong adopts a machine mechanism theory and inquired into the dynamic state contact of breast and chest dress. They develop a kind of according to contact mechanics theory for basal of the number of 3D dynamic state Sports bra pressure imitate of mechanics model [3]. Computing the model can imitate the dynamics characteristic of breast, and when the Sports bra transforms, the breast is subjected to of pressure value and distribute in response to the dint, which can be seen as Fig. 58.2.

In Korea, the researcher from Yonsei University was postponed to investigate a dependable breast boundary measure a technique method and provided new breast shape thus parameter. This method use of is the shadow that is mutually 3D to move a line, scan 37 women’s breast, find out the continuous natural boundary of breast, more accurately measure a physical volume of breast. The curvature radius of breast bottom boundary is a very important parameter for designing comfort, match the bra of body, this parameter seems to be particularly.

Fig. 58.3 The standard for elastic trend of bra

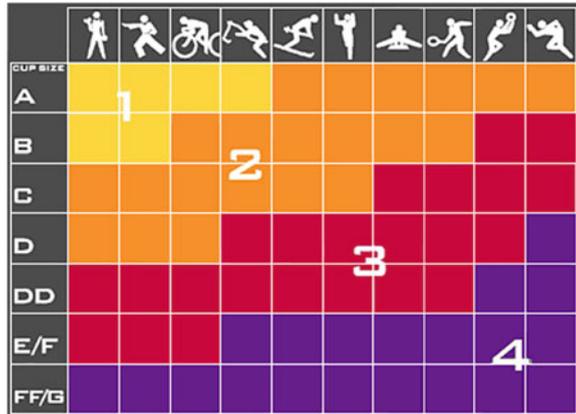


Table 58.1 The level of motion control

Control strength	Movement type
Light	Yoga, walking, gardening
Moderate	Cycling, hiking
Strong	Tennis, football, jogging
The strongest	Running, intense training, riding

Along with the number technique is in the application in the clothing profession, sport chest dress of 3D conjecture design very meaningful, is the dimensions system of establishment and perfect lady’s clothing, it can provide science basis. The researcher of engineering science and technology university in Xian graduate school is engaged in this research, in 270 young ladies whom they study, their age from 18 to 30 years old, and birth and growth are in the west of China and carry on a body scanning to them. Measure of the statistics data analyze a processing through a SPSS software, end, the young female’s breast shape is been divided into 9 kinds of characteristic index signs. And the experiment provided the technique parameter of sport chest dress design for us [4].

Along with the research maturity of technique and sport Sports bra market, at Europe the nation established the norm table of exercising the bra. The table can give manufacturer and purchase the customer in the process to provide reasonable instruction. Flexible standard such as Fig. 58.3 show, it showed different movable level or the request of control under to the influence of the breast.

In the table, the diagram mark of diagram represents different sport control level. The capital letter of alphabet is from A to G represent different Sports bra model number. Four kinds of colors represent different influence degree. Generally speaking, according to exercising the control level definition of strength is four degrees as follows: Light degree, mid-degree, various stronger and the strongest (Table 58.1 show) sport Sports bra product is in this aspect of in the development of research for the very first time is unveiled.

58.4 Conclusions

From the above-mentioned research, we set out to exercise chest dress from the angle of concern women's health have already acquired very great success. Learn through strict analysis and graduate student material resources, the human body engineering learn, and forerunner of mathematics and calculator theory and technical foundation top carried on an improvement to the product. Carry on a survey to the relation of the breast and sport chest dress for the sake of the applicability and comfort of the solution product. The research discovers that the breast is in the process of exercising in the meeting moves on three flat surfaces, in the aspects of reducing breast ambulation, exercise the chest dress more general Sports bra more effective, because exercise the chest dress reduce three two among those of sport flat surfaces, but the Sports bra reduces breast's sport on a flat surface. And exercise the breast that the chests dress didn't distort, it provides enough support to still have Jian like "turtle hull" of the function of milk [5].

Because the breast is in the process of exercising in of the ambulation is very complicated, stretch such as the skin, losing of torso really, the dynamic equilibrium attribute of bra, biomechanics and mental state analyze, these other researches should discuss further to acquire perfect sport Sports bra.

References

1. Mao Yongxian, Liu Junhong, Yang Yong (2003) The analysis on its related factors and self-examination of breast. *J Nurs Sci* 18(04):340–343
2. Tan Qingyu, Zhang Wei, Yu Bin (2008) The 3D reconstruction and volume measurement system of breast by Computer aided design. *J Tissue Eng Reconstr Surg* 04(06):323–326
3. Liu Chunjun, Sun Jingjing (2011) Research on the volume change of breast by using the three-dimensional scanning technique. *Chin J Aesthet Med* 9(20):1401–1405
4. Li Feng, Ji Gongrong, Fu Jianguo (2006) A measuring device for breast volume and its application in mammoplasty augmentation. *Chin J Aesthet Med* 15(11):1258–1261
5. Xia Youchen, Bi HongSen, You Weitao (2006) The structure reconstruction of the breast suspension for correction of breast ptosis. *Chin J Minim Invasive Surg* 6(10):766–768

Chapter 59

Research of CAS in Physical Training

Fang-Yu Wang

Abstract The all-around permeate and intervention of information technology in sports training has become one of the main trends of the development of competitive sports. Players in addition to hard training, scientific training method is effective way to improve athletic performance. By using the method of literature review, the study analyzes the application of information technology in recent years in the field of sports training in China, focusing on analysis of the computer aided motion (CAS) in improving the scientific training level and sports level of athletes in the sports training. This article also makes a summary of athletics training on the basis of CAS, and at the end it mainly deals with the future of the application of CAS in athletics training, thus can facilitate the sports workers in sport scientific research field.

Keywords Prospect · Sports emulation · Assisting training

59.1 Introduction

The information technology, represented by computer technique and network techniques, has all-around penetration and intervention into exercise training field, which has become one of the main trends of the modern competitive sports development. The advanced information technology can make the training more systematic and scientific, greatly improving the training efficiency and sports performance. As the development of the era, information technology increasingly

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strengthens in various application study of exercise training, achieving actual effect [1]. This essay analyses the computer assistant sport technology, CAS in sports training.

59.2 Computer Assistant Sport (CAS)

CAS (Computer Assistant Sport) is the English abbreviation for computer assistant sport, the product blended with various information technologies. The technology in CAS includes mechanical and electronic integration intelligent testing technology, computer graph technology, video processing technique, large database management and Internet technology. The teaching experience of the gym teacher, training intention of the coaches, the organization scheme of the director and the training process of the athletes are reproduced through computer simulation technique, an experimental technology subject to explain, analyze, forecast, organize and evaluate the sports system [2].

59.3 The Application of Sports Technology CAS

The modern competitive sports is developed rapidly in high, difficult, perfect way, this makes the sports training turns more to the modern technology means. To dig the human potential to the greatest extent, modern sports need the continuous intervention of the scientific technology. This needs the comprehensive application of the subject knowledge related to sports science, and adoption of the systematic and scientific ways to study the inherent law of the sports. The adoption of CAS technology is a research work to achieve this goal. Its overall objective is: to study the key technology such as three-dimensional human body movement simulation and video analysis facing sports training, aimed at realizing two progress and changes in sports training method: transformation from the method based on eye observation to the method based on high-precision video capture and the method of human body sports measurement; the transformation from the training analysis method based on experience to the simulation human body sports analysis method, improving more rapidly and effectively the training level and sports performance. As the further development of sports CAS technology, the technology based on sports CAS must widely used in the sports field.

59.4 The Sports Simulation System Based on CAS

The so-called sports simulation system based on CAS is to simulate the sports system using CAS technology. CAS technology has good application prospect in

sports simulation; this is decided by the characteristics of CAS technology. This technology can offer effective and brand new training means for sports workers and athletes. Meanwhile the expansion of the application range of CAS technology can also boost this technology. Many of the current virtual environment goals are to train the students about the decision-making and strategy ability in specific environment, such as aviation simulation, car driving simulation, parachute jumping and fire fighting situation. The research and development staffs do more research into virtual games and various training driving simulation, for example, Walls and others (1998) evaluated the property of the yacht sailing against the wind using virtual yacht sailing simulator [1]. Yeadon (2000) [2] actually considered using the tiny precise model to make the coach help the trainees to know where the plane is during aviation maneuver flight performance. The coach can use simulation model for testing their up to date theory, and the trainees can first experience the new maneuver flight in the virtual environment, of course, this experience allows mistake, without the risk of injury. Virtual environment is applied less in competitive sports training, the main reason is that such training requires more in various performance index of the system than that of virtual games, such as the requirement for friendly interaction, instantaneity, high-precision and strong immersive among users, meanwhile it needs the joint participation of many feeling of athletes (such as vision, sense of hearing touch and sense of smell). At present, limited by the software and hardware technology condition of CAS technology, such as the more expensive dedicated interactive equipment of CAS technology, the inconvenient and inflexible existing interactive method, the system instantaneity and precision needing improvement, these constraining factors restrict the application and dissemination of CAS technology in sports simulation technology field. As the progress of CAS technology, it is convinced of the fact that there is more and more innovative application in the near future.

59.4.1 Functional Requirements

59.4.1.1 Building Virtual Training Scene

According to the specific sports events, there are specific requirements for the training scenes: such as: the modeling of virtual training site, virtual training equipment and the virtual human, etc.

59.4.1.2 The Capture of the Sports Data

Directly record the sports data of the sports entity through the sensor tracking equipment and use it to generate the computer animation. The largest advantage of this method is its ability to capture the data of the human real motion(including training appliances), due to the generated motion is basically the motion “copy” of

main body, human(or appliances), the effect is very life-like, and it can ensure the scientificity of the training.

59.4.1.3 Motion Replaying and Revealing

Motion reproduction is an important requirement based on CAS sports simulation system, traditional camera shooting methods can not be successful under some conditions. For example, the training technology videotape in the sailing boat sailboard training is not ideal enough, some can not be realized. When doing innovation research into the new underway motion through simulation system, for example, in the gymnastics item, the coaches make the gymnast produce the new technology motion through the modeling of the real gymnast motion, and the rearranging of it, it can precisely reproduce the gymnastics motion of the gymnast, and makes them fully immerse themselves into the virtual environment, just as they are personally on the scene, finally it can help the gymnasts improve and innovate their technology motion so that they can improve their technology level.

59.4.1.4 Graphical Representation Training Effect Analysis

The graphical representation training effect analysis method is the error assessment method to show the error analysis result through graphical representation, usually divided into online and offline assessment method.

59.4.2 System Components

The sports simulation system based on CAS can be divided into immersive and non-immersive sports simulation systems, the former needs equipment such as head mounted three-dimensional stereoscopic displayer, stereo glasses, data gloves, stereo headphone, graphic workstation and high-performance computer, which makes the users feel more authentic stereoscopic vision and stereoscopic sense of hearing, and does the natural interactive operation with the virtual environment so that the users can fully immerse themselves into the virtual environment, just like being personally on the scene, the characteristics for this system is expensive equipment, strong immersive sense; and the latter mainly depends on software to establish the virtual environment with rich vision sense and hearing sense, its characteristics is economy and convenience.

59.4.3 Key Technology

The key technology of the sports simulation system based on CAS is as follow:

The acquisition of the human body sports parameter

Acquire the human body sports parameter through the analysis, description and the behavior understanding of its sport. The specific content includes:

Rapid and accurate extraction of the human body outline

Rapid and accurate extraction of the human body outline is a rather important and difficult problem. This is due to various effects on the captured image in the dynamic environment, such as the change in atmosphere, illumination condition, even the confusing distraction with the background, the shadow of the sports target, the dodging between object and environment as well as among the object, even the motion of the video camera, these bring difficulty in the accurate and effective extraction of the human body outline. In the basis of the extraction of the human body outline, we further study and realize the synthesis of the motion panorama gram and the overlying display of various motions.

The capture of the motion data

The motion capture technology is to use sensors to record the motion of the real human body in form of three-dimension, then the computer drives the virtual human in the screen based on the recorded data. The greatest advantage for this method is its ability to capture the real sports data of human being, because the generated motion is basically the replica of the human body motion, it can have life-like effect, and generate numerous complicated motion.

The modeling based on physics and physiology

At present, the human body modeling of the sports simulation system based on CAS usually means the modeling based on human body physical property and physiological property, where the human body physical property means human body form, structure, quality, athletic ability and the adaptation ability, etc. The physiological property mainly includes human body metabolism index of pulse, blood pressure and lung's capacity, as well as the function index of various organs and various systems.

Virtual human animation since its development in 80 s of the last century till now, human animation experiences four developmental stages: kinematics control, dynamics control, motion control and motion capture based on controller. Among them, motion capture technology has the characteristics such as high efficiency and excellent sense of reality, highly valued by the researchers in human body animation.

Real time drawing and interaction due to its involvement of virtual site and virtual human (athletes), in the virtual sports simulation environment with the participation of virtual human, real time drawing and interaction seems to be especially important. Real time drawing technology is divided into visible judge, gradation details, the drawing technology based on images. Here the interaction concept mainly means the uses' interaction with the system through CAS technology interactive equipment, such as to select the parameter like human body physical property through interaction.

59.5 The Introduction of Our Research and Development Current Situation at Present

The system of athletics aerobics dancing training based on CAS. Aerobics dancing is one of the competitive sports events, with its own motion key point. Under the accompaniment of the music, it is based on various elemental motion of calisthenics, absorbing numerous motions of dance, artistic gymnastics, modern dance and martial art, and it is developed into sporting events with its unique style through arrangement and combination. Among them, competitive aerobics dancing is developed and formed based on health building aerobics dancing, with the ability to accomplish the consecutive, complicated and high strength motion, it has form of expression of entire exercise, where it shows comprehensive use of consecutive motion combination, flexibility, physical strength and seven kinds of basic pace and its perfect accomplishment combined with the difficult motion. The rules have strict rules in a set of arrangement, the accomplishment of the motion, the amount of the difficult motion, etc.

To realize the arrangement and preferable selection of the computer auxiliary motions the coaches can arrange and select preferably a set of motion in accordance with the athlete characteristics to improve the match results of the athletes.

To realize the comparison between the sports simulation result and the athlete motion in one screen

It mainly studies the comparison between standard motion and the video in one screen. Aimed at the video of the human body motion, taking the pictures of the position and direction of the video camera, the corresponding human body sports results will be displayed in one screen based on the same position. The realization of the comparison in one screen can rapidly, accurately compare the differences between the accomplished motion of the athletes and the standard motion, giving the specific improvement opinions and suggestion for the athletes and coaches.

59.6 Summary

In summary, the information technology, represented by computer technique and network techniques, has all-around penetration and intervention into exercise training field, which has become one of the main trends of the modern competitive sports development. But the existing researches are not perfect enough, there are few products which can be applied into the sports training practice, and parts of the products already developed are less than satisfactory. The main issues needs solving in the future are: further strengthen the integration and accuracy of the system in the training data collection; further strengthen the maneuverability and practical applicability of the system in motion technology analysis; further strengthen the pertinence and intelligent decision making ability in sports training accessory system level. Our nation training normalization application and research

field still faces the big challenge of how to transform the existing applied research results into a kind of mature tool which can assist the coaches in improving training and its efficiency to really realize a big promotion of our nation's training scientific level.

References

1. Xunwei (2010) The activity of task driven method in computer teaching in physical education institution. *J Harbin Inst Phys Educ* 2:30-37
2. Jiajun W (2007) The research on implementation of the intelligent computer assisted instruction system in the physical educations teaching and training. *J Jilin Inst Phys Educ* 2:371-379

Chapter 60

Research on Coupling Mechanism and Analysis on Effect Factors of Taichi Exercise

Jingyi Wu, Yichen Wang and Yan Chen

Abstract Tai Chi is the Chinese sports culture, which form and develop from the combination with Qigong theory from the ancient plain dialectical materialism and the theory of Yin-Yang five elements. With the social development, Taichiquan has attracted more and more people's attention, which is now generally accepted as a way of keeping good health. This paper took the method of the interview and the literature survey to study the effect factors of Tai Chi exercise, and analyzed on the coupling mechanism, in further put forwards to the corresponding counter-measure and the suggestion.

Keywords Tai Chiquan · Physical exercise · Influencing factors · Coupling mechanism

60.1 Introduction

Tai Chi is one of the relatively long origin Chinese sports, which began in the late Ming and early Qing Dynasty. It caters to the needs of Qigong and theory of meridian combination, and to learn some techniques, as well as the Yin-yang and five elements theory and the formation of [1, 2]. It is China's national essence. With the development of society, Taichi is favored by people more and more, because it is a way of keeping good health of yin and Yang, but the Taichiquan exercise has also been the obstacles [3, 4]. This paper researched on a number of factors that effected Taichiquan exercise by adopting the interview and questionnaire survey method,

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and studied the mechanism of the coupling of Taichiquan by combining some commonly used methods, such as the mathematical statistics and logical analysis [5]. Then solved the problem, and put forward the corresponding countermeasure and the suggestion [6, 7].

60.2 The Research Object and Method

60.2.1 Research Object and Contents

We investigated the residents from 4 communities of Hongqiao district in Tianjin through questionnaire survey, the contents of its questionnaire mainly whether containment took part in exercising of Taichi, took part in time that Tai chi exercise and the purpose of Tai chi exercise and the place, reason of influence for exercise. Among them. The questionnaire statistics is as shown in Table 60.1.

60.2.2 Investigated the Age and Sex Distribution of Numbers as Shown in Table 60.2

It can be seen by the statistical data, in four communities, the most age group number participating in Taichiquan exercise and the highest number is the 61–65 years old person, had 36.0 %, secondly is 56–60 years old person, they had 33.3 %, then is 65 first anniversary above of, they had 23.4 %. But the statistics meant in the old people of 50–55 first anniversaries to take part in that Taichi toughens to have 7.2 % as a result [8, 9].

Moreover, we can also see in the middle of investigating object, it is in 61–65 first anniversaries to take part in the male age segment that Taichi toughens mostly concentration. But take part in the female age segment that Taichi toughens to

Table 60.1 The questionnaire statistics

	The number of questionnaires	Recovery of the questionnaire	The effective questionnaire
A community	35	35	35
B community	30	30	28
C community	25	25	25
D community	25	25	23
Total	115	115	111

Table 60.2 Age and sex statistics table

Age distribution				
Sex	50–55 years old	56–60 years old	61–65 years old	Over 65 years old
Male	3	17	32	23
Female	5	20	8	3
Total	8	37	40	26
Percentage	7.2 %	33.3 %	36.0 %	23.4 %

Table 60.3 Location distance perception

	Less than 1 km	1–2 km	2–3 km	More than 3 km
Very convenient	40	18	2	0
A little far	5	17	11	0
Far away	0	3	15	0

mostly concentrate in 56–60 first anniversaries. But carried to belong to just retire in this age, living standing alone, took part in Taichi to toughen thus to enrich his/her own life, reduced standing alone feeling [10].

60.2.3 The Investigation of Taichiquan Exercise and Perceived Situation Investigation, Which Can Be Seen as Table 60.3

In order to better representation of Taichiquan Exercise on exercise location distance perception, we use the data in Table 60.3 to make the bar chart, as shown in Fig. 60.1:

60.2.4 We Adopt the Thought of Mathematical Statistics to Process the Statistical Data

The statistical data were analyzed by χ^2 test, significance level $p < 0.1\chi^2$ test’s basic idea:

First: Hypothesis overall $X \sim N(0, 1)$, $X_1, X_2, X_3, \dots, X_n$ is the sample statistics of X .

The define of χ^2 is: $\chi^2 = X_1^2 + X_2^2 + X_3^2 + \dots + X_n^2, X_i \sim N(0, 1)$

χ^2 obeys n degrees of freedom, which is the Chi-square distribution.

Probability density function:

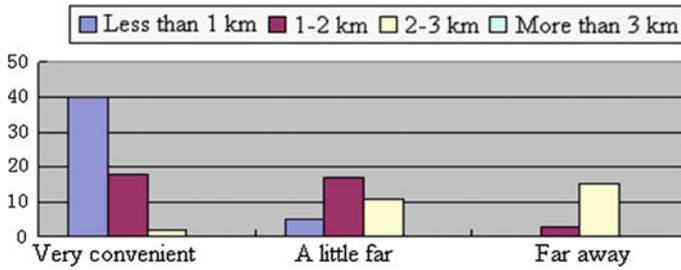


Fig. 60.1 Distance perception bar chart

$$f(x) = \begin{cases} \frac{1}{2^{\frac{\mu}{2}}\Gamma(\frac{\mu}{2})}x^{\frac{\mu}{2}-1}e^{-\frac{x}{2}}, x \geq 0, \\ 0, x < 0 \end{cases} \tag{60.1}$$

60.3 Analysis of Effect Factors

We did data analysis and got influence factors according to the result of survey questionnaire among four communities investigated. Through the questionnaires collected from 12 the effect of Tai Chi exercise factors. The statistical results as shown in Table 60.4.

Analysis on the results of coupling factors

We analyzed the statistical result through going factorization. First, the factorization is a branch of analytical diverse statistics technique, its main purpose the inspissation is a few main factors from numerous factors. It is to pass to study numerous changes measured of internal dependence relation, investigate to prognosticate the basic structure in the data, counteract minority of a few

Table 60.4 Influence of Tai Chi exercise factors

Item	Influence factors
X1	Site selection
X2	Environmental weather factors
X3	Difficulty level of Action
X4	Taichiquan exercise atmosphere
X5	The cognition of Tai Chi Health Effect
X6	With or without Tai Chi instructor
X7	Tai Chi instructor level
X8	Personal health condition
X9	Promotion strength of Taichiquan
X10	The effects of friends and relatives
X11	Taichiquan hobbies
X12	Individual emotional and psychological factors

assumptions to change to measure to mean basic data structure. Factorization at the beginning is BE got up by the psychologist development, the psychologist starts using the mankind’s behavior and ability of the factorization models explanation most and checks Er Si in 1904. Si Pierre Man (Charles Spearman) announced paper 1 paper concerning factorization on American psychology magazine.

The method of factorization contains 2 types. A type of is quest factorization, verifying sex factorization is another. This paper adoption is the factorization method of quest a typical model within factorization, the analytical the method not and in advance suppose factor and measure the relation of item, but let the data “oneself talks”. This paper passes 115 questionnaires, to influence degree of four review to mapping 12 carry on a factorization empress in factor at this of result, and carry on categorizing to assign name to according to the total sex characteristic of factor.

From the impact of various factors influencing factor table, we can see that Psychological factor consists of X11 (Taichiquan hobbies) and X12 (Individual emotional and psychological factors). Exercise environment factor consists of X2 (Environmental weather factors), X4 (Taichiquan exercise atmosphere) and X7 (Tai Chi instructor level). Publicity and guidance factors consists of X6 (With or without Tai Chi instructor) and X9 (Taichiquan promotion efforts). Behavior conformity factor consists of X10 (effect of relatives and friends). Project factor consists of X3 (Difficulty level of Action) and X5 (The cognition of Tai Chi Health

Table 60.5 The results of factor analysis

Common factor name	Element item	Load	Contribution rate (%)	The cumulative contribution rate (%)
Psychological factor	X11: Taichiquan hobbies	0.589	13.845	13.845
	X12: Individual emotional and psychological factors	0.723		
Exercise environment factor	X2: Environmental weather factors	0.646	11.914	25.760
	X4: Taichiquan exercise atmosphere	0.667		
Publicity and guidance factors	X7: Tai Chi instructor level	0.332	10.86	36.620
	X6: With or without Tai Chi instructor	0.779		
Behavior conformity factor	X9: Taichiquan promotion efforts	0.199	9.151	45.772
	X10: The effects of friends and relatives	0.677		
Project factor	X3: Difficulty level of Action	0.830	9.022	54.794
	X5: The cognition of Tai Chi Health Effect	0.166		
Exercise condition factor	X8: Personal physical condition	0.900	8.578	63.372
	X1: Site selection	0.208		

Effect). Exercise condition factor consists of X8: (Personal physical condition) and X1 (Site selection). Among them, the load and contribution rate such as shown in Table 60.5

60.4 Conclusion

In this paper, by using interview and questionnaire survey method, we studied the effect of Taichiquan Exercise on some factors, and influence factors based on the analysis of influence result. Through statistical analysis, what resulted in its impact factor proportion is the largest of their psychological factors, such as the Tai Chi interest and personal emotion and psychological factors. Followed by exercise environment factors such as environment, weather factors of Taichiquan exercise atmosphere, Tai Chi instructor level etc., publicity and guidance factors accounted for 10.86 of the proportion have no Taichiquan instructor. Among them, personal physical condition and site selection where the exercise condition factor accounts for the proportion of the smallest.

References

1. Wang C (2003) The popularization and promotion of Taichiquan in Universities. *Sports Sci* 01:42–45
2. Liu C (2005) The motives and characteristics of old people's participating in Taichiquan exercise. *J Xi'an Phys Educ Univ* 21:123–124
3. Cheng X, Zhang K (2008) The overview on physical exercise behavior in foreign country. *Hubei Sports Sci Technol* 4:5–7
4. Zhang L, Ren W (2002) The research progress of sports psychology, vol 525. Higher Education Press, Beijing, pp 361–367
5. Qiu P, Tian X (2005) Taichiquan's universal harmony values. *J Phys Educ* 12(3):70–72
6. Jiao C (2009) Study on elder people's Taichiquan development advantage in the compaper of new rural and national fitness program. *Fighting-martial arts Sci* 2:103–105
7. Zhang W (2007) The factors of influence community residents' physical exercise. *Bull Sport Sci* 5(10):23
8. Li F (2005) Research on the motivation of physical exercise in different stages. *J Xiao gan Univ* 3:48–52
9. Yang X (2003) The experimental study on the influence on psychological health of college students by Taichiquan. *J Tianjin Univ Sport* 1:77–79
10. Li J, Chen G, Wang L (2009) The psychological effect of old people's participating in physical exercise. *J Xi'an Phys Educ Univ* 01:31–32

Chapter 61

Humanistic Value of Sport and Spirit of Sports

Li-mei Zheng

Abstract With the development of time and progress of social, sports functions and role play are constantly changing, the traditional focus on sport and physical values of the body must be the direction to the spiritual and psychological transformation. The reality of human society, individuals, groups and organizations are inseparable from the concern for people's own property, sports, too, as an integral part of people's spiritual culture, the spirit of sport is only a general understanding of the current sports and sublimation, also people has to further improve the understanding of sports to fundamentally improve people's health. From the general sense of the sports, people pay more attention to physical sports, very few people to study the spirit of sports. Or that the considerable number of people will confuse the spirit of sport and mental health, and that the spirit of sport is mental health. In fact, the spirit of sports from more in-depth, broader and higher level of understanding of the function and value of sports, mental health is just one part.

Keywords Mental sport · Sports culture · Human values

61.1 Introduction

With the social progress and development of the times, sports from the minority sports professionals specializing in occupational and minority members of society enjoy the leisure and entertainment which becomes an important part of modern life

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and modern lifelong need. The functionality of modern sport is not only to enhance physical fitness, mental health but also protect and improve the quality of life and improve lifestyle. The sport has become a necessary part of people's health life. Development of science and technology really improve the human living conditions, living conditions and medical conditions, while allowing an increase in interest in the human, living comfort and health and longevity. However, it also caused environmental pollution, reduced physical activity, exacerbated by the increase in the incidence of nervous and mental impatience, mood, blood pressure, heart disease at the same time. These are called "modern disease" or "diseases of civilization". Therefore, the rational and scientific sport is fundamental to the treatment and elimination of many positive and effective means "modern disease". Further, the sports concept to further expand the spirit of sports in society in the future prospects is very bright.

61.2 Concept of Traditional Sports

Sports are a joint hub of bone as a lever, muscle fitness, recreation and athletics of the power of combining human activities. The body's central nervous system of domination and control this activity. Specifically, it has two meanings: First, the sport is called for physical education. It is the study of sports knowledge and skills which can develop their physical, educational activities to enhance physical fitness, furthermore, the process of training and shaping of the human body is an important part of education. Second, it is called sport. It is to explore the potential for physical fitness, improve motor skills, and entertainment. Its purpose is to explore the potential of physical fitness, and improve motor skills, entertainment; it is also an important part of social culture. It has an invaluable role in the economic, political, and cultural development [1].

China's domestic sports concept is influenced by the Japanese in the 1970s; we generally believe that sport is an educational activity. Later it was discovered that all of education is only sports a variety of epitaxial features an education, not sports, but merely an attribute of sport. So people in determining the sports concept sports as a cultural activity are part of the culture of the society. Therefore, the extension of sports is expanded [2]. Beijing Sports University, the English translation is: Beijing University of the Physical Education, which "sports" that corresponds to the vocabulary of the Physical education in the context of China, "sports" obviously refers not only to the Physical education, the Physical education is a educational activities, competitive sports, social, sports and other non-physical education areas in various activities is not included The reality of individual psychological qualities can not be divorced from the individual's physiological qualities and can not exist in isolation. The physiological quality is the psychological quality of the material bearer. A healthy body is the basis and premise of individual psychology-round development of the material. Therefore, we cannot leave the physiological basis to talk about psychological development,

this is just an abstract theoretical studies. In reality, even if the individual spiritual development so perfect, the results of the lack of a strong physique is still one-sided.

Conversely, if you do not pay attention to the development of the mental element and solitary develop physical fitness, physical, sports skills, sports concept is equally one-sided. Study the full development of abstract level, physiological with psychological development. Sports contain the physical and psychological. Obviously, the sport is a comprehensive physical and mental development, the traditional understanding of the sports concept must be extended. From the education point of view, the connotation of the concept of modern sports should be educated physically and mentally harmonious development of sports not only inherently includes the moral, intellectual, and the Sam Yuk, but from the content and main tasks of the modern sports wood should be harmonious nutrition, health, physical skills, techniques and physical and mental development of the organic unity of the four [3].

61.3 Sports Concept Should Reflect the Function

Awareness of the sport function is still the eyes of the beholder wise see wisdom. The understanding of the different main reason is the relatively accurate understanding of the sports concept. The traditional concept of the sports that the nature of sports is to enhance the physical, but competitive sports beyond the limits of the objectives and characteristics of the athletes body injury, and this is obvious to all. There is a problem of this reality sports to enhance physical fitness that have been questioned, we must examine its basic meaning and fundamental value to examine the nature of sports. If you consider the pursuit of that truth to all human cultural phenomenon, but also have the material properties of natural phenomena, and the organization of the social phenomenon of the spiritual attributes of the property and human phenomena. So we can not simply be a sharp distinction between the natures of things. However, the focus in these three categories of attributes, and three pursuits of various kinds of cultural reflect their own characteristics, the formation of a variety of cultural phenomena.

Accordingly, it can be said: the transformation of the body's natural significance as a material property is the nature of sports destination where the premise and foundation of all sports functions and values; the transformation of the role of the people on the social significance as an organizational attribute, as well as the psychological sense of the spiritual attributes of emotional transformation is a sports derivative of the target [4]. The nature of sports is different and reflects the different functions of sports. Based on the above three properties, the function of sports in the following three aspects: the individual transformation function, social function and psychological function. Individual transformation functions include: to enhance individual physical fitness, develop individual awareness of competition and cooperation, enrich the individual and cultural life; social features include: sports

exchange function, the educational function of sport, sports, economic functions; psychological features include: training national sports the spirit of improving the social and psychological.

61.4 The Spirit of Sports Concept

61.4.1 The Proposed Concept of the Spirit of Sport

Sport is a culture, according to the Book of Changes records: astronomy through observation, can know the changes of the times; by observing the humanities, can control the world. The word culture comes from this, in accordance with the humanities to educate the meaning of the following three: First, the sum of material and spiritual wealth created by mankind especially the spiritual wealth, such as literature, art, education, science; Second, archeology, language, referring to the same historical period ruins, relics of the complex; The third refers to the ability of language and general knowledge of the standard. In short, culture is created by human beings in the course of history the material and spiritual wealth [5]. Culture as the essential characteristics of the sports people of the spirit of sports function in addition to help people keep fit, the most important thing to improve the spiritual realm and the moral sentiments of the people.

61.4.2 People's Cultural Property

Human nature is not physical things, but a process of self-fashioning: the real humanity is nothing more than the unlimited creative activities. Person's status is linked with human nature; human creative activity is closely related to the human face. People engaged in the history of the creative activity of a specific target in a variety of activities, outcome and process, but they inevitably tend to a common overall objective, outcome and process. In the creation of cultural activities will inevitably shape the people into a culture [6]. Sports culture for the people, not an accidental thing, a pastime, it constitutes a part of human nature, is an important factor of human nature.

61.4.3 The Nature and Characteristics of Sport is People-Oriented

People-oriented concept of Marx's early writings is an important concept. The main object of the human nature of personified natural initiative. For Marx, man is the existence of an object. Only after the object of the productive labor of the people,

natural objects can be incorporated into to the object relations, and thus become the object of the people. Natural objects can be included in the object relationship, the object of human. Marx: the object of labor is the objectification of human life, the products of labor is an object materialized as objects of labor, which is the object of labor; labor is the objectification of labor [7]. In the creation process of the productive labor of the people and the reality of practice, natural objects marked with the person's mark have become the personification of nature or the second. In this case, nature is not only refers to the external to the objective nature, but also including the organic unity of the indispensable elements. In this way, the concept of People-oriented, you must do two-way understanding. In other words, the activities of the object, inherently contains two inseparable aspects: on the one hand, the object of the human nature that human beings through their own creations to show the process to realize their own value; on the other hand, the performance of the body into a real human body, the external natural world transformation of man's inorganic body. Therefore, the essence of the concept of humane includes not only the people of the natural process but includes both natural persons of the process. In the human transformation of nature and transform their own reality, these two aspects of the process is the organic unity of the two uniform basis in the practice, the practice of sport activities are also included. The nature and characteristics of sport is People-oriented.

61.5 The Value of the Spirit of Sport

61.5.1 The Value of Sport as a Cultural

The value of sport as a cultural category is the value of the sports culture; it can meet the demand in accordance with its rules of life of people, the individual's own natural existence, the individual's own naturally better existence and the value of persistent.

61.5.2 The Value of the Community Sports Culture

The sports culture is the value of the Community through the acquisition of culture, heritage and the creative process to shape the different individuals. In the presence of people's cultural dimension, the sport can achieve cultural diversity, adapt to environmental changes and provide a variety of options to achieve human sustainable survival services.

61.5.3 Sports and Cultural Value of Individual Human

Sports culture the humanistic value of sports as a cultural, in terms of cultural subjectivity of human values, human existence as a culture, in the process of acquisition, inheritance, and the creation of culture, shaping, development, and improve people and enjoy the cultural subjectivity of man as man should have transcendent value; value is, as a means of human adaptation, it is the cultural property of the people's unity.

61.6 Conclusion

Humanistic value of the sports culture is the human being as an expression of culture in sports. Reflected in the sports culture in the presence of people's cultural dimensions shaping the self, self-perfection and enjoy the culture as a man should have subjectivity, and transcendence of the ethical values. Only pay attention to the humanistic value of sports for individuals, one can effectively play the function of the value of sports culture adaptation of human life. The only sports the cultural values of the individual may realize the sports social value, so that individual to become an integral part of the (social) Community.

References

1. Wang X, Ma Y (2009) Further understanding of the concept of sports. *Hebei Inst Phys Educ* (5):4-5
2. Wang Z (2008) Philosophical perspective the concept of the evolution of sports three characteristics. *Fighting* 48(6):162-267
3. Xinmin S (1991) Modern sports concept and the status and mission of the school sports Chinese Society of Education. *J Chinese Soc Educ* 05:37-44
4. Dong YJ (2004) Sports concepts and physical function theory. *Phys Cult Guide* 1:32-34
5. Dong J (2001) For nearly 25 years, more Chinese and foreign sports concept study. *Sports Sci* 2:31-35
6. Modine Batista (2005) *Philosophical anthropology*. Heilongjiang People's Publishing House 5:111-114
7. Xiong D (2004) Sports and localization of the concept of holistic thinking—and other comrades, and Han Dan questionable. *Sports Sci* 2:8-12

Chapter 62

Study on Characteristics and Value of Ethnic Minorities Eco-Sports

Hui-Jun Gao

Abstract Eco-sports more and more become modern people's common pursuit. This article, as a study on the characteristics, costs and value of Guangxi ethnic minorities' eco-sports (taking Rongshui Miao Autonomous County's reed-pipe and horse fight festival as an example), explains from the point of view of ecology that the ethnic minorities' indigenous sports are suitable for the conditions of the local people and are of a primitive cultural nature, which is necessary to better develop the ethnic minorities' traditional local sports.

Keywords Guangxi · Ethnic minorities · Eco-sports · Costs and Value

62.1 Introduction

In the long history of cultures, there is abundant colorful intangible sports cultural heritages handed down by the ethnic minorities in our country. The ethnic minorities' traditional sports were formed in a long history handed down in the form of game; they have profound cultural content, claim low fit-keeping costs and offer unique utilization value. Along with the development in the social civilization, people's values system, thinking, behavior and lifestyle change accordingly, and similarly, the ethnic sports in our country are becoming commercialized competition under the action of the western commodity-oriented mentality on sports, which raises the costs of the sports and bars most common people from participating. Under the propaganda about and protection of intangible cultural

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heritages, the ethical sports face both challenge and crisis and the scholars have begun looking at eco-sports in new ways. Eco-sports, which can be popularized, are amusing, healthy and suitable for local people, and will be made to return to their original nature.

62.2 “Eco-Sports” and “Reed-Pipe and Horse Fight Festival”

62.2.1 Definition of Eco-Sports

As can be searched out from the Internet by the Baidu search engine, eco-sports are defined as “activities incorporating the well-coordinated elements of sports, cultures and ecology, where each of the elements exists on the basis of, and develops together with, the others. Eco-sports are intended to, through the sports in social and natural environment, display people’s health, personality and humanitarian care for nature, society and ecology, so as to maintain a harmoniously developing world. Eco-sports reflect a harmonious and unified relation between human, sports and environment. In an exploration into the value of eco-sports by Li Fengmei, eco-sports are defined as “a new form of sports chosen after rethinking of the conditions of existing sports, which is intended to realize a sustainable development of sports, cultures and economy.”

62.2.2 Origin and Development of the “Reed-Pipe and Horse Fight Festival”

Rongshui Miao Autonomous County, an administrative region of Liuzhou, is located near to Guizhou-Guangxi border; it is the earliest Miao autonomous county established in China and the only Miao autonomous county in Guangxi. It has Miao, Yao, Dong, Zhuang, Han, Shui and other ethnic minorities. It has abundant resources and uniquely striking folkways, which is known as “land of festivals”, “land of cinnamon and reed-pipe”, “land of Chinese reed-pipe and horse fight festival”. The Reed-Pipe and Horse Fight Festival is a traditional cultural activity exists in China only. Legend has it that, long before, an old chieftain of Miao people had a daughter when he’s old. The daughter was beautiful and smart and attracted many men’s courtship. The family of the daughter found it was difficult to choose from the men, and then decided to hold a horse fight to choose the man to marry the daughter. The horse fight accomplished a good marriage at last. So the “horse fighting spirit” cherished by the daughter created a folk activity of competition and amusement. Reed pipes were originated in ancient time by Miao people as a respect for Zhuge Liang. Reed-pipe Dance is well popularized as a festival sacrifice. Reed pipes and reed-pipe band are almost found in every village and hamlet. The reed-

pipe and horse fight festival including massive reed-pipe sacrifice, Caitang dance and fierce horse fight was very grand and involves tons of people. In 1987, Rongshui Miao People's Government designated November 26 as Miao's festival of reed-pipe and horse fight. The festival had been successfully held for 11 years by 2011. In 2005, Rongshui Miao's Festival was listed as a national intangible cultural heritage, which was first of its kind in China. In 2006, the festival of reed-pipe and horse fight was listed as Guangxi's intangible cultural heritage [1].

62.3 Characteristics of the “Reed-Pipe and Horse Fight Festival” of Miao Autonomous County, Guangxi

62.3.1 Ethical Quality and Its Uniqueness

Every ethnic group has developed their own unique cultural characteristics in history for their special geological environment and folkway. Rongshui Miao Autonomous County of Guangxi has under it four townships and 16 towns, it has a population of 204.3 hundred people, accounting for 41.29 % of the county's total. The heelside sports event is a grand folk sports event of Miao people held between January 3 and 15 (lunar calendar), including Reed-pipe dance, horse fight, bird fight, horse racing, dragon dance, lion dance, etc., where the horse fight is the fiercest. Each time when the event is in, the people in all nearby villages and hamlets will be dressed in festival attires and gather together at Gulong Hillside to celebrate the festival in various forms, such as the very grand reed-pipe sacrifice and reed-pipe dance. Ethnic qualities are essential nature of ethnic groups. The natural environment of hilly land with little arable land decided the indigenous residents' living conditions and their natural-social form of sports.

62.3.2 Homogenization and Isolation

Homogenization and isolation are opposite but unified sides of contradiction. The cultural diversification in the world creates many contradictions and conflicts with ethnic groups, and at the same time, also offers an arena on which to develop ethnic group's cultures outward. As the first Miao autonomous county in China, Rongshui County should have traditional cultures which could be easily homogenized. Limited by geographic and communications conditions, Rongshui Miao's traditional cultures have long existed and developed in isolated environment, so they are being a relatively isolated natural and social environment, hence the local people's ethnic qualities and their traditional sports cultures, such as the well preserved reed-pipe dance, Caitang reed-pipe dance, horse fight, cock fight, etc.

62.3.3 Religious Qualities and Mass Recreational Element

With many mountains and hills but little arable land, Guangxi has a harsh natural environment, warm and humid climate and is apt to be hit by diseases. Miao people's traditional festivals prevailing in the hilly northwestern Rongshui Miao Autonomous County mostly have the factor of religious sacrifice. For fear of natural disasters, Miao people still have an old cult for nature (totem and nature), and for their ancient ancestors, tribal chieftain (Pangu Reverential King). Miao People believe in God of Mountain, God of Grain, God of Field, God of Land, God of Leiyi and other God of natural things. Every time when there is a festival or after a grain is sown or harvested, Miao people will gather in thousand to play reed pipes, present horse fight, and offer sacrifice and pray for good weather and bumper harvest. Horse fight has become an important way to brace Miao people's prowess, increase contact between peoples and promote unity and love among ethnic groups. In those sacrificial activities, all forms of traditional sports and cultural activities are also held. The randomness, seasonality and broad mass of participation shattered the limitation of out-of-the-way mountainous area—in fact it is the need of cultural existence.

62.4 The Costs and Value of the “Reed-Pipe and Horse Fight Festival” of Rongshui, Guangxi

62.4.1 Economic Costs and Health Value

Costs are inputs for activities. People do not create value out of nothing; they, all in all, change the form of substance of object (create value). People create things of value to meet their needs for consuming some material wealth. Creating costs needs conditions. Creating conditions also needs conditions: materials, energy and information, all of which incur costs of an activity [2]. Most of the cultural activities of ethnic minorities' traditional festivals need to be held in a harmoniously interrelated natural-social environment of beautiful, green hillside ground with good air. With many mountains and little arable land where is suitable for bamboo groves' growth, Rongshui Miao Autonomous County is one of nine key forestry-oriented counties in Southern China. The local residents quite love reed and are good at reed-pipe dance. During Miao people's traditional festivals: Spring Festival, Bumper Harvest Festival, Mid-Autumn Festival, Reed-Pipe Festival, etc., all villages and hamlets will have their own reed-pipe band play music and enjoy the festival. Horse fight is an indispensable activity of Miao people's annual traditional festival. Since ancient times, the Miao People amuse themselves with horse fight. Their living environment is very suitable for raising horses. Their festival activities include horse fight and racing. The horse fight site is chosen on a flat ground on the village border. The event site is similar to actual living

environment of the residents, where the things needed in the event can be acquired on the site, making tools are easy, and the participants do not need to have high qualities, so it can be easily popularized. The participants in the event vary from thousands to tens of thousands in quantity, which makes the local festival fitness promoting event held in a natural condition.

62.4.2 Cultural Education and Communications

In the history, Miao people lived on mountains for generations and were a typical self-sufficient agricultural ethnic group. They had very bad communications, which seriously limited their economic growth and their cultural exchange with the outside world. So horses became their important means of transportation. Rongshui Miao people visited their relatives at the traditional hillside horse fight and reed-pipe festival. Each time when the festival comes, the Miao people would try their best to go home and celebrate the festival, to increase their tribes' cohesion, which was also an old form of educating the new generation on the traditional culture, thus to hand down the culture to new generation. Not only the horse fight and reed-pipe festival increases people's fitness, but also it is amusing and can improve the balance of people's social life, which is also an important carrier of Miao people's culture loved and participated in by the local people. The annual "reed-pipe and horse fight festival" has become an important way to increase the contact among the local people and promote the local people's unity and friendship, which is also an important window and a channel to the outside world which help the outside world learn about Rongshui Miao people's cultures and renovate their own traditional cultures, to speed up the development of local economy.

62.4.3 Recreation and Competition

Sports come from life. Hu Xiaoming points out in his *Recreation Promotes Fitness* that the physical recreation and nature are united in agricultural society [3]. As an indispensable part of the mass sports in our country, the ethnic group's traditional sports are an important fitness keeping method for the ethnic groups, and they are easy to do, have rich contents, varied forms and high interest and are suitable for all people, old or young, to participate in. Reed culture is an all-people culture among Miao people, which includes reed pipe music, reed pipe dance, bird fight, horse fight, etc., where the Caitang dance is grand and horse fight is the major part of the festival activities participated in by most people. Since ancient times, Miao people had a common habit of raising, loving and playing with horses, which gradually developed into a folk culture which is attractive, amusing and is a place young man and women court each other. Each time when the horse fight is over,

the site is overwhelmed with hurrah, gunshot, firecrackers explosion and reed-pipe music, and the winners adorned with ribbons and cockades will receive award there and will be respected by people [1]. In comparison with modern sports, folk sports are oriented to recreation, life and randomness; those characteristics are closely related to people's life and production, which make the sports receptive to the mass and the mass is easy to be adapted to the sports. The sports are more a means of sacrifice, fitness and boy-girl courtship than a form of competition.

62.4.4 Sustainability and Benefits

The sustainability of sports eco-environment is closely related to the harmony between culture and nature. Sustainable development of sports is reflected in the organic combination of people, sports and environment, in the vitality and liveliness of sports—a sub-system of society, in the organic tie between different levels of sports, with increase of input in sports resources, it is the fact that the modern sports development is a basis of and preparation for the future sports, which show increasingly sound organization of sports, variedness of sports items and improvement of sports quality [4]. The sustainability and benefits of Rongshui Miao People's "reed pipe and horse fight festival" is reflected in the fact that the ethnic sports are sustainable, and as a whole industry, the sports are sustainable. In 1987, Rongshui Miao People's Government designated November 26 as "reed pipe and horse fight festival", thus to make use of the local advantages and enhance the reed pipe and horse fight culture and tourist brand and benefit the local people. In the festival, the Rongshui County held a grand reed pipe evening gala, including Caitang reed-pipe dance, horse fight, cock fight, reed pipe music, folk songs and dance, food exhibition, investment invitation, etc., thus to display the colorful local folkways. According to the statistics, by the end of October this year, Rongshui County received altogether 1.02 million tourists, realized 375 million yuan [5]. The sports tourism and industry and the unique local cultures are combined to have created a value of incorporating modern sports. For the time being, the state vigorously encourages nation-wide fitness improvement campaign to improve the whole people's living quality and increase people's physical fitness, which is on a fast track of ascension.

62.5 Summary

The traditional ethnic sports play a positive role in improving the fitness of ethnic group, and in promoting social and economic development. The unique geographic characteristics decided that Rongshui Miao people's traditional sports are natural and ecological. The "reed pipe and horse fight festival", under the intangible cultural heritage protection, integrates such capacities as fitness keeping,

recreation, artistry and competition. It is necessary to build sustainable eco-system in ethnic areas, development traditional ethnic eco-sports tourism and industry, and take positive measures, to facilitate the harmony between the people and nature, between people and society.

References

1. Portal website of Rongshui Miao Autonomous Government <http://www.rongshui.gov.cn/>
2. Yan T, Li G, Gao J (2002) Value and costs of competition-oriented sports. Beijing Sports Univ J 5:295–296
3. Hu X (2005) Recreation promotes health, sports cultural guidance. 03:4
4. Wu M (2004) On sustainable development of sports eco-system. 03:22
5. China news website <http://www.chinanews.com>

Chapter 63

Research on Declining Credit of Chinese Professional Athletes

Dawei Li and Ying Qi

Abstract This research was conducted from the perspective of the declining credit of Chinese athletes. By sorting our the real life cases, we get to know these cases involved such different groups as sports managements, coaches, athletes family members and etc. The thesis analyzed its causes and indicated the serious harms to the sports career. This is a cheating behaviour on sports integrity which not only offended sports spirit but also disturbed the fair play principles. On top of that, image in front of international audiences.

Keywords Athletes · Declining credit · Countermeasures

63.1 Introduction

Good faith is also a traditional moral of People's Republic of China. The ancients said like this: an individual's moral is a combination of inner beauty and exterior behavior. Keep good moral at heart and behave with good faith [1]. Loss or win is temporary however, credit is everlasting. Like case of motivation enhancing drug use, the declining credit means the athletes win medals in match both at home and abroad in a way of fraud [2, 3]. Once in a while, the motivation enhancing drug use

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problem was a long suspicious problem for international medias. This type of fraud is the abnormal phenomenon caused by the pursue of gold medals and related benefits. Recently, nine athletes from China Figure Skating Team were suspected with age fraud.

China Skating Association hold press conference and officially clarify the ages of Zhang Dan and Zhang Hao. Their ages were confirmed in line with the ID card. It was claimed that what made the errors due to the careless operation in the registering process. But the unclear confirmed result aroused more international media's suspicion. The case was called off for a while, but no one can avoid such a fact: There were more 'mistakes' on athletes' ages on the official website. When recalling the painful experience, we always naturally relate it to the dishonesty. In fact, lacking of honesty is a public secret in sports circle. It is like a scar in our heart. When international media put the truth on the table, we get hurt and feel painful in heart. The sports professional moral is in a crisis.

63.2 Background and Current Status of the Declining Honesty of Chinese Athletes in Recent Years

In the evening of April 28, 2010, the International Olympic Committee published that after the investigation conducted by International Gymnastics Union, because the female player Dong Fangxiao was under 16 when taking part in 2000 Olympic Games in Sydney [4, 5], the bronze medal she won was recalled. The fourth American winner benefited and became the winner of the bronze medal. In 2010 the 13th Guangdong Sports Games, according to the regulations, the athletes should not be aged between 9 to 18. In 2009, Guangzhou Sports Bureau checked the bone age of 15 thousand teenagers and 2113 were suspected age fraud. The deputy director of the bureau stated that in the certain sports program, 16 players in team C were found using false age which is not in line with the bone age. Some of the athletes even were 6 or 7 year old older than the requested age.

In December 2010, when the China Football Association registered name for Feng Renliang happened to find that the age he has already registered before was not in line with the age on his ID card. This further disclosed Feng Renliang's false age. China Football Association attached great importance on this case. In the interview, the chairman of the association also stated that the China Association would never avoid and hide players' age fraud scandal. On December 24, 2010, the Discipline Committee of China Football Association released punish solution for the Feng Renliang case of Shanghai Shenhua Team. The participation in the third round of the match was canceled. The Shenhua Club was fined 20,000 RMB. The train head club was fined 30,000 RMB [6].

63.2.1 The Root Cause of the Declining Honesty of Chinese Athletes

63.2.1.1 System

Insufficient system supply poor market monitor.

Such correspondent systems as credit record, credit organization and monitoring system which keep pace with the international market economy have not yet been established. Therefore, the record and monitor toward these clubs are mainly in charge by the department of industrial commerce, taxes, banks as well as industrial association. But there is no complete system. The monitoring performance is also expected to be improved. Changing ages is a abnormal product under the pursue of gold medals in Olympic Games. It is not an individual issue. It requires different groups' coordination. So this is a benefit linked fraud. The age fraud in China female gymnastic team has been "narrowed down" deliberately. But the punishments from the International Sports Union still disclosed the painful experience of Chinese Sports. What is ridiculous is that the similar scandals are likely to move on due to its huge profits. Most of the nation wide competitions have age limits.

Once a ceratin athlete is outstanding but the age is elder, he or she can get the match opportunity by changing age. The cases "change the older ones into smaller ones" usually happen on such programs as football, basketball, track and field and heavy athletics. Athletes over 18 are grownups. They are more competitive in strength, height, weight than teenagers. For the athletes who were changed into the older ones, the final aim was that younger athletes were more competitive in body flexibility which was more helpful in completing higher difficult actions. This is the key for age fraud. For such programs as gymnastics and figure skating, the younger the better. Because as the athlete grow older, the bones will to some extent affect the performance. This is also why the age of Dong Fangxiao was changed from 14 to 16 [7]. One local team took the risk and luckily avoid punishment, other teams would gradually imitate. As time passes, changing age become an underground rule of the sports circle. The team who do not change ages may become the loser. At present, the record and monitor to the individuals are still empty. Problems are solved within the association.

Government behavior lacks of norms.

As China is in the process of the improvement of market scheme, regulation and order. With the development, new policies, rules and regulations will be launched to replace the old ones which could not catch up with the trend of the market development. In the process, the variation of policy is unavoidable. This also increased the uncertainty of the market. Athletics sports is a pyramid, the people reach the top of the pyramid is countable and a majority of people just become the foundation of other athletes' success. Everyone is trying to reach the top and do not sacrifice in the competition. They do this with every possible means without consider rules and regulations. Within the benefits driven, the local officials and

coaches will choose a teenager who has the similar age as the athlete who is supposed to take the bone age check in order to get the right result and pass the checking. Later on, relative monitoring organization installed video cam to monitor the bone checking, local team officials and coaches then switch the aim to the bone age checking experts. According to the latest information, an athlete who was 19 was read 16. This is obviously the private operation result. China athletic sports carries out “the national system” ‘Gaining honors in Olympic Games’ and ‘gold medal strategy’.

They are adopted when there is any contraction. But more often, administrative means were used to interfere market and disturbed the original unstable supply and demand relationship. The American athlete Merritt, the double champion of 400 m in Olympic Games and in world championship was found using forbidden drugs and was forbid to take part in matches by the International Track and Field Union. Merritt needed to make self-criticism on a nationwide basis. The chairman of the American Track and Field Union also blamed Merritt in public: Merritt’s career was contaminated by using forbidden drugs. This behaviour also reflected an extremely immature and declining responsibilities of the world top athletes. However, when dealing with these cases, our athletes, coaches or relative organizations all would like to make different kinds of excuses to avoid the liabilities.

63.2.2 Culture

From the perspective of sociology, credit is a culture phenomenon. Confucius reckons that ‘Trust your friends’, Take “Faith” as one important form of performance. It requires “Faith based on basic respectiveness”. ‘cautious and faithful’ ‘The Analects of Confucius. Learning’. Mengzi once said: honest people is on the right track, the people who thinks about being faithful is real human.’ Mengzi Li Loushang’ Take faith as the top of the nature and social community. According to ‘Zhong Yong’: A faithful person should be built by oneself, a good moral should be formed by oneself. An honest one gains from the beginning to the end. A dishonest one gets nothing. Faith is Chinese tradition science ancient times. Mengzi also strongly highlighted the importance of it. But, it can be found that this traditional is just a very extensive life philosophy which is good for building an individual’s good personality. But we can find that the Confucianists culture which have dominated Chinese people for thousands of years is a life philosophy to a greater sense. Its requirements for “credit” and “faith” is just a spirit intention of philosophy. It is a philosophy for building nice personality.

But China is not a contractual society but a society with different classes and the traditional culture people have been pursuing were not bind by the law. To a greater extent, people’s behavior was confined by moral spirit and religion. This is one of the factors of lacking law spirit. China is a society with different social class status but not a Contractual Society. In our traditional culture, what people have been pursuing was not confined by the documents, Law code. So, to a greater

extent, people's behaviors were restricted by the moral education and the religious power. This is also a very essential reason that our national lack of the legal spirit. This is a link which is Benefit driven tempted parents, induced coaches and pushed managements. Tracing with the root cause for fraud, benefit is the reason. With the phenomenon deeply rooted in our system, the unfair play is gradually forming to a mode. The sense that gold medals only, higher scores first is constantly forcing people to get them by every possible means. By encourage athletes to go age fraud, not only athletes themselves can get enough benefits from it, the managements can also make more achievements and the coaches can also be granted with a certain amount of money as reward by the local government as well as the country. The award the coaches get are normally the same as the athletes get. Some coaches even do lots of work to change athletes ages and help them get the opportunity to take part in different matches and get awards from them.

Although China has switched from planning economy to market economy, there is still no perfect Contractual Economy. After getting the opportunities by age fraud, both coaches and athletes can also get more subsidies for the training preparation for the matches abroad. Although athletes have won many gold medals in recent years, winning more gold medals should not be a challenging thing. However, the system has not yet changed its direction. More officials would like to get the promotion by creating more achievements. So, the spirit of pursuing higher record and more gold medals still not changed. On the one hand, people are self benefited, on the other hand, the insufficient system led to the dishonesty. The age fraud issue is usually found among teenager athletes, the change can be made easily in provincial team. Parents would prefer to agree with the age change in view of getting the opportunity for their children. Coaches would like to assist the changes with an expectation to get better performance. So this in turn encouraged the age fraud.

63.2.3 Politics

In the transformation from a lag behind agriculture country to the industrialized one, China is born with insufficient credit system which is a critical symbol of market economy. The age fraud issues were found frequently in recent years. The achievements in Olympic Games, National Games and Provincial Games were all highly encouraged. Each party was trying to get enough medals and reach the target. Some of them even was forced to fraud in games. Especially when the departments of the General Bureau search for solutions for changing ages since this is the fastest way to get achievement. Local Sports Bureau pursue achievements is one of the problems, too. In China, with the current system. The allocation of sports resources is totally undertaken by the government. Athletes and their teams are like chess. They just abide by the order but without any personal wills. The Chinese sports is the result of benefit pursuing. Dong Fangxiao and Feng Renliang are the scapegoat in the age fraud issue. To some extent, we should

say that they sacrificed for the achievements the sports circle expected. Sports is a reflection of the society. The age fraud issue is the Chinese credit problem. Seemingly, age fraud was taken for granted, relative departments were very cooperative. But if athletes fraud in athletic court, they also will fraud in the society. They will gradually take fraud for granted and feel reluctant to obey the laws.

Age fraud is as using poisonous drugs which is gradually ruining the body of Chinese Sports. It is highly advocated that every one of the athletes should do it from themselves individually. Eliminating age fraud play fairly. This is the only way to maintain the survival of the sports circle. According to the formal procedure, it is almost impossible for a common citizen to demand age change in the public security department. However, it is common for athletes. We did hear some measures that had been taken to fight against age fraud, like bone age checking, anti over age, but we saw slight changes. Benefits still dive more people to continue to fraud. The so called measures were not big enough to scare them. When Dong Fangxiao was found age fraud, many people feel sorry for her because she was just one of the scapegoats. About who changed the age” has already been a suspicious issue. China lost a bronze medal in Sydney Olympic Games because of the age fraud issue of Dong Fangxiao. The secrete of age fraud of Chinese athletes has broken the iceberg of worldwide.

63.2.4 Legal System

Law, as the last base line of social morality is the last defense for maintaining peace and righteousness. In theory, there were some counter measures upon the similar problems. But the only one who were punished were usually athletes themselves, the hidden operators were usually forgiven. Law, as the basic norm, should be standard, complete and flawless. Jiang Xiaoyu, the committee member of CPPCC, the deputy director of Educational, scientific, cultural, sanitary and physical committee, ex executive deputy chairman of Beijing Olympic Committee said: There are such cases as fake balls, fraud soccer, false age, unfair judges, etc. But the concrete punishment system toward these behaviors is not perfect.

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Regretfully, the law also lack of credit. On the one hand, the quality of legislation worries us a lot. For the National Games or even more attractive Olympic

Games, Some local functional departments was tempted under the ‘achievements creation project’ and motivated to get involved into the age fraud issue. Actually, there were unconformities in many legal documents. Or contradictions, unreasonable approvals could be seen easily. In fact, just because of the pursue of fame and benefits, for quite a while, age fraud issue of the Chinese sports circle has been the public secrete. [8] What is more ridiculous is that relative functional departments on the one hand claim that the age fraud is impudent, on the other hand, they have fun in getting involved into it.

Judging from the current complementation status of justice, the punishment for changing one’s age is uncommon. This is why the trend is not likely to come to an end. Seeing it from another perspective, the job should be restricted from the household register department. So once the fraud happens in the future, it should be checked from the source. Relative people who get involved into this fraud should shoulder the responsibility. But up to now, there is still no special law to regulate the athletes for fraud and dishonesty. Next is the official corruption phenomenon is becoming even serious and make people show indifference to the law. The chain effect it takes is that relative organizations were not yet confirmed to be the fraud main body; there are no responsibilities for them to take. Therefore, relative departments just will continue to fraud. On top of that, sometimes the coach who gets involved in the fraud is at the same time a judge. So, the age fraud issue is really a malignant tumor which can not be removed in a short time.

63.3 Chinese Athletes Credit Reconstruction and Counter Measures

63.3.1 Setting up Complete Credit Policy Regulation System

Credit as the basic norm of the modern market economic activity, beside the traditional education means and social moral education, further constructions should be reinforced on law and system. No restrictions from the law and the system, people tend to be easily tempted and become dishonest in front of benefit. Simply reply on improving moral by education is not realistic. So specific justice system is the requisite to guard honesty and credit.

63.3.2 Setting up Athletes Social Credit System

On the point of credit, as an individual, it mainly depends on the justice on the expected credit lost cost of one’s own. If the credit lost increase, reducing athletes credit lost profit is the basic path for enhancing good faith. The union credits add system is establishing athletes personal information service credit system through

the special credit service organization. By collecting the credit information of athletes, integrate the credit records of elsewhere. The crediting service is open to the whole society. This is helpful in dealing with the contradictions between the society and people, between organizations and organizations. The punishment for the athletes who lost credit, the establishment of the system can increase its punishment force and prolong the punishment time.

References

1. Wang F, Yang Q (1992) Competition and Moral. Shanxi Education Press House, Tai Yuan, vol 37, pp 361–368
2. Sina Sports (2011) Nine ice skating athletes were suspected with age fraud [EB/OL]. <http://sports.sina.com.cn>
3. Yi K (2010) Perceiving China sports circle age “black hole”. *Xinmin Wkly* 10:56
4. Sohu Sports. Age fraud scandal [EB/OL]. <http://sports.sohu.com/20090317/n262835933.shtm.l>
5. Sina Spots (2009) Striking age fraud cases in China football circle changes. Who stole their ages? [EB/OL]. <http://sports.sina.com.cn> 03-03
6. Zhong L (2010) Zhang Day tracked into “age’s fraud” trouble when dating. Basketball player Yi Jianlian has ever met the similar problem *Jinling Evening Newsp* 06:04
7. Tecent Sports (2011) Roger fights against age fraud [EB/OL]. <http://sports.sina.com.cn> 02:16
8. Tian S (2009) Looking back on to the past and look into the future, 30 years of Chinese sports legislation construction. *Law Mag* (9):9–13

Chapter 64

Research of Sport Videography Technology on Formula One Grand Prix

Mingming Cai and Jiang Li

Abstract The paper aims to explore the use and value of the Sport Videography technology in F1, for the development of the sport videography technology in other areas do draw. Through to the 2011 F1 championship in three station of various sport videography technology application the number of times the statistics, Observation push, pull, shake, wave, move, track with the application and advantages. Analysis of the connotation of sport Videography technology. The results show that, sport Videography technology in F1 incorporates a lot of high-tech elements, to show the value of F1.

Keywords Sport videography · On Tv · Videography technology · F1

64.1 Introduction

F1 on TV as the world's tallest TV technology level one, it contains research value is huge. Now almost the entire sports event broadcast television personalities in the study will reference F1 RSS technology. F1 game show of strength, speed, the beauty of the competition shocking, and in the course of a game all kinds of television cameras switching, use also breathtaking. As other programs television personalities should do more to study them, because of the F1 on TV in the

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conversion of the lens, the artistic performance, of the game take hold, can teach us many things [1].

But in fact strip F1 TV pictures gorgeous appearance, to our core or that a few sports camera the most basic elements. Put a move feeling strong sports very well presents to the audience, sports camera technology is always the most important part. High-tech factors is important, at the broadcast television pictures of should be using it. And those who are not ginseng add up to the same very high-tech F1 lens to shock people [2]. The most important is the need of domestic television personalities will be better able to grasp the characteristics of the object must express, will these features and sports camera technology organic unifies in together, will inevitably made such as “F1 general lightning fast” as the shock effect [3].

64.2 The Sport Videography on F1

Sports Videography mainly includes the “Push”, “Pull”, “Shake”, “Move”, “Track” with five shooting mode (Table 64.1).

64.2.1 “Push” in the Use of Sport Videography on F1

“Push” is refers to the camera to be shooting near main body, or change to the main body of the focal length near a shooting method. For example in a F1 after the game, the car to stop, when cameraman often can give a car a whole lens, then change the focal length, or change position, slowly zoom in on the car tires parts. This is to let the audience better to have a look at the car, the tyres protection after the game. Some drivers to tyre protection is better, the surface is smooth, such as jenson button. And some drivers like radical driving, tire will be very serious toro rosso, such as Hamilton. Again, each stand the champions of the national anthem is to be awarded prizes, cameraman would also give its a far and nearby the push is taken. Then we can be more true to see the driver of facial expression, can go together to share the joy of his title. “Push” can cause visual moved forward effect, played a prominent was filmed the effect of main body [4].

Table 64.1 On the game of F1 in the number of use (2011)

	Push	Pull	Wave	Move	Track
ShangHai	46	43	46	51	65
MonteCarlo	43	42	51	54	61
SilverStone	41	45	46	56	58

64.2.2 “Pull” in the Use of Sport Videography on F1

“Pull” is to point to pull away from the camera was filmed the main body, or change the focal length makes the picture by almost to a far photographing method. In the process of broadcast in F1, and taken and it is often used. Before the game, when more than 20 cars are parked in the starting line, teams are doing final preparations. At this time, cameraman will put a camera on top of a car tires, give a big features. Then cameraman will pull back slowly lens, until the whole car shot. It is to make the audience know the team to the driver used first what kind of tires, because the game tyre strategy also is very important. The audience through the lens can know the driver is the womb with hard or soft tyres, when it’s raining can know the womb is with the heavy rain or neutral child. So can make the audience for the team’s tyre strategy is about a understanding. And, if a certain driver in the game for out of the race. Then cameraman will first tell the scene a support his audience a close-up, then pull back, we can see a whole piece of the audience like sighs and dismayed. And can cause visual taken back effect, which is beneficial to the main body, and the main performance at that time environment.

64.2.3 “Wave” in the Use of Sport Videography on F1

Wave perturbation is refers to the camera flight reservation motionless, with the aid of the tripod activities of the human body itself or photographed chassis, the movement of the optical lens axis camera shooting method. Say a bit of image, taken as if people turn shake head to see the scenery around. In a race in F1, wave mostly for the car of travel is taken. For example in Japan suzuka bend the spoon, the camera is fixed in the meadows apex. When the car after, the camera will bend, with the car into corners, the exit, this series of process is through the camera lens is taken to the performance of the wave. Again, in the spa circuit first straight, cameraman in middle position until the next to set up a camera on the grass. That way, when the car high speed after, the camera lens can then follow the car movement together. The Shanghai sports a F1 commentary LiBing give him a image of the call: “left” the camera lens. This is a wave of perturbation process, just because the wave speed is faster, so as to let a person produce a “left” feeling. Wave lens the picture more consistency, can let the audience clearly see the object was filmed inside this paragraph of time trajectory. In addition, in F1 competition, such wave can let the audience more taken at the scene. Imagine that you stood in the track, eyes on a car to car speeding up, then the first turn, and then watch it far away, this is a picture of how shocked the picture. Of course, the “left” lens or should not use too much, because lens transformation too fast, can make the audience feel dizzy.

64.2.4 “Move” in the Use of Sport Videography on F1

Move is to point to the camera fixed taken in activities in the object then the shooting sports. F1 competition, the move is taken by frame technology is on the car's miniature video camera to finish. For example this graph, the camera is fixed in the at hand of car above the intake next to the car body. This is also so far more with a flight reservation because this lens can be very intuitive see drivers the operation, can see how drivers corner, how to overtake, how to miss, and so on. In addition, this year's F1 race introduced DRS (adjustable rear wing) system, almost all of the teams are in the rear of the car is to the direction of the rear wing with a camera, DRS in order to monitor the operation of the system. The camera in a race in F1, the application of improved greatly the words. The audience sat in front of the television, is like sitting in the cockpit of the F1 car, followed the driver to enjoy the game. When we see on television lens on both sides of the scenery of the fast track back backwards, the visual sense of satisfaction, and experience of the realism, is the movement of other general lens can't achieve the effect [5].

64.2.5 “Track” in the Use of Sport Videography on F1

“Push” in the use of sport videography on F1 with perturbation is refers to the camera with the movement was always taken together with the main body of the shooting sports. Due to the speed of the F1 was so fast, so the general camera is fundamental to keep up with the F1 car. In F1 competition in two can use only with perturbation: one is the helicopter aerial, the other is the car stops, the team next to the bridge has a camera line, the camera can follow the car to shoot. Each station of the game, the organizing committee will arrange a helicopter in heaven followed for shooting. When two car by near, are likely to happen beyond, aerial often will be used by the. In this process, the audience can see clearly that the relationship between the distances between the two cars, can obviously felt on the straight that even faster, can be visualized corners of the line, which walk corner speed better and faster. The audience if tight stare at F1 racing in the aerial lens; it is not easy to see it fast. But if you look at the scenery around, such as track next to the tree and the audience, some of the streets next to the travel and the car, you will find that F1 car as general from flank rushing. This-the speed is very visual impact. The shooting with lens for continuous way and detailed performance was filmed in the movement of the main body, can hand over to treat a shooting the movement direction of the main body, speed and the relationship and the surrounding environment [6].

64.3 The Advantage of Sport Videography on F1

64.3.1 The Diversity of Sport Videography on F1

Relative to other sports, it can be adjusted for F1 are a variety of subjects. Take the football match, for example of a football match, about ninety percent of the lens to the football will broadcast. In addition to the players and the ball around his defenders, we can hardly see the audience every movement of the other players. Sometimes pitch or the pitch what happened unexpected situation, for example the crowd stands, the pitch has ground the player was injured, and the camera will give some explanation. But general in this case is the game pauses, during matches is not to take care of these the lens. And there are different F1 match, in the course of a game, the first two riders can happen beyond, the last two riders will probably happen beyond each other [7]. So F1 lens is generally don't get time staring at a car. The director general will pay attention to the close by two car or a small cabal, other alone into a group of car lens generally not concern. So in F1 match when see also have a kind of experience: if long time no leading car lens, it means that the car of the operation is stable, nothing happens. In addition, the F1 match only care about the results of a race car. The team the team has been working in the pit of the dynamic; The change of the clouds of heaven; A driver back to the back of the pit lane alone after the game; The driver support up to, the audience of everyone audience expression, can become the F1 in the things on camera. The F1 stand has more than 20 car component of the big games, which doomed lens is not too limited. The TV camera is a main body, but it is certainly not all [8].

64.3.2 The Features of Sport Videography on F1

The characteristics of F1 is speed, the big game, which doomed F1 competition broadcast can't be like that when the football match with a panoramic camera to take care of all. This requires the course of a game to switch often lens, and all this premise is around the track to have a sufficient number of cameras. According to not complete count, every race, only official arrangement in raced around the flight reservation about 30–50. In addition, every car on installation 2–3 a camera [9]. So now, every game, the official lens is nearly one hundred! And in football game, is only about 20 a flight reservation. This makes the audience can from more angles to appreciate to F1 race. Second, F1 is very good combines RSS party of F1 characteristics, the move is taken and applications with perturbation, make TV picture more force. In game, a lot of the accessory lens will let you have a boiling passion, and will let you aerial clearly see that F1 car next to relative to the reference “rapid”. In football, we can hardly see the move taken such a shooting style. The use of the more is taken and stood in the stadium push by the wave is taken. Sometimes also used aerial, general before the game will from go up and

fall to a lens, main is to let our viewers know about the appearance of the stadium. Because the football field and the ball high in the sky on look is really small, so the aerial such a gimmick in football game generally will not use. Can say, it is precisely because the very good caught F1 “fast”, F1 TV broadcast will so appealing.

64.3.3 The Application of High-Tech

F1 on TV after more than 40 years, have now reached the point where a very mature. It can easily will be presented to the audience, and this in itself is a very great things. In addition to the application of the technology that camera outside, now of the F1 broadcast more participation in the high-tech factors. From the 80s is simple and the original subtitles to now scrolling marquee rankings, telemetering data and so on show, F1 on TV with the development of science and technology is becoming more and more advanced and humanization. Now sit at home watching F1 race, you can be in F1 many data. During the event, broadcast will often broadcast the current ranking and the time difference between each driver. For some wonderful scenes from each Angle director of slow motion again. In some in the turn tail or straight, there will be a APEX speed traps, the game will often speed traps you publish a when the pace of the race. In addition, you will also have the fastest lap, stops drivers take and so on the rankings. In the car chase limber, the screen will often give each time point of the car and limber after time contrast, thus let the audience better see the two cars at their respective what kind of sections. In the drivers stops, the screen appeared again a track of remote sensing system (similar to GPS), it has the main driver of the competition at this point in the position, can let the audience more intuitive to see whether the driver in the pit lane beyond. In addition, when the driver’s subjective lens, often can appear a small circle the bottom left corner of the graph type data. It has the throttle, brake control drivers, speed table, have a speedometer, have G force table in 2010, and new introduced KERS (power recovery system) and DRS (adjustable rear wing system), in the chart will have to react. What is more, the car stops, the screen will appear thermal imaging systems, the audience can very clearly see the car tires, engine, radiator of high temperature, such as the temperature of the parts. And in football game, television viewers now in addition to see both sides in the starting lineup of the list and after the game to see both sides of the technical statistics besides, still can’t seem to other aspects reflect there are high-tech intervention. So say, F1 on TV success and high-tech technology is inseparable. I think, as technology advances, more high-tech will be used for F1 television pictures in; leave the audience will be more substantial must have the visual feast.

References

1. Eason G, Noble B, Sneddon IN (1955) On certain integrals of Lipschitz-Hankel type involving products of Bessel functions. *Philos Trans R Soc Lond A*247:529–551
2. Clerk Maxwell J (1892) *A treatise on electricity and magnetism*, 3rd edn. Clarendon, Oxford, vol 2, pp 68–73
3. Jacobs IS, Bean CP (1963) Fine particles, thin films and exchange anisotropy. In: Rado GT, Suhl H (eds) *Magnetism*, vol III. Academic, New York, vol 28, pp 271–350
4. Elissa K Title of paper if known (unpublished)
5. Nicole R Title of paper with only first word capitalized. *J Name Stand Abbrev* (in press)
6. Yorozu Y, Hirano M, Oka K, Tagawa Y (1987) Electron spectroscopy studies on magneto-optical media and plastic substrate interface. *IEEE Trans J Mag Jpn* 2:740–741
7. Young M (1989) *The technical writer's handbook*. University Science, Mill Valley, vol 5, pp 224–228
8. Electronic Publication: Digital Object Identifiers (DOIs): Article in a journal
9. Kornack D, Rakic P (2001) Cell proliferation without neurogenesis in adult primate neocortex. Science doi: [10.1126/science.1065467](https://doi.org/10.1126/science.1065467). Article in a conference proceedings 294:2127–2130

Chapter 65

Research on Chinese Athletes Age Fraud Scandal

Ying Qi

Abstract This thesis is written from the brand new perspective of athletes age fraud scandal. By sorting out athletes age frauds of recent years, we get to know that the cases involved parents of athletes, government residence register managements and etc. The harms it brought about have been analyzed and serious group cheating behaviour which seriously ruined honesty has been disclosed. For the sports field, this also greatly offended the sports spirit and affected the fair play principle as well damaged the image in front of international audiences.

Keywords Athletes · Age fraud · Credit crisis

65.1 Introduction

The age scandal of China Sports Circle published on “Post Olympic Times” has become a public secret. Like using the spirit enhancing drugs, the purpose of age scandal is in getting profits by fraud, taking improper advantages etc. For quite a long time, the issue Chinese athletes using spirit enhancing drugs has been the international suspicion. Likewise, age scandal is a twisted social phenomenon based on profit and gold medals. Lately, after the nine figure skating athletes were reported to be age fraud, China Skating Association conducted a press conference for the scandal and officially published the registered age of the two athletes Zhang Dan and Zhang Hao are in line with their real respective age. The previous

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misunderstanding was defined as the “lower grade mistakes” of the working process. But the explanation was suspected by international medias because of its un-transparency. The scandal has not yet been eased by the press conference. The heated discussion it caused is still not over yet. Constant age frauds are still going on and have revealed the moral crisis China Sports Circle is facing with.

65.2 Brief Account of the Age Fraud Scandal Involving Nine Figure Skating Athletes

According to the report of American Union Press, the updated athletes name list published on the official website of China Skating Association, the age information of the following nine athletes are not in conformity with the real age registered on the official website of the International Skating Union. They are Zhang Dan, Zhang Hao, Sui Wenjing, Han Cong, Geng Bingwa and etc. Their ages are not in line with the stipulated age for sports matches. The response China Figure Skating Association has made is The athletes Zhang Dan and Zhang Hao have reached the legal ages for taking part in international sports matches. The information China Skating Association published was partially incorrect due to the careless handling in documents submission of candidate units, information collection as well as the checking performance of our association. Obviously, this response is either a “truth” or a “crisis eliminating excuse. Later on, the statesman of the International Skating Union stated that after the confirmation of the International Skating Union, the silver medal winner, the China figure skating athlete Zhang Dan and Zhang Hao did not break the rules by providing false age in international matches [1].

65.3 Relative Comments on Age Fraud Scandals of Chinese Athletes

65.3.1 Brief Account

When it comes to the history of age fraud scandal, the most striking one is the one happened in 2004. At that moment, the China Football Association was forced to check on the bone age of the teenager players, the result is: In the 1610 players aged at 1989,1990, the unaccepted rate was up to 27.7 %, 446 players were found not in line with the legal age. According to the scientific research abroad, ability loss the fraud age made has its regulations: under the age of 17, if the age is corrected 1 year less, he will lose 30 % opportunity for getting succeed. If the age is corrected 3 years less, he will lose 90 % opportunity for getting succeed.

In 2007 Thailand Bangkok University Sports Games basketball match, the age of some players are older than the real age. Although China delegated clarified

there was no problem in Chinese athletes ages, but the image the scandal has established would not be eliminated immediately. There are still doubts. And on the Asia U-18 men baskets ball youth championship, Asia Basket Ball union once gain pointed out that there might be problems with some Chinese athletes ages. But this case ended without a solution.

In November 2008, it was reported by media that on the CBA new match season program, the ages of over 36 athletes were found not in conformity with the ages on the last match season, including Yi Jianlian. And the age of Tang Zhengdong was 2 years older than the previous published one. This immediately aroused people's focus. China Basketball Association immediately performed investigation and finally 8 athletes were confirmed to be false age.

In July 2009, National Teenager Pingpang Match, many teenager players were found using the false age. 90 from the 259 athletes who went through bone age checking were found age fraud. The unaccepted rate reached to 34.7 %. Meanwhile, over two athletes from Shanxi Zhishan Dongliang Team and Shenzhen South Mountain boy team were eliminated the opportunity for taking part in the group competition.

In the evening of April 28, 2010, the International Olympic Committee published that after the investigation conducted by International Gymnastics Union, because the female player Dong Fangxiao was under 16 when taking part in 2000 Olympic Games in Sydney, the bronze medal she won was recalled. The fourth American winner benefited and became the winner of the bronze medal.

In 2010 the 13th Guangdong Sports Games, according to the regulations, the athletes should not be aged between 9 to 18. In 2009, Guangzhou Sports Bureau checked the bone age of 15,000 teenagers and 2113 were suspected age fraud. The deputy director of the bureau stated that in the certain sports program, 16 players in team C were found using false age which is not in line with the bone age. Some of the athletes even were 6 or 7 year old older than the requested age.

In December 2010, when the China Football Association registered name for Feng Renliang happened to find that the age he has already registered before was not in line with the age on his ID card. This further disclosed Feng Renliang's false age. China Football Association attached great importance on this case. In the interview, the chairman of the association also stated that the China Association would never avoid and hide players' age fraud scandal. On December 24, 2010, the Discipline Committee of China Football Association released punishes solution for the Feng Renliang case of Shanghai Shenhua Team. The participation in the third round of the match was canceled. The Shenhua Club was fined 20,000 RMB. The train head club was fined 30,000 RMB.

65.3.2 Comments from the Professionals of Sports

Xu Shaolian, the director of Chengdu Business Newspaper Sports Department said: Actually, the age fraud cases of China female gymnastic team has been

“narrowed down” deliberately. But the punishments from the International Sports Union still disclosed the painful experience of Chinese Sports. What is ridiculous is that the similar scandals is likely to move on due to its huge profits. Take the age fraud case of Feng Renliang as an example; we can imagine if there is no change on system, the scandal will never come to an end [2]. Professional Sports commentator Bi Xidong said: the previous gym player Dong Fangxiao was found age fraud and the bronze medal was deprived. This is a common phenomenon of China sports circle. Dong Fangxiao and Deng Renliang are just two of them. The sports newspaper Chinese version deputy director of the Editing Department said: Many people would consider it due to the perseverance of American.

Dong Fangxiao was eager to get the position which led to the differences between the two documentaries of the International Olympic Committee. Also, some Chinese coaches of American Gymnastic Association didn't stand up to the case. Less people reflected the hidden truth of “20 years old this year and 18 years of next year”. Why different groups can remain united in getting the medal. Why there is a sharp decrease on gymnastic players. Du Wen, the executive editor in chief of Eastern Sports Newspaper said: The age fraud scandal will not only affect the winning of one Olympic medal. Sun Zhengping, the professional sports commentator of CCTV said: China gymnastic age fraud cases are the problems passed from history. This is a warning to Chinese Sports: We should compete with carefulness and do things with honesty. Competitiveness works. Jiang Xiaoyu, the committee member of CPPCC, the deputy director of Educational, scientific, cultural, sanitary and physical committee, ex executive deputy chairman of Beijing Olympic Committee said: There are such cases as fake balls, fraud soccer, false age, unfair judges, etc. But the concrete punishment system toward these behaviors is not perfect. The department of legislation and law should take some measures to establish a sports regulation like forbid the using of spirit enhancing drugs. The principles should be confirmed further and make the sports circle has a rule to rely on.

65.4 The Reasons for the Chinese Athletes Age Fraud Issue

65.4.1 Profit Driven, Group Fraud

The age fraud issues were found frequently in recent years. The achievements in Olympic Games, National Games and Provincial Games were all highly encouraged. Each party was trying to get enough medals and reach the target. Some of them even were forced to fraud in games. Especially when the departments of the General Bureau search for solutions for changing ages since this is the fastest way to get achievement. Local Sports Bureau pursue achievements is one of the problems, too. In the athletes appraisal, the requisite indicator is athlete's performance. Age fraud is as using poisonous drugs which is gradually ruining the

body of Chinese Sports. It is highly advocated that every one of the athletes should do it from themselves individually. Eliminating age fraud play fairly. This is the only way to maintain the survival of the sports circle. According to the formal procedure, it is almost impossible for a common citizen to demand age change in the public security department. However, it is common for athletes. We did hear some measures that had been taken to fight against age fraud, like bone age checking, anti over age, but we saw slight changes. Benefits still dive more people to continue to fraud. The so called measures were not big enough to scare them. When Dong Fangxiao was found age fraud, many people feel sorry for her because she was just one of the scapegoats [3]. About who changed the age” has already been a suspicious issue. China lost a bronze medal in Sydney Olympic Games because of the age fraud issue of Dong Fangxiao. The secrete of age fraud of Chinese athletes has broken the iceberg of worldwide.

This is a link which is Benefit driven tempted parents, induced coaches and pushed managements. Tracing with the root cause for fraud, benefit is the reason. With the phenomenon deeply rooted in our system, the unfair play is gradually forming to a mode. The sense that gold medals only, higher scores first is constantly forcing people to get them by every possible means. By encourage athletes to go age fraud, not only athletes themselves can get enough benefits from it, the managements can also make more achievements and the coaches can also be granted with a certain amount of money as reward by the local government as well as the country. The award the coaches get are normally the same as the athletes get.

Some coaches even do lots of work to change athletes ages and help them get the opportunity to take part in different matches and get awards from them. After getting the opportunities by age fraud, both coaches and athletes can also get more subsidies for the training preparation for the matches abroad. Although athletes have won many gold medals in recent years, winning more gold medals should not be a challenging thing. However, the system has not yet changed its direction. More officials would like to get the promotion by creating more achievements. So, the spirit of pursuing higher record and more gold medals still not changed [4]. The age fraud issue is usually found among teenager athletes, the change can be made easily in provincial team. Parents would prefer to agree with the age change in view of getting the opportunity for their children. Coaches would like to assist the changes with an expectation to get better performance. So this in turn encouraged the age fraud.

65.4.2 Insufficient System, Nowhere to Investigate Responsibilities

Most of the nationwide competitions have age limits. Once a ceratin athlete is outstanding but the age is elder, he or she can get the match opportunity by changing age. The cases “change the older ones into smaller ones” usually happen on such programs as football, basketball, track and field and heavy athletics.

Athletes over 18 are grownups. They are more competitive in strength, height, weight than teenagers. For the athletes who were changed into the older ones, the final aim was that younger athletes were more competitive in body flexibility which was more helpful in completing higher difficult actions.

This is the key for age fraud. For such programs as gymnastics and figure skating, the younger the better. Because as the athlete grow older, the bones will to some extent affect the performance. This is also why the age of Dong Fangxiao was changed from 14 to 16 [5]. One local team took the risk and luckily avoid punishment, other teams would gradually imitate. As time passes, changing age become an underground rule of the sports circle. The team who do not change ages may become the looser. Initially, the monitoring effect was good. Some athletes even felt afraid to accept bone age checking. But within the benefits driven, the local officials and coaches will choose a teenager who has the similar age as the athlete who is supposed to take the bone age check in order to get the right result and pass the checking. Later on, relative monitoring organization installed video cam to monitor the bone checking, local team officials and coaches then switch the aim to the bone age checking experts. According to the latest information, an athlete who was 19 was read 16. This is obviously the private operation result. Judging from the current situation, the age fraud is less likely to be handled by law. This is the root cause of the increasing age fraud. Seeing it from another perspective, the job should be restricted from the household register department. So once the fraud happens in the future, it should be checked from the source. Relative people who get involved into this fraud should shoulder the responsibility [6].

In theory, there were some counter measures upon the similar problems. But the only one who were punished were usually athletes themselves, the hidden operators were usually forgiven. After the Dong Fangxiao case, relative organization reckoned it as the move of 'some coaches'. Likewise, the Feng Renliang case was also considered as the behavior of 'a certain club' [7]. But actually, the Chinese age fraud issue is a systematic project which cannot be finished by a certain individual or a unit. For the National Games or even more attractive Olympic Games, Some local functional departments was tempted under the 'achievements creation project' and motivated to get involved into the age fraud issue. In fact, just because of the pursue of fame and benefits, for quite a while, age fraud issue of the Chinese sports circle has been the public secrete [8].

What is more ridiculous is that relative functional departments on the one hand claim that the age fraud is impudent, on the other hand, they have fun in getting involved into it. Any people with common sense should know that without the close cooperation among relative organization department, there is no way to change ages smoothly. Up to now, almost all the age fraud behaviors became 'personal behavior'. The chain effect it takes is that relative organizations were not yet confirmed to be the fraud main body; there are no responsibilities for them to take. Therefore, relative departments just will continue to fraud. On top of that, sometimes the coach who gets involved in the fraud is at the same time a judge. So, the age fraud issue is really a malignant tumor which cannot be removed in a short time [9].

65.5 Conclusion

The athletes age fraud scandals created unprecedented crisis on honesty in China sports circle. But it is also a good thing. In the gradual improving process, the intended age fraud issues will constantly be found out and punished [10]. This means China is going to enjoy a better future after shoot the problems fundamentally. China wants to become a strong country. A nation without fraud should be the basic condition. Fair play is even more important than winning medals. This is the basic value of Chinese sports. China is stepping forward toward a target of becoming strong country. The correct value should be established to guard the credit of Chinese Sports [11].

Spirit enhancing drug is one of the factors that affect the athletics fair play principle. But the behaviors which go against the rules have similar damage. Age fraud issue is the same. Medals are important but fair play of greater importance. Gaofeng, the Chinese wrestling athlete won the ‘World Fair Play Medal’ of 2010 in Lausanne Switzerland, the venue of International Olympic Committee, appraised by members of the International Fair Play Committee and the International Sports Journalist Association. Gao Feng didn’t win gold medal in Guangzhou Asia Games. But his spirit touched the audiences. The rival of Gao Feng, Zarincrayi from Iran got hurt in knees and got off the stage. Gao feng hold him and helped him get off the stage. Gao Feng did this just wanted to help people but not just got medal. This is the real sports. The most relaxing one.

References

1. Wang F, Yang Q (1992) Competition and moral. Shanxi Education Press House, Tai Yuan, vol 13, pp 33–38
2. Yi K (2010) Perceiving China sports circle age “black hole”. Xinmin Wkly 10:56
3. Sina Spots (2009) Striking age fraud cases in China football circle changes. Who stole their ages? [EB/OL]. <http://sports.sina.com.cn> 03-03
4. Sohu Sports. Age Fraud Scandal [EB/OL]. <http://sports.sohu.com/20090317/n262835933.shtm.l>
5. Tcent Sports (2011) Roger fights against age fraud [EB/OL]. <http://sports.sina.com.cn> 02–16
6. Yu J, Yao L (2003) The current status and counter measures for Chinese athletic sports declining credit. Harbin Sports Inst Campus Newsp 3:13
7. Tian S (2009) Looking back on to the past and look into the future, 30 years of Chinese sports legislation construction. Law Mag 9:9–13
8. Song J (2007) The research on the declining of the credit of Chinese athletic sports professional and its reconstruction. Guangzhou Sports Inst Campus Newsp 1:35–38
9. Tcent Sports (2011) Roger fights against age fraud [EB/OL]. <http://sports.sina.com.cn> 02–16
10. Wang Q, Zhao Y (2007) The perceives of the teenagers sports star worships. Sports Cult Guid J 1:61–62
11. Tian S (2009) Looking back on to the past and look into the future, 30 years of Chinese sports legislation construction. Law Mag 9:9–13

Chapter 66

Research of Teaching Environment of P.E

Lu Chen, Qiang Zhang, Shuai Chen and Quanzhong Zhao

Abstract Teaching of human beings can never be conducted without the support of environment. The elements of teaching environment are in all of aspects and stages of teaching in different forms, and imperceptibly influence the teaching process and effect. It has become an important issue that needs carefully studying in modern physical education to correctly know the roles of teaching environment in education, how to successfully create a good teaching environment which may be more suitable for and promote teaching better. In the paper, the concept, the constituents and design principles of the teaching environment of P.E. are further researched by using documents and materials and interviewing experts to provide references for further research into physical education environment.

Keywords Teaching environment · Teaching environment of P.E. · Design · Elements

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66.1 Research Objective

The teaching environment of P.E. is a complicated system, inside which various factors interact with and depend on each other and influence the physical education objective, what to be taught in physical education, physical education form and effect and the development of physical education [1, 2]. Accordingly, we must attach great importance to the influence of teaching environment on the physical education system, and make great efforts to create a good physical education environment.

66.2 Object and Method of Research

66.2.1 Object of Research

The concept, constituents and design principle of the teaching environment of P.E. as the main object of research.

66.2.2 Method of Research

The paper deals with the teaching mode of physical education by using documents and materials and interviewing experts.

66.3 Results and Analysis

66.3.1 Defining Concepts

The teaching environment of physical education is defined as the combination of various objective conditions and subjective conditions necessary for physical education activities of schools, which mainly include the physical environment of education and the psychological environment of education [3].

66.3.2 Constituents of Teaching Environment of Physical Education

Physical education is a special learning activity [4, 5]. Besides theory courses in classroom, it also includes the skill courses outdoors that take more than half of the time. Accordingly, the teaching environment of P.E. plays an important role in the

success of physical education. In physical education, all of conditions that exert influence on the teaching the learning collectively constitute the physical education environment. It also includes the physical environment of education and the psychological environment of education.

66.3.2.1 Physical Teaching Environment of Physical Education

The physical environment of education is the entirety consisting of all of material conditions for teaching, and is the material basis for teaching. The school buildings, the teaching facilities, the colors, the light and the temperature of classroom are all elements of physical environment of education. “The physical environment of education is an artificial environment and exerts important influence on teaching.”

1. Natural environment of education includes the geographical environment of school, campus environment, position of classroom and indoor layout and so on. It also exerts important influence on students’ learning. Good natural environment of education shall be beautiful campus, graceful, quiet, neat, ordered classroom, plain but decent arrangement so that students may study happily and easily and their nerve action are free from any distraction. Accordingly, Johann Amos Comennius proposed that “Schools shall be built at a quiet place far away from crowd and distractions”, “schools shall be a happy place and shall look attractive both inside and outside.”
2. Teaching facilities include all of basic tools necessary for teaching, such as desks and chairs, laboratory apparatuses, books and documents, sports equipment, and various electrified education instruments. The colors and shapes of the teaching facilities exert important influence on teaching. On one hand, teaching requirements shall be fully met and great importance shall be attached to the practicability of the tools, and on the other hand, the tools shall be well designed without distracting students.
3. Space–time environment of teaching includes class schedule, class scale, arrangement of seats or teams and so on. In education, scientific scheduling exerts great influence on teaching. According to experimental research, human beings show different athletic abilities in different time intervals in a day. Scientists have drawn the daily athletic ability curves according to the test results. It is found in the results that we are the most agile and can study best in the morning and can do exercises best in the afternoon in one day. Accordingly, we had better have theory courses of sports in the morning and do physical exercises or have skill courses in the afternoon.

66.3.2.2 Constituents of Psychological Teaching Environment of Physical Education

Good psychological teaching environment exerts great importance on teaching. Firstly, it is helpful for communicating teaching information, promoting the psychological compatibility and affective communication between teachers and students, and between students; secondly, it is helpful for overwhelming and eliminating students' physiological fatigue and psychological fatigue, improving students' learning efficiency and teaching effect; thirdly, it is helpful for maintaining normal order in education and students to successfully complete teaching tasks. The factors for constituting the psychological environment of education are very complicated, which mainly include:

Environment of human relation

Although learning is the individual's psychological activity, it is always under the influence of partners and teachers in a social environment to different extent, which thus forms the environment of human relation including relations between partners, and between teachers and students. The effectiveness of imparting information to students depends on harmony between teachers and students, just as the old Chinese saying says "Students like teachers' lessons as they like teachers." If teachers and students trust and understand each other, are intimate to each other, an easy, happy and living teaching atmosphere may be easy to form, which is helpful for communicating teaching information smoothly and teaching activity to proceed smoothly, thus improving learning efficiency. The relation between students in a class is also very important for teaching in classroom. Coordination, competition, argument, imitation, observation, judgment, and comprehension and so on influence students' achievements and concept.

Atmosphere in classroom

"Atmosphere in classroom is also the psychological atmosphere in classroom, and is mainly the sentiment and emotion of students in classroom, resulting from the interaction between teachers and students, and between students. Once formed, the emotion and sentiment will become a social pressure to influence students' attitude, action and learning effect." Teaching activity is held in class, and different groups have formed different psychological atmosphere in class according to their specifications and model of action; the psychological atmosphere is an important factor of psychological environment of education, besides, teachers' prestige and fame are important factors restricting classroom atmosphere.

Individuals' psychological factors

Individuals' psychological factors are important psychological factors exerting influence on teaching, and are presented as the influence of individuals' psychological development level, individuals' characters, motives, aspiration and anxiety on teaching activity. Students' emotional experience exerts direct influence on students' achievements and use of their abilities. Satisfaction, easiness, stable emotion can arouse their strong motivation to learn. On the contrary, lack of confidence, depression, panic and fear will exert direct influence on students' learning efficiency and use of their ability. In addition, students having different

characters have different attitudes towards learning. Accordingly, students shall be taught on an individual basis, and relevant teaching measures shall be taken to help students to use their positive factors, and it is an important factor.

66.3.3 Design Principles of Teaching Environment of Physical Education

Scientific creation and organization of teaching environment of physical education is one of the objectives of research into the teaching environment of physical education. In order to realize the expected education and teaching objective, the following principles shall be followed in respect of the teaching environment:

66.3.3.1 Objective

Teaching environment shall be created subject to the education and teaching objectives which are both direct and indirect. Direct education and teaching objectives are those specified in teaching programs, which are substantive, such as mastery of knowledge, training of skill, and development of abilities; indirect education and teaching objectives are the conditions for reaching the substantive objectives, and are also called tool-oriented objectives, such as arousing students' drive, cultivation of interest, emotional influence, unconscious exploration, stimulation enthusiasm and so on. Creation of teaching environment must be subject to the two objectives and the tool-oriented objectives are more important.

66.3.3.2 Richness

Teaching environment shall be created by using several stimulating ways which shall be non-repetitive as far as possible, in particular conveying the same information in a nonverbal manner to provide rich learning background for students. According to psychological research, human beings can only remember 15 % of knowledge they have heard; 25 % of what they have seen, and 85 % of what they have both heard and seen, Albert Mehrabian also summarized one formula: the total effect = 7 % by texts + 38 % by sound + 5 % by facial expression. Obviously, rich information stimulation is helpful for coordination of multiple feels, the simultaneous development of the left brain and the right brain and the improvement of learning effect.

66.3.3.3 Happiness

Teaching environment shall be created so that students may be emotionally active and happy. Students' learning course is also mixed with emotion. Emotion plays an organizing and destroying role in learning. According to research of modern psychological study, unhappy matters are unconsciously resisted by perception. Accordingly, easy and comfortable facilities indoors, active atmosphere, well-equipped safe and healthful outdoor facilities, creative and artistic teaching are general requirements for happiness.

In total, the three factors are the overall requirements, and essential factors of one organic entirety focusing on developing students potential for study and teaching environment. As Василий Александрович Сухомлинский said: "An education environment is necessary for reaching the expected result of education."

66.4 Conclusion

The concept of the teaching environment of physical education is defined as follows: the teaching environment of physical education is the combination of various objective conditions and subjective conditions necessary for teaching of sports education in schools, and includes physical environment and psychological environment.

The teaching environment of physical education consists of the physical environment and psychological environment. The former includes the natural environment of teaching, scale and number of students of a class, seat and queue arrangement and so on; the latter includes the relationship in schools, teaching atmosphere in classroom, individuals' psychological factors and so on.

Scientific creation and organization of teaching environment of physical education shall be subject to the principles of objective, richness and happiness.

The teaching environment of physical education can influence students' cognition and emotion, drive to learn, behaviors, students' learning effect and efficiency.

Environment is a critical factor of teaching activities. The same goes for physical teaching. And physical teaching is an important subject of modern physical teaching's theories. We should pay enough attention to environment's influence on physical teaching system and take active actions to educate a comfortable physical teaching environment.

In the end, I suppose: 1. schools should strive to provide enough physical place and facilities, and the facilities' measure should fit for the demand of students' physical growth. 2. Make the physical place neither vacant nor crowded. 3. Build up a harmonious interpersonal relationship in the process of physical teaching, cultivate students' physical awareness, develop good physical tradition and atmosphere, and create the tridimensional physical network including school, home, and society.

References

1. Zhang Z (2005) P.E. teaching theory. Scientific Press 3:43–48
2. Yao L (003) Constituents, function and design of teaching environment of physical education, May 03:38–44
3. Zhai S (2004) About the relation between teaching environment and teaching system of physical education. Hubei P.E Science and Technology, Hubei
4. Zhou W (2012) About creation and optimization of teaching environment of P.E. Research into P.E. Science, 04:40–45
5. Xin Zhang (2007) Research into the teaching environment of P.E. Shandong Normal University 4:18–24

Chapter 67

SWOT Analysis and Development Strategies on the Chinese Wushu

Hongchang Li and Hongyu Li

Abstract Wushu is a traditional national sport which has the function of attack and defense, fitness, entertainment and appreciation, and it is a treasure of Chinese culture. With the SWOT analysis methods of modern management, this paper systematically analyzes the development of Chinese Wushu about the strengths, weaknesses, opportunities and the threats, and proposes the idea of development of the Chinese Wushu.

Keywords Wushu · Development · SWTO analysis

67.1 Introduction

Chinese Wushu has a long history in Chinese Folk for thousands of years as chinese nation's fine cultural heritage. It is subject to the subtle influence of Chinese classical philosophy, aesthetics, military studies, ethics, medicine etc. [1]. Chinese Wushu have many social functions such as fitness, self-defense, spiritual cultivation, sports and entertainment [2, 3]. Chinese Wushu have a unique movement pattern, characteristics, many martial art, boxing categories and Wushu theory. Wushu not only loved by the masses in china, but also by many countries people in the world.

SWOT analysis is also known as trend analysis. This approach can be taken into account Internal and external conditions which is closely related with the object of study, by the way, We can work out development strategies, plans and measures.

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SWOT analysis was first proposed by Harvard Business School professor Andrews in the early 1960s. The explanation of four letters SWOT is this: S stands for strengths or advantages (Strengths); W stands for weakness or weaknesses (Weakness); O is on behalf of the external environment opportunities (Opportunities); T is the external environment threats (Threats). SWOT analysis is widely used in strategic research and competitive analysis, It has become the importance analysis tools about strategic management and competitive intelligence. This paper analyzes the development of Chinese modern Wushu from the overall strategic perspective, to promote Chinese Wushu into the international sports through the economics research methods [4, 5].

67.2 The Advantage of Chinese Wushu Development (Strengths)

67.2.1 The Chinese Government and State Leaders Support Wushu

The first day of the new China was founded, the development of Chinese Wushu business was referred to the new agenda of sports work, the former National Sports Commission also has established Wushu subjects, Wushu place, Wushu Research Institute, College of Physical Education set up Wushu subject to train Wushu expertise. The leaders of the Communist Party of China, Zhu De, Liu Shaoqi, He Long have done an important instructions to the continuation and development of the Wushu. Comrade Mao Zedong and Deng Xiaoping put forward the call of the practice Taijiquan for the people's health, And they often practice this sport. Especially Comrade Deng Xiaoping's inscription "Taijiquan is good" brought a boom of practicing Taijiquan at that time. In 2007, Premier Wen Jiabao had a morning exercise in an early morning with the local people in Japan when he visited Japan, and Premier Wen Jiabao practiced a Taijiquan, This move has been the unprecedented publicity effect to the Taijiquan [6].

67.2.2 Wushu Has a Variety of Functions

Wushu has not been eliminated by history in China for thousands of years, the facts show that the Wushu has many positive effects to society in different historical periods, and it shows a strong vitality. Wushu features include: a fitness function, combat function, watch the entertainment function, the educational function and economic function. With the increase of international sports exchanges, People around the world enhance the understanding of Wushu function. They began to learn Wushu, practice Wushu, watch Wushu competitions and performances [7-9].

People find that Wushu is not only the movement of an exercise, but also a kind of spiritual products and an enjoyment consumer goods. Foreign lovers of Wushu has become more and more, This also shows that the international community need and desire of this spirit products of Wushu. A variety of functions of Wushu provides a solid practical foundation for the development of Chinese wushu, and lay most convincing theoretical foundation to the development of the international sports field.

67.2.3 The Cultivation of the Wushu Professionals

In 1984, the State Council formally established that wushu was a discipline, and approved to recruit graduate, and approved to recruit doctoral students in 1996. In 1997, this discipline was officially confirmed as Ethnic Traditional Sports, and that made the academic status of the Wushu get to a new height. At this point, the martial art discipline can develop the highest level of education professionals like other general disciplines. At present there are about 16 colleges and universities which offer the Traditional National Sports. The growth of the Wushu professionals promote the stability and expansion of the academic team, Wushu theory has been greatly developed, and the construction of the Wushu subjects form a good development trend.

67.3 The Disadvantage of the Wushu Development (Weakness)

67.3.1 Lack of Professional Personnel to the International Promotion

At this stage, China has not yet professional talent who can spread the Wushu to the international. The Chinese people who engaged in the Wushu promotion are mainly expatriate coaches, sports school graduates, retired athletes and coaches and sports enthusiasts. These people spread Wushu to the international by virtue of their own sports experience, But they are not professional Wushu promoter, they cannot show the most brilliant aspect of the Chinese Wushu in the world. Professional Wushu promoter must have a high technical level and profound traditional culture.

67.3.2 The Lack of Strong Support of Social Intermediary Organizations

The intermediary organization is an important force which can promote the Wushu competition market to become mature; it is a further division product of the Wushu market. Intermediary as a service organization with expertise and extensive experience has a lot of information about the market supply and demand, it is familiar with the various laws and policies, understand the multi-stakeholder needs, and can stand on the height of the collaboration to look at the problem.

But for now, the Wushu intermediary is less well known and blindness on the operation of the market. Because the Wushu intermediary is too great importance to relations with government departments, not pay attention to the relationship with the main players in the market, so its function does not work properly, and the market operational efficiency of the Wushu competition is greatly reduced. The result is that all kinds of Wushu competitions cannot be promoted and organized and the effect of the competitions fail to achieve the purpose and influence.

67.3.3 Wushu Techniques Are Not Standardized and Unified

Chinese Wushu has a lot of martial arts, and there is not unified basic tutorial, which became the main reason for Wushu is still difficult to enter the education system. In 1986, the statistical results about national Wushu categories show that there are about 129 kinds of boxing which are more influential and Systematic. Even there are several technical branches in the same boxing. It is very difficult to inherit and develop Wushu on an international scale because of its Confusion.

67.4 Opportunity for Wushu Development (Opportunities)

67.4.1 The Demand for of People's Lives

The Wushu is facing a golden opportunity to spread it to the international after the successful transformation of China's economic system and the trend of globalization. A potentially huge consumer groups and the market have been formed with the sustained and rapid economic development. With the development of China's economy, people will weaken the demand for substance consumer products, People need more service consumer products which are directly related to people's health and quality of life. The increasingly rich market of sports competition expand the ranks of the ornamental sports consumers in Chinese sports market. Sports are more and more favored by people, the awareness of life-long sports is gradual strengthening, sports consumer demand is increasing, and sports

consumer demand is increasingly diverse, specialized, standardized. Wushu is loved by people as a important project in national fitness campaign. A lot of people practice Wushu, and Wushu has been an integral part of their lives.

67.4.2 A Broad Space for Wushu Development

In the end of the twentieth century, the Wushu Management Center of State Sport General Administration set up the scientific research base to research that how the Wushu can become Olympic event for many years. In 2001, Beijing successfully won the right to host the 29th Olympic Games, this is a great good news to Wushu workers and lovers, To let Wushu become an Olympic event is the desire of all people interested in Chinese Wushu. Although Wushu did not become an Olympic event after a long and difficult effort, It finally has the opportunity to debut during the Olympic Games in Beijing, but the identity of the appearance is a very special -ad hoc project.

Wushu is neither a formal event, nor is the performances, and is named as “Wushu competition in Beijing Olympic Games”. There are 10 medals distributed in the routine competition without Sanda. Wushu competition medals are different from the other 28 official events, that thing is a milestone in the Wushu development. Chinese Wushu will eventually enter the Olympic Games in our unremitting efforts.

67.4.3 A Strong Demand for Wushu Development

After joining WTO, China expand the communication and contact of domestic and international markets, and accelerate the opening of China’s Wushu industry. As people’s living standards improve, people will increase demand for the Wushu products, which not only reflected in the demand for Wushu physical fitness function, but also the strong diversification trend for Wushu products demand. With the large number of Chinese Wushu films released in foreign countries as well as the kung fu star Bruce Lee, Jet Li, Jackie Chan have attracted a lot of international audiences, more and more films added elements of Chinese Wushu. Substantial international audiences are deeply interested in Wushu, and continue to join the ranks of Wushu.

67.4.4 The Wushu Will More Widely Face the World

The Wushu are unmatched by any sports on fitness, self-defense, self-cultivation, health care, entertainment from the point of view of national culture and sports

blend. Many foreigners come to China to learn Wushu with the interest of the Oriental Wushu culture, and China also send some Wushu professionals abroad to perform and teach, this has formed a wide range of East–West cultural exchange. In recent years, the competition rules of the competitive Wushu constantly improved, and the creation of the coaches and referee training courses, organization of international Wushu competition, the establishment of the International Wushu Federation, so that countries and organizations involved in an increasing number, not only in Asia, the Americas and Europe have gradually established the Wushu Federation and Chinese Wushu was more widely carried out.

In 1994, Wushu was formally accepted by the international single sports leagues. The Wushu is very comprehensive from a fitness point of view, Wushu is also more abundant connotation, the practice is not the limit of venues and equipment, simple activities, easy to carry out and publicize therefore, and the Wushu will also be more widely to the world.

67.5 The Challenge in the Process of Wushu Development (Threats)

67.5.1 Foreign Martial Art Competition

With the economic globalization, the West culture and ideology gradually penetrate to China, This will affect the Chinese Wushu which embodies the basic meaning and spirit of Chinese traditional culture. Now we are faced with a not be optimistic and very grim reality, From Japan, karate, kendo, and South Korea Taekwondo is very popular recently in China, has gradually become a youth fashion movement. The Karate and Kendo in Japan and the Taekwondo in South Korea are very popular recently in China, and have gradually become a youth fashion movement. These martial art projects from abroad began to compete for the market with Chinese Wushu, and gradually gained recognition and favor of the majority of young people.

67.5.2 Athletics Is Not Thorough

In 2008, Chinese Competitive Wushu was shut out of Olympics, that is a painful historical reflection, so we should re-examine the defects of competitive Wushu. Secularization and specialization is parallel in the modern world sports culture. Specialization is implemented mainly through some quantitative indicators which is the pursuit of a fair scale on the basis of quantization. Today, competitive Wushu competition results are difficult to quantify precisely, the game is easy to lose a fair. Therefore, there are many way to go for the Chinese competitive Wushu if it wants to become international competitive culture.

67.5.3 The Reform of the Wushu

The reform of the Wushu has been focused on the competitive sports, while ignoring the development of the mass Wushu. For a long time, the Competitive Wushu and Sanda are two leading brands of Wushu, which resulted that many excellent traditional Wushu schools are free in the fringe of the Wushu development. Competitive Wushu is further away from the Wushu fighting, it moves more like gymnastics and dance, so that the majority of young people are unable to learn and explore the real Wushu martial connotation. The Offensive and defensive combat actions in the Wushu today are reflected in a fighting that is processed, These actions are very complex unlike taekwondo that is easy to learn, which increases the high degree of difficulty to those who learn Wushu, so that they give up and change to learn those easy projects. These situations need some reform to reverse.

67.6 Wushu Promotion Strategy

As soon as possible to formulate the relevant technical standards of the Wushu to plan and organize, to form a promotion model system with Chinese characteristics, so that we can promote the uniform standards to the country and the world.

To formulate Wushu technical standard and determine the Wushu heritage and the genre, and write tutorials according to these standards. Wushu need be innovative in teaching methods and curriculum to integrate into the teaching of school sports. We can choose the most representative boxing from numerous Wushu to compile a simplified routine.

To set up a column about the popularity of Wushu knowledge through the media, hold Wushu exchange activities, and establish a Wushu Association in school. Wushu should take the initiative to go abroad to teach Wushu techniques. Wushu must be innovative in teaching methods and curriculum. To strengthen the publicity of Wushu etiquette and Wushu culture in the teaching.

To speed up the development of the Wushu industry, develop the system of protection of the Wushu, and actively participate in domestic and international sports competition in the market. To develop a comprehensive talent who should understand the Wushu and proficient in modern business management.

To set up a special Wushu promotion agency. The inheritance of Wushu for mass is spontaneous rather than conscious though the mass is main. If we want to make the Wushu be for wide dissemination and promotion in China and world-wide, we should give full play to the duties of the Wushu Research Institute to develop the Wushu. And to change the concepts and ideas which are funded by the state that formed under the planned economic system, to establish a new philosophy of “people-oriented” in order to promote the promotion and sustainable development of the Wushu as a fundamental objective, we should put the

popularity, market and industry of Wushu as the primary means to quickly and effectively increase the Wushu practitioners and the number of visitors.

To learn from the promotion and development experience of Taekwondo. Taekwondo as an Oriental Traditional National Sports which is similar to the Wushu become an Sydney Olympic Games official event in 2000 through the efforts of the South Korean government and people, using the rules of the original Olympic events setting.

Taekwondo was as a demonstration project in three Olympic Games that is 1988 Seoul Olympics, 1992 Barcelona Olympics and 1996 Atlanta Olympic Games. There are a lot of experience to learn about Taekwondo enter the Olympic Games, which mainly include: the establishment of a powerful specialized agencies; progressive and scientific domestic and international spread; easy entrance; combination of playing and practicing; based on the local community and schools; the objectivity and operability of criteria. These experiences are “Achilles heel” of Wushu dissemination, Taekwondo carry out the transformation in accordance with the Olympic Games or the modern competitive sports mode in order to achieve the international spread, to repair its “shape” and did not lose its “God”. Wushu can do this in theory.

The development of Wushu can not rest on its past laurels, but should focus on the future development of the Wushu, and integrate into the mainstream of world culture with a positive attitude. On the one hand, we should recognize that the various advantages and concepts of Western sports culture provide us the reference of the Wushu development; On the other hand, we should question the Western sports starting from Wushu characteristics, and ultimately establish a scientific and rational structural system. Chinese Wushu only learn from the advanced concepts of Western sports to promote the sustainable development of the Wushu.

References

1. Dong Z (2007) Consideration on condition of Wushu industry development in china. *Sports Sci Technol Inst* 4:15–19
2. Liu H, Diao Z (2004) The discussion on training martial arts international promotion personne. *J Jilin Inst Phys Edu* 4:65–67
3. Qiu P (2001) A research on the status of the Chinese martial arts in the world sports. *J Tianjin Inst Phys Educ* 22:37–43
4. Yao Q, Liu J (2004) The analysis on the resources and the development of Chinese martial arts. *J Guangzhou Inst Phys Educ* 3:119–121
5. Liu J, Chen P (2005) Problems and countermeasures in development of Wushu industry in China. *J Wuhan Inst Phys Edu* 1:123–130
6. Li S (2007) On inheritance and development of Chinese traditional Wushu. *J Wuhan Inst Phys Edu* 41:40–44
7. Xin X (2009) Analysis of Wushu inheritance manners. *J Phys Edu* 16:105–108
8. Sun C (2010) Consideration on the transformation of martial arts from skill teaching to culture inheriting. *J Cap Inst Phys Edu* 22:89–91
9. Wang L, Yu D (2009) Difficult position and countermeasures of inheritance of traditional Wushu as intangible cultural heritage. *J Shanghai Univ Sport* 33:85–88

Chapter 68

Research on Sports Pragmaticality in Higher Education Reform

Mingchang Liu and Liuhe Wang

Abstract Making higher education reform as the starting point, this essay aims at exploring the era necessity of quality education reform, thus analyzing the function as well as status of college sports in the further reform of education. This essay expounded and proved that college sports is a combination of nurturing the body and nurturing the heart; it is one of the important methods which carry out quality education. It also served as a preliminary research on how to reform college sports education. By doing so, the development of its pragmaticality will be promoted under the higher education reform more perfectly.

Keywords Higher education · Quality education · Lifelong sports · Pragmaticality

68.1 Introduction

With the constant development of China's economy and the reform of science and technology system, with the modernization of economy, and with people's increasing educational requests, a reform in the field of education is imperative. Higher education is the bibcock of education, while college sports education is a significant part of higher education. It is the essential factor in the course of talent training. The development of the times provides conditions and power for higher education reform. However, it has also brought higher education reform unprecedented opportunities and challenges. Confronted with this situation, sports education appears extremely important. To better adapt to the need of higher education reform,

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college sports education must keep pace with The Times, must continuously research new problems, new cases, and must master the characteristics and laws of college sports education under the new situation.

68.2 The Era Necessity of Quality Education in Higher Education Reform

68.2.1 Definitions of Quality and Quality Education

Quality is a kind of relatively stable psychological quality formed on the congenital physiological and psychological basis, under the effects of education and social environment, as well as the knowledge internalization. It is a ideal combination of psychological, body, and a series of ideological and moral quality and characteristics. While quality education intends to cultivate persons of moral quality, of ideals, of knowledge and of disciplines, thus comprehensively cultivate persons of good physical quality, psychological quality, rich knowledge of science and culture, noble moral quality, excellent social practice ability and perfect personality. Accordingly, college quality education is a variety of education designed for college students. It helps lay a good foundation for these students to learn how to gain knowledge, how to be a real person, how to labor, how to keep fitness and how to live. By this way, it can help college students coordinately develop their moral quality, intellectual quality, physical quality and other qualities. Quality education is the comprehensive development of education. With its ultimate aim of promoting the overall development of personal qualities, it consists not only of individuality, but also of commonality. Mr Mao Zedong once said, “We must guarantee that the educated can get development in the moral education, intellectual education and sports education. Thus making them become socialist laborers with consciousness and knowledge.” Specifically speaking, college quality education is physical quality education, science and culture education and moral and character education, and puts cultivating college students’ innovative spirit and practice⁴ ability as its key point. Sports education itself is a significant part of quality. Sports education on college students can not only keep their mental and physical healthy and developing harmoniously, but also promote the students’ overall development by effective moral and intellectual teaching during the process of sports education.

68.2.2 Background of College Quality Education Reform

In the wake of the change of global politics and economic situation as well as the economic and social development of China, our nation’s higher education is facing constantly new problems. Mr. Jiang Zemin pointed out that, “To realize

modernization, our nation should have some first-class universities which own the world's advanced level. Universities like these should be cradles which train and bring up creative talents of high quality, should provide the scientific basis of the front to understand the unknown world, to explore the objectivity and to solve great issues human faces, should be the significant force that motive knowledge innovation and science and technology achievements, and then make them transform into real productive forces, and should be the communication bridge of our excellent ethnic culture and the world advanced civilization achievements." Likewise, Mr. Hu Jintao pointed out that, "We must try the best to nurture high quality talents, since high quality talents are important strength that decides the destiny of the country and nation, are strong backings to establish an innovative country. Malicious efforts should be put in order to improve the comprehensive quality. To achieve this goal, students have to learn the knowledge of science, to actively cultivate their behavioral refinement, to increase the knowledge accumulation, to actively strengthen moral cultivation, to exercise more to stay healthy and to foster good psychological quality, in order to really realize their all-round development. Malicious efforts should also be laid to improve the ability of practice, and accordingly students should actively participate in social practice." [1] Both two state leaders have put forward the requirements on college quality education, improve the comprehensive quality of college students, and thus make their contributions to richening and progressing our country. Meanwhile, the views of these two state leaders have guided the reform of higher education.

68.3 Functions and Meanings of College Sports in Strengthening College Students' Comprehensive Quality

The central committee of the communist party of the state council on education reform deepening comprehensive promotion of quality education decision pointed out that, "To carry out quality education is to carry out the Party's education policy. Improving the quality of the nation is a fundamental purpose, to comprehensively promote quality education and sports education is an important part of quality education." Quality education in college sports education mainly includes ideological quality, culture quality, ability quality, psychological quality and physical quality. "for the evaluation of function, we should change the one-sided social-only value or the one-sided subject-only value into the subject value which fully respect people under the premise of meeting the needs of social development so that make social value and subject value develop evenly and coordinately." [2] This value showed clearly that sports an important part of school education. Its main tasks are helping students master basic sports knowledge, skills and scientific theoretical approach of physical training. Thus, to improve college students' physiological and psychological function, in the mean time fostering

their noble moral sentiment, and their team spirits of solidarity and mutual assistance and so forth. As an effective way of quality education, it is a significant mean to carry out quality education. By sports teaching in classes and all kinds of sports matches, the improvement of college students' comprehensive quality can be effectively promoted. The former Education Secretary Chen ZhiLi once said, "school sports has not only important function in enhancing students' physical strength but also has distinct function in training students' indomitable fighting spirit and will, as well as the spirit of unity and mutual aid." Therefore, according to the characteristics of school sports, we must not adopt narrow thoughts to talk about sports in isolation. On the contrary, we should look it with a wider view, and thus to develop the function of sports. As an important part of school education, sports plays a vital role in improving on a full round of college students' comprehensive quality. Sports can help improve college students' comprehensive quality, give them healthy bodies. It also effectively works hand in hand with quality education, establishing a good foundation for training college students' all-round development. School sports teaching should organically unite moral teaching, intellectual teaching, aesthetic teaching and teachings of other aspects into each link of sporting activities. It should as well actively construct a sports course system which adjusts to quality education from the guiding thought purposes, methods contents and formats of education.

68.4 Problems the College Sports Education Should Pay Notice under Quality Education Reform

68.4.1 The Change of Sports Teaching Concept

School sports should focus on the healthy and all-round development of students' physical and psychological quality rather than only concentrate on students' physical fitness. There are distinctive differences between the college sports whose goal is to "cultivate the overall development of students" and the college sports whose goal is to "enhance the physical strength of students". The latter puts enhancing students' physical strength as its direct goal and neglects the long-term effect of enhancing students' physical strength and the life-time effect of sports. Consequently, a negative situation like this may occur: After leaving the campus and stepping into society, students will gradually move away from sports as without the pressure of taking sports examination. They also become far from sports and fitness gradually. College sports cannot ignore students' psychological factors and factors such as social adaptation. It must pay attention to set up a education concept which will improve students' comprehensive quality, It should lay the enhancement of students' physical strength as its long-term goal. It should not only start from the physical health of college students to build

students' sports awareness, ability and habits, etc., but also give full consideration to aspects of college students' physiology, psychology and social adaptation, etc., in terms of education contents and patterns for teaching and learning, college sports should stress sports' feature of life-time, social adaptation and the realization of sports' social functions. For this reason, college sports first needs change of education concept, and then selects sports teaching contents which are suitable for students from the point of view of social adaptation and psychology. College sports should also abandon the simple biological sports view and form a multi-dimensional one, viewing a person's body, emotion, thought, character, will and behavior as a whole. With its ultimate goals to realize college students' highest life value and roundly improve their quality and ability, college sports should change from "cultivate the body" to "cultivate the person", change from simply pursue college students' external technical level and physical strength to pursuing a comprehensive and coordinated development of students' body and mind, thus breaking down the former teaching system that regards the imparting and mastering of sports technology as the main line and setting up a scientific and reasonable new teaching system which takes the practice as the means, completely accomplishing the goals of enhancing physical strength, imparting sports culture, fostering students' awareness and ability of taking life-time sports and fitness, and the will of sticking to exercise. By this way a helpful foundation will be laid to make students engaged in life-time sports and fitness. The change of college sports teaching thought will further broaden the connotation of physical education, and embody the final value of sports teaching with life, future and sociality.

68.4.2 Enhance Students' Extracurricular Sports Activity Managements; Strengthen the Ligament Function of College Sports

Extracurricular sports activities are continuation and effective supplement of PE classes, are sports activities college students contact most except for PE classes, and the real embodiment of students' interest in sports. If schools perform the correct guidance, attention and support, a better result will be gained. As for these extracurricular sports activities, the schools' related departments should not be only confined to provide equipment, courts, or the insurance of time for students. They need to focus on many angles such as students' mind and physiology, society and education, and give full consideration to them. Not only should they give guidance on technique, but also help students establish sports organizations of different scales and make them scaled, systemized and habituated. They should hold lectures about sports knowledge, sports injury and rehabilitation as well to provide the most effective help for students as regards to extracurricular sports activities. "College sports are required to build a relatively solid bridge between

primary and secondary school sports and social sports. College sports should continue the institutionalized school sports education and at the same time to reinforce the integration with social sports on the account of the lifelong sports awareness, habits and ability a student should have in the future. Thus, the transitional task of passing the mandatory school sports education to the autonomy social sports education.”[3].

68.4.3 Enhance the Construction of Campus Sports Culture Environment

Sports culture environment influences students with a special culture atmosphere. Students are always being imperceptibly influenced. It can be say that sports culture environment has functions of nurturing, guiding and encouraging students. It is a indispensable part in cultivating a sound personality. During the formation of students’ sports awareness and sports value, the influence of culture environment is of very important function. “If taking physical exercise for an hour every day, we will be able to work 50 years for motherland’s health”. This is a sound propaganda of campus culture. Liu Bin once said in one of his essay that,” contemporary college students are the main force of the spreading of sports culture. They not only preserve, transfer all excellent sports culture in human history, but also create advanced culture which keeps pace with The Times by selecting and integrating those valuable culture elements “[4]As for cultivating campus culture, schools can make some billboards which related to the very sports projects in sports fields and other places students always go. These billboards include essential technology, the value of physical exercise, safety precautions, etc. the gym should correspondingly set up a fitness-propagandizing corridor to demonstrate contents like the influences of exercising towards human body and mind, the requirements and functions of warming-ups of sports activities, the normal value of body shape of each age. On the other hand, full play should be given to the education functions of PE classes. In sports teaching, the teacher’s leading role should be given full display. The teacher is to introduce the rich sports history and culture to students to elevate students’ interest towards sports and train students’ sense of physical exercise. The teacher should also form a deeper understanding of the functions of school sports education on cultivating and promoting a person’s comprehensive development. And only by practice, and by deepen the understanding and affection towards sports can students truly improve their sports cultural literacy.

68.4.4 Strengthen Student Association Management; Effectively Promote the Development of College Students' Sports Community

College sports community is a sports organization set up spontaneously by students with sports specialty to meet sports needs of different levels and from different aspects. As Liu Jie said, "Sports community is an important part of college student associations, is an important carrier of school sports, campus culture and the product of campus culture. It plays a vital role in the construction of campus culture. The activities which held by the sports community can effectively help school sports cultivate students' lifelong habit of taking physical exercises. It is a crucial way to implement quality education." Sports community is of great impacts on both construction of campus sports culture and school sports services. College sports community also does many a job in giving off students' interest and specialty, in improving students' sports technology and organization and management ability, in alleviating learning tension, in expanding students' scope of communication, in training students' lifelong sports awareness, in promoting the construction of campus culture, and in boosting the development of school sports education. Therefore, related management and guidance should be strengthened, associational activities further regulated, various kinds of rules and regulations improved, an effective incentive mechanism established. It also a must to increase the supervision of the sports clubs, to emphasize on the cultivation and development of the sports clubs, to improve the quality of sports organization' cadres, and to select a batch of club leaders who own sound organization and coordination ability. Meanwhile, the school's physical education department should give powerful guidance to the sports clubs, and offer necessary fields, funds, technical support, etc.

68.5 Conclusion

College sports are an important part of higher education. It plays a vital role during the process of quality education reform. It is of crucial effect during the overall development of students' physical and psychological quality. The formation of a healthy physical strength, the cultivation of cooperation awareness, the shape of a strong character, and the training of interpersonal skills can all find full expression in sports. Therefore, only by continuously strengthening the reform and construction of college sports education can the reform of higher education be perfectly promoted.

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References

1. Hu J (2008) Speech in Beijing University in 2008. www.xinhuanet.com
2. Pan E (1998) The transformation of higher education thought stepping into the twenty first century. Liaoning Higher Education Research
3. Li L, Peng Q (2010) Analysis on China's higher education in the new period and the demands of sports development towards college sports. 06:86–87
4. Liu B (2006) Sports culture inheritance in universities sports teaching. 5:14

Chapter 69

Study on Interactive Division Teaching Method in Sports Dance Compulsory Class of Physical Education

Hua Tan and Wanfeng Xia

Abstract Sports dance was introduced into China for not a long time, and the teaching research of it is developed slower than other sports arts. Therefore there is much necessary for us to take further study of it. Using the methods of reference, the questionnaire investigation, the data summarization and so on, made the teaching test in the compulsory class of the sports dance class of North China Institute of Science and Technology. After comparing the research results with the effects of traditional teaching method and analyzing its effects of students' relations, confidence and teaching result, it turns out that the interactive division teaching method is superior to the traditional teaching method and will make an effective improvement in teaching result of sports dancing.

Keywords Sports dance · Interactive division · Cooperative learning · Self-evaluation

69.1 Introduction

With the deeper reform in physical teaching curriculum, the reform of physical teaching method has become the core problem in physical teaching curriculum reform. The research of teaching method is a comprehensive problem, and it has a positive conformity effect in the reform of physical teaching course, teaching method, and teaching structure [1].

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“Interactive division” teaching method is a new teaching method which is developed on the basis of Stratification level teaching theory and cooperative learning method. “Interactive division” teaching method in sports dance takes the hierarchy as the main course, it is possible and responsible for all the students; It takes the small group cooperation as the teaching form; and its final point is to develop their ability of unity and cooperativeness, to improve their purpose and interest of learning sports dance, and to develop their positivity. It is teaching methods which can help the students make a progress.

69.2 Research Object and Method

Forty eight students were chosen from the students of 2009 undergraduates in North China Institute of Science and Technology as samples, and divided into two classes, each of which has 24 students, and the number of boys and girls is the same.

The methods in this paper uses consist of literature, questionnaire and mathematical statistics, logic analysis, and teaching experiment.

69.3 Conclusion and Analysis

69.3.1 The Design of the Questionnaire

After having read the relevant teaching materials about sports dance teaching, we design a questionnaire with 14 questions and a Self-confidence assessment questionnaire with five questions in September, 2009. The questionnaire’s reliability has been tested with split half method. According to the Flanagan formula ($r = 2[1 - (SDa^2 + sDb^2)/SDt^2]$) [2], work out that the reliability coefficient of this investigation is 0.893, and it is pretty high. The questionnaires are sent to the students and get it back at sight, during the beginning of February, to the middle of July, in 2010. The total number of the questionnaires was 48, and all of them were got back, and the recovery was 100 %. The total number of valid return was 48, and the valid usable return rate was 100 %. The total usable rate was 100 %.

69.3.2 Teaching Experiment

The Design Method of The Experiment: Examine the differences between the groups through comparing design.

69.3.2.1 Experiment Time and Objects

Samples selecting before the experiment: To make sure the initial condition of the experimental group and the control group were the same, made a technical evaluation of Waltz bronze routine (They had learnt it in their first college year, and they had taken the technical evaluation) for the 8 sports dance classes (total 246 students) [3, 4]. All the performances of the test would be taken into statistics, and found out the 24 pair dancers who had got similar score, and then tested them again. The result showed that the two groups had the same initial condition. Picking one group randomly as the experimental group (24 students), and the other as the control group (24students).

The first stage of the formal experiment: The experiment was taken in the 2009 sports dance elective classes of North China Institute of Science and Technology during March, 2010 to May, 2010. Divided the selected 24 pairs students into two groups randomly, and picked one group as the experimental group (24 students). Using the “Interactive Division” Teaching Method to organize the basis course of the sports dance for the experimental group, and the content of the course is the silver routine of Waltz; The other group was the control group, The basis course with the traditional teaching method (Teacher explain-demonstrate-students practice-teacher correct the wrong actions-consolidate and improve), the teaching content was the same as the experimental group. In order to control the experimental condition more strictly, and to avoid the impact of other elements of subject and object, and to guarantee the objectivity of the experiment, the experiment strictly control the experiment factors, The two classes of this experiment had the same teaching condition, the same teaching environment and the same teacher (I taught the two groups), except for the teaching method choosing.

The second stage of the formal experiment: The experiment was taken in the 2009 sports dance elective classes of North China Institute of Science and Technology during March, 2010 to May, 2010. The second stage of the formal experiment had the same groups with the first stage, as the second stage was the continue of the first stage. choosing the “Interactive Division” Teaching Method to organize the basis course of the sports dance for the experimental group, and the content of the course is the golden routine of Waltz; the other group (the control group) took the basis course with the traditional teaching method (Teacher explain-demonstrate-students practice-teacher correct the wrong actions-consolidate and improve), the teaching content and the teacher was the same as the experimental group.

69.3.2.2 The Evaluation Method of the Experiment Result

A technical evaluation group was found to learn the standard of the technical evaluation of sports dancing, which would unify the standard and decrease the evaluated error [5-8]. Unified standard, same method and same technical

evaluation group were used in the experiment from the start to finish. (The technical evaluation group did not know which the experimental group was before the experiment began).

69.3.2.3 Check the Experimental Effect Index

The Technical Evaluation

A technical evaluation of bronze routine for the students was made before the experiment to find out the students who had less difference, and then divided them into experimental group and control group randomly. Proceeding the technical evaluation of bronze routine and golden routine of Waltz for the two groups after the experiment, which was to checkout the impact of the different teaching methods for the students.

Self-Confidence Evaluation

This paper uses the technical of Bandura (1997)–Self-confidence test method, to test the students’ self-confidence before and after the experiment. The method is that the students made a score on a rating scale which consists of five topics relative with sports dancing technical actions, and their self-confidence would be measured with quantitative value. The number range are from 0(no self-confidence) to 100(strongest self-confidence). Then added up the five scores, and got an average number by dividing the result and the final result was the self-confidence value of the student. To make sure the reliability of the evaluation, pick randomly over half of the samples to retest their self-confidence a week after the former test. Using the “Product-moment correlation coefficient” to make mathematical statistics for the two tested values, and the correlation coefficient was 0.941, which was proved to be very notable. That is to say that the two tests have a highly relativity and reliability.

69.3.2.4 Contrast of the Two Groups of Students

Contrast of the Technical Level of the Two Groups of Students

Table 69.1 shows that early in the experiment, the two groups of students had no significant difference at duration and basic rhythm, body line, whole action, rhythm expression, and footwork skills in their technical evaluation of Waltz bronze routine. This state clearly that the two groups had the same technical level, so that the division was reliably and there was comparability between the two groups. Table 69.2 show the test result of their technical evaluation after a period of teaching experiment. The result shows that the two groups had significant

Table 69.1 The technical evaluation table of Waltz bronze routine of two groups before the experiment

Stage	Test Index	Value	The control group $\bar{x} \pm s$	N	The experimental group $\bar{x} \pm s$
Before the experiment	Duration and basic rhythm	10	8.3417 \pm 0.5208	24	8.4458 \pm 0.54372
	Body line	10	8.6833 \pm 0.30740	24	8.7250 \pm 0.37096
	Whole action	10	8.0958 \pm 0.55754	24	8.3167 \pm 0.56850
	Rhythm expression	10	8.0792 \pm 0.56104	24	8.1417 \pm 0.56562
	Footwork skills	10	7.8250 \pm 0.79359	24	7.8083 \pm 0.67625
	Total score	50	41.437 \pm 2.62642	24	41.02 \pm 2.54341

Table 69.2 The technical evaluation table of two groups after the experiment

	Test Index	Value	The control group $\bar{x} \pm S$	N	The experimental group $\bar{x} \pm S$
The first stage	Duration and basic rhythm	10	8.4250 \pm 0.52108	24	8.9875 \pm 0.55975
	Whole action	10	8.7833 \pm 0.34850	24	8.8667 \pm 0.31300
	Body line	10	8.2333 \pm 0.53703	24	8.5792 \pm 0.51413
	Rhythm expression	10	8.2292 \pm 0.55363	24	8.7792 \pm 0.53485
	Footwork skills	10	7.9667 \pm 0.69449	24	8.2250 \pm 0.66741
	Total score	50	41.637 \pm 2.474888	24	42.937 \pm 2.32188
The second stage	Duration and basic rhythm	10	8.5833 \pm 0.48871	24	8.8500 \pm 0.53161
	Whole action	10	8.9083 \pm 0.30775	24	9.0083 \pm 0.31885
	Body line	10	8.3167 \pm 0.51047	24	8.7958 \pm 0.44573
	Rhythm expression	10	8.5500 \pm 0.51752	24	8.9917 \pm 0.44027
	Footwork skills	10	8.0042 \pm 0.66886	24	8.6375 \pm 0.60203
	Total score	50	42.3625 \pm 2.23875	24	44.5000 \pm 1.95693

difference that the experimental group had better sense of duration and basic rhythm than the control group.

Contrast of the Self-confidence of the Two Groups of Students

Self-confidence evaluation was conducted for the experimental group and the control group before and after the experiment. The result showed that the two groups of students both had stronger self-confidence in varying degrees as their improvement of skills of sports dancing. However, the experiment group had showed obviously stronger self-confidence than the control group during the class. This prove that the “Interactive division” teaching method have an active effect on cultivate the students’ psychological quality when they have sports.

69.4 Conclusion

The result of teaching experiment indicate that compared with the traditional teaching method, using the “interactive division” teaching method in the sports dancing technical teaching can get a better teaching effectiveness.

Using the “interactive division” teaching method in the sports dancing technical teaching can better cultivate the students’ solidarity cooperation spirit and their collective sense of honor. “Interactive division” teaching method is more suitable for the students’ psychological demands as it better combines the leading of the teacher and the subjectivity of the students.

Using the “interactive division” teaching method in the sports dancing teaching can improve the students’ self-confidence and their ability to communicate.

References

1. Xue Y, Zhang A (2004) Education. Hebei Science and Technology Press
2. Fan L (2001) Sports education teaching theory. vol 2, issue no 4, People Education Press, Beijing, pp 58–64
3. Zhou D (1992) Sports scientific research, vol 3. Beijing Sports Institute Press, pp 14–20
4. Ceng F (2005) The sports dance athletes scientific selection. People’s Sports Press 22(1):392–399
5. Li Z (2004) Research on sports dance present situation and the countermeasure. J Beijing Sport Univ 2(3):20–25
6. Liu G (2005) Research on sport dancing effect on body fat. J Wuhan Sports Inst 10(10):290–297
7. Deng J (1999) Sports dance characteristic. J Chengdu Sport Univ 1(2):192–194
8. Li L (2003) Discussion on the value of sports dance and the necessity of its opening in universities. J Beijing Sport Univ 5(6):29–35

Chapter 70

Multifunctional Swimming Strokes Assistantship Design

Tie-xiong Zhang, Hong-mei Wen, Ting-ting Long
and Zheng-ping Wan

Abstract Applying principles and reverse thinking methods in such subjects as sports biomechanics, geometry, it aims to design a multifunctional swimming strokes assistantship device used for learners. It has multifunction such as learning assistantship on water, water leisure, swimming race in dragon boats and assistant learning on the land. The device is a kind of perfect auxiliary equipment currently in the functions of swimming teaching, water leisure and so on, making up for the deficiency of the traditional teaching methods, and improving teaching efficiency. Also, it enriches and develops the aquatic sports auxiliary equipment, with good promotion and application values.

Keywords Multifunctional swimming strokes assistantship design · Design · Application research

70.1 Introduction

At present, swimming beginners generally choose life buoy, the auxiliary equipment life jackets for learning and leisure in water, and they all have in common, which is all set, and put them on, have prevent swimmer sinking role, and can make again the swimmer head dew on the surface, and to keep the swimmer's breath, for swimmers create water learning swimming action and leisure conditions [1, 2].

But in the strokes, auxiliary teaching and learning function Hugh close all have certain limitations. Therefore, in order to solve the swimmers in troubled learn all kinds of strokes and water recreational equipment is the lack of strong, for swimming

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beginners overcome fear of drowning fear and safety, relaxed, short-term learned to swim create conditions. Based on teaching practice and exploration for the years, using the reverse thinking method, design the multi-function strokes student device. This design has changed the traditional wear in the water of the people, wear bathing suit and life buoy for leisure, sports and learn all of the way of strokes, breaking the people's traditional thinking inertia and mode [3]. The beginners in smooth pitching learn all kinds of strokes on the instrument, safe and convenient prone, seat in a multi-function strokes the student on leisure, sports and entertainment, enrich and develop the aquatic sports auxiliary equipment, and it has a good promotion and application value.

70.2 Multifunctional Swimming Strokes Assistantship Device Design and Application Methods

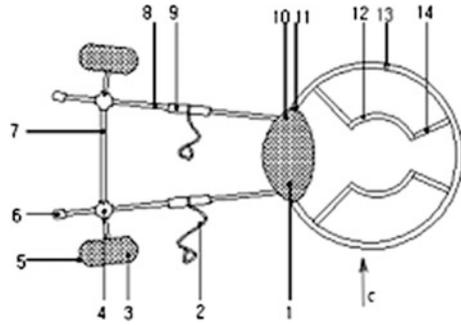
70.2.1 Design Principle of Multifunctional Swimming Strokes Assistantship Device

This design USES sports biomechanics, sports training study and geometry of the subjects such as principle and reverse thinking method, according to determine the geometry three a plane (enhance the stability), design three elliptic airbags, card buckle marbles type link rod, at the same time, the breaststroke strokes of learning through the limit of the slot design, according to enforce its correct action line to learn and practice [4]. Student is divided into: elliptic airbags, breaststroke arms stroke ways, card buckled elliptical marbles type connection rod three parts. It basically is to bring the swimmer in practice and the learning process smoothly to float in horizontal plane, lie supine, learning all kinds of strokes arm, leg ministry, breathe for different stages of the decomposition, complete technical movement. In the study, such as when the backstroke the freestyle stroke tear down the multi-function strokes in front of the student stroke elliptic way and card buckle marbles type coupling bar after, can learn the freestyle, backstroke, strokes. Its design clever place is connection for the marble type card buckle coupling, demolition, the outfit is very convenient.

70.2.2 The Structure of Multifunctional Swimming Stroke Assistantship Device

1) three oval air tightness to buckle 3) 2) the connecting rod marbles type card buckle activities socket 4) the connecting rod 5) link rod 6) slide set of 7) marbles type card buckle the connection box 8) Stroke elliptic round within the tao 9) circular ellipse stroke elliptic way round the 10) within the u-shaped stroke elliptic way limit slot (Fig. 70.1).

Fig. 70.1 Structure of the multifunctional swimming stroke assistantship device



70.2.3 The Function and Application Method of Multifunctional Swimming Stroke Assistantship Device

Multifunctional Swimming Stroke Assistantship Device enables practitioner float on water smoothly, from the equipment structure to learn all kinds of strokes, the teal three air provide a stable for beginners of plane and the characteristics of the balance, solve the difficulty in the water balance and to study on the surface of the recumbent problem [5], to overcome swimming beginners' fear and prevent the occurrence of choke water have the positive role. Especially the breaststroke beginners, the student to breaststroke arms and legs move a movement play a standard role, the breaststroke arms, legs, and the movement of the curve track to beginners provide reasonable support, make beginners technical movements in U shaped arm elliptic limiting grooves are constrained, and to enforce its in the correct action line to practice, solve the didn't swim in the water technology action learning support equipment, it is the current of the research innovations.

Multi-function strokes the student can be used as auxiliary training equipment breaststroke on land, in the course of teaching can be more intuitive, also easy to teachers guide and error correction, be helpful for beginners master correct technical movement on land, shorten the transition to the water in the practice time.

Pull down in front of the multifunctional swimming stroke assistantship device elliptic way and the coupling and can be used for the freestyle, backstroke, action learning stroke and correct the mistakes movement.

Leisure, entertainment function: multi-function strokes the student users can lie and sit in the instrument to enjoy the happiness of the floating, it is safe, stable. (The equipment can pull down; also don't open multi-function strokes in front of the student stroke elliptic way).

Water Dragon Boat Festival function: multi-function strokes student users can sit in the equipment to practice single paddle boat, also can be sit it to practice single paddle boat and fitness, also can lay down, sit in the equipment of the single dragon boat crossing, fitness and leisure. (pull down multi-function strokes in front of the student stroke elliptic way).

Water entertainment: each person a multi-function strokes in the financial aid device can be a variety of water game, leisure, entertainment. Such as: water basketball, volleyball and so on. (Pull down multi-function strokes in front of the student stroke elliptic way).

70.3 Object of Study and Methods

70.3.1 Object of Study

In 2009, take Hunan science and technology university has ten teaching classes and total 473 people as the object of study, 1–5 classes as experimental classes, 6–10 as comparative classes. Random in experimental classes and comparative classes can't swim students in comparative experiments, including 47 experimental classes and comparative classes 42 people. The quality in the body before experiment: 50 m run, standing long jump, seat bottom bend test, the body quality test scores is not significant differences, indicates that the experiments sample effective.

70.3.2 Object of Methods

Teaching experiments, the study contents: breaststroke, class: 16 h, for four hours every week. Experimental classes students use multifunction strokes to practice, which in comparative classes students practice using the traditional method, the instructor is must be with 2 years or above experience in teaching, an associate professor of rich.

In the test, we are hired three people of the swimming special teachers, among them, associate with one professor and two lecturers, their level are one the referee. According to school swimming test type requirements, technical rating and respectively 20, 30, 50 m breaststroke swimming distance of the test. With no time limit, be restricted to distance and breast stroke technical movement. The test scores is list as the completion examination results of student. Experiments and tests are in a double-blind manner.

70.4 Results and the Analysis

The experimental group and control group the breaststroke teaching skills analysis and comparison of the index. From Table 70.1 can analysis that the beginners achieve 95.7 % from the swim breaststroke experimental group more than 20 m,

Table 70.1 Comparative analysis index of teaching experiment group and each control group skill

Technical indicators	20 m Breaststroke		30 m Breaststroke		Technique Evaluation (Score over 8 points up)	
	(Score)	(%)	(Score)	(%)	(Score)	(%)
	The Experimental Group	45	95.7	36	76.5	33
The Control Group	29	69.4	20	47.6	10	23.5
P	P < 0.05		P < 0.05		P < 0.05	

Table 70.2 Application analysis of multifunctional swimming aid using (%)

Content	Good		General		Poor	
	Teacher	Student	Teacher	Student	Teacher	Student
Application effect	70	85.1	20	10.6	10	4.3
Learning interest	70	90.5	10	6.2	20	3.3
Preventing water choke	90	95.7	10	4.3	0	0
Prevention of fear	90	93.6	10	4.3	0	2.1
Balance	100	100	0	0	0	0
Convenience	70	75	10	14.4	20	10.6
Extension value	70	83.2	10	10.6	20	6.2

the control group in the breaststroke swim the distance above 20 m beginners to 69.4 %, T test and control group have significantly difference ($P < 0.05$), skill score eight points above the value by T test and control group have significantly difference ($P < 0.05$), show that using the multi-function strokes student students' effect is better than conventional teaching method students' effect. Through the multi-function strokes the student practice, the breaststroke arms, legs, and the movement of the curve track to beginners provide reasonable support, make beginners technical movements in U shaped arm elliptic limiting grooves are constrained, and to enforce its in the correct action line to practice, at the same time, the student can make the learners on the it in a prone position, be helpful for students to master the body balance, to overcome the fear psychology, easy exercises. Meanwhile, through the multi-function strokes in the student practice, be helpful for action to fix, shorten the learning of the movement generalization and differentiation, faster to action automation, short course learning efficiency. And the 50 m breaststroke long distances, the experimental group and control group T test no significant difference ($P > 0.05$), show that the multi-function strokes to improve student swimming beginners special endurance effect is not apparent, due to the causes of learners breaststroke technology action after skilled, using the multi-function strokes student device balance and buoyancy practice, save the physical strength.

From Table 70.2 multi-function strokes the survey and analysis of financial aid applications after 16 h, after for four hours a week the application experiment respectively on the swimming beginners and ten teachers begin to the questionnaire

survey, it is show that the application effect of the multifunctional financial aid, study interest, prevent choke water, prevent fear psychology, application value and so on all said the full affirmation.

70.5 The Conclusion and Suggestion

The experimental results show that the multifunctional swimming stroke assistantship device solves the difficulty or easy balance in the water and recumbent problem on the surface, enrich and develop the aquatic sports auxiliary equipment.

The multi-function equipment can improve student swimming teaching effect is remarkable.

The equipment to prevent stroke multi-function fears, prevent choke water has a positive effect.

Multifunctional equipment student device, it can increase learners fun and exciting, can be the teachers, students accept, can be used as a teaching auxiliary equipment and conventional water recreational equipment on the wide application.

The multi-function strokes is not suitable for improve student swimming endurance results, in the teaching, we can exercise and use other development means of endurance.

By experiment teaching with the funds and the limits of the articles, the sample is small, have a certain limitation, in the process of use inspection.

References

1. Tian M-j (2006) Exercise training. Higher Education Press, Beijing
2. Zhang J-l (2001) Swimming athlete strength training equipment research. *Machinery* 5:22–28
3. Chai J-s (2002) Research on law of skill transfer. *J Beijing Sport Univ* 3:11–19
4. Yao C-h, Zhang X (2004) The breaststroke land training simulator design and application. *Hubei Sports Sci Technol* 4:3–15
5. Wang H, Xu L (2002) Using the triangle type air cushion breaststroke training device for swimming teaching. *J Wuhan Sports Inst* 1:81–89

Chapter 71

Practical Application of Creative Education in College Football Teaching

Faqiang Qiu and Yi Zhou

Abstract Based on the basic situation of football education in several sports colleges, this paper focuses on the problem crux affecting the comprehensive students' quality improvement and teaching effect in the sports college football education, proposes the creative education program in accordance with the current teaching reform situation, and proves the good effects of creative education in the penetration of football teaching, so as to suggest creative education method for the sustainable development of sports college football education and provide some theoretical help for implementing the teaching reform of scientific development concept in accordance with the requirements of our country at this stage, and finally lays a solid theoretical foundation for teaching comprehensive and outstanding talent for the sound development of China's sports.

Keywords Football education · College · Application

71.1 Introduction

The scientific development concept requires the education focus on people, however, the inherited traditional education thinking in past years severely limits the development of “people”, a variety of education reforms are performed one after another, such as teaching materials, teaching methods, evaluation criteria,

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while the teaching model is always a change in form but not in content, the students lose their freshness in learning, the teachers teach for the main purpose and seriously neglect the ultimate education goal of students learning, it completely deviates from the individual needs of students, and the personnel training system is out of the correct way from the source [1, 2]. As a football teacher of Sports College, the author has a comprehensive understanding about the importance of a good education form to the development of colleges and the college personnel training. The college education must have a thorough innovation imperative reform, as one of the sports college courses, the football education should also contribute its strength for the innovative reform of college education, therefore, after painstaking and careful research, the author proposes the implementation of creative education in sports college football teaching [3].

At present, the creative education is widely applied in the sports college education, especially the application in football, basketball, volleyball, athletics, aerobics, martial arts and other traditional sports, it can open the interest door for the students, make the classroom atmosphere active, so as to increase the participation level, and allow the students to take the initiative to master new skills, improve physical ability in self-learning process, and cultivates their minds to make it more responsive to the society. However, the implementation of these creative educations have slight blindness, the teacher did not appreciate the true meaning of creative education, and the penetration in the classroom is relatively stiff and does not reach the best effect of creative education [4]. In order to change such unsatisfied situation, many scholars have proposed their constructive comments for their own researches. The implementation of creative education in the physical education teaching should uphold six principles, i.e., the subjectivity, democracy, heuristic, motivate, questioning and development; establish the educational reform countermeasure for open class teaching environment, and apply the intellectual stimulation method, shortcomings listing method, smart skills and other new innovative teaching skills, and focus on training the non-logical thinking ability of students, and conduct unique research contents [5]. So far, the creative education study on football is rare, for the sports colleges with higher requirement level, the football teaching creative education reform is even more urgent.

71.2 Problems in Tradition Football Education Teaching

At present, the technical subject teaching of sports colleges commonly focuses on technology teaching and learning and neglect the doctrines teaching, the phenomenon seriously affects the students' logical thinking ability and language ability, which results in the majority of students receiving bad feedback in their graduating education practice and a lower advantage than other professional students when participating in the trial lecture of teaching interview, or the ability is enough for the practice method and curriculum arrangement of teaching technical actions as a teacher in the practice class, but when carrying out technical and

tactical theoretical guidance, they will often be regarded as poor language organization, technical term insufficiency and poor research ability, and finally affect the normal teaching order.

The football teaching of major sports colleges still put the football skill and tactical level in the first place when training the students, they only concern about “standard” test at the end of the term, which is similar with the exam-oriented education, and neglect the practical ability training of the football theoretical knowledge, research and innovation ability, teaching and training in quality-oriented education. In the teaching process, the teachers only teach the imagery of technical teaching, and the students only imitate and memorize the example action and neglect the in-depth knowledge and understanding of football sports and the process of upgrading the imagery for the idea. This type of football training class is a competitive sport and it can not implement the training objective of “training sports education personnel with comprehensive development, but also the primary cause which results in the professional theoretical knowledge is not solid and weak practical ability.

The sports college football teaching is still the textbook-centered teaching with boring and dull teaching contents, the teaching method is rigid and single, it over-emphasizes the rigor and ration of the teaching organization and focuses only on football technical specifications, exercise load and exercises density, while ignoring to render the correct classroom atmosphere, to stimulate the students’ learn interest and the learning and practicing interaction sessions, it can not train the students’ habit of keeping physical practice, seriously affect the eventual goal realization of lifelong sports. The mechanized classroom atmosphere makes the football class teaching of sports colleges a programmed practice step-by-step, so that the students lose the motivation to learn and seriously impact on the effect of teaching.

With the continuing reform of the teaching method, the multimedia modern teaching methods come into the sports college football teaching class, in addition, various modern teaching method changes every day, but most of the teachers still maintain the traditional concept, they apply the old ways and means, these concepts have threaten our teaching quality and seriously impact the development of teaching level, which requires the teacher to keep learning and improve their operational capacity and broaden their knowledge field, and the colleges must continue to organize teacher training activities to create a platform of mutual learning and experience exchange for the teachers.

Under the new situation of quality-oriented education, the education shall be mainly based on cultivating the talents, most of the sports colleges basically performed appraisal method reform to adapt to the implementation of quality-oriented education better, the main contents of the performance evaluation include the football professional technical standard test, theoretical knowledge test and daily performance. However, the technical evaluation score of most colleges is accounting for 50–70 % of the total score, the theoretical result is accounted for 20–40 %, and the daily performance is accounted for about 10 % only, this situation seems to be a replacement of exam-oriented education only, apply 10 % of the total

score to represent the penetration of quality-oriented education, the implementation effect can be easily imagined, it not only ignores the evaluation of student ability culture, but also does not have objective teaching evaluation criteria varied in accordance with the performance of the students, in addition to developing the metric scale for the students' basic football skills and tactical level development, it lacks the evaluation standards for the students' physical quality and progress extent, learning and research capability, the quality-oriented education seems impossible. This kind of evaluation mechanism will not only fail to inspire the students' to learning motivation, lack encourage to the students with poor performance, it will also hinder the ability of students and finally cause the students losing their learning confidence and just pay attention to their learning results, and they will gradually neglect the importance of learning process in the end.

71.3 Practical Application of Creative Education in Football Teaching

71.3.1 Change the Teaching Idea

The traditional education has too much thinking in common and too little personality, the creativity of students is difficult to perform. Innovation can not be realized without personality, the developments of independence and creativity are complementary to the development of the students own personality. In the teaching process, it's necessary to establish the unified requirement for the teaching process and teaching effect, but if the requirements for all activities are exactly the same, it is not conducive to the personality development of students, in order to obtain the common and personality coordination, the scalability of management system must be demonstrated in teaching, so as to reflect the consistency between principle and flexibility, the consistency between uniformity and diversity, the consistency between stability and mobility.

The fundamental difference between creative education and traditional education is that whether the students are the subjects of teaching activities. A complete teaching activity always includes two aspects, i.e., the teaching and learning. In traditional teaching, the teaching activities of the subject are always finished by the teacher; the dominant position of students is usually ignored, and the students usually accept the knowledge in the passive manner of "cramming method of teaching". This will make teaching a simple transfer process of knowledge and skills, the learning of students is entirely dependent on the teacher teaching, they completely lose their initiative and only interest in the outcomes and goals, lack the passion and desire to the process of exploring new knowledge and truth, the result is that they often have access excellent technical skills and lack the innovation spirit and innovation ability. The root cause of this situation is that the relationship between teacher and students in teaching process is totally reversed, which completely obliterates the subjectivity of the students.

The creative education will not deny the role of the teacher while fully respecting and ensuring the dominant position of the students. In the creative education, the teacher is just a mean of “preaching, teaching and explaining” for the students rather than a purpose, their main roles are to guide the students to develop and improve the innovation ability through learning.

71.3.2 Reform of Teaching Model

The football sports have a high degree of skill and collectivity, it is not easy matter to learn and master every action. In order to enable the students to master the learned technical action, and give full play to their subjective consciousnesses and cultivate their innovation abilities. Dissolve the creative education into football teaching, implement the teaching model of creative education and build the teaching model, it shows the effect of teaching model in football teaching, the preparation work before lesson is directly related to the class effect. Preparedness ensures success and unpreparedness spells failure, necessary preparation work before lesson can help accelerating the students’ correct understanding about the technical movements, in the football teaching process, require the students to preview the new contents to be learned, so that the students can have a rational understanding on the technical action specifications, in the class teaching, the teacher is a intuitive demonstration to them, point out the associated difficulty and key links of the skill and action before the demonstration, and require the students to seriously observe the demonstration.

Innovation can make a person happy, and beauty-seeking can make a person pleasure. The teacher should pay special attention to train the students their own abilities for scientific design and organization practice, in the class teaching, give the students free choices and encourage the students to use the mastered sports knowledge to solve practical problems and encourage them to bravely explore and dare to practice. With the continuous growth of the students’ knowledge, skills and physical quality, their independent learning ability, problem analysis ability, problem-solving ability has also been greatly improved than the past. Therefore, in the new teaching model, the students should refer the material or the practice method provided by the teacher for practice, and they can also design practice forms and methods on their own, and give full play to the initiative of the students, induce and inspire the students to actively participate in the teaching activities, so as to reflect the teaching idea of students as the principal and teacher as the guider. To a great extent, this model can not only meet the requirement of students’ learning desire, and it can give full play to the imagination and innovation abilities of the students, under the impetus of this valence, it will form a harmonious atmosphere of “scenario”—teacher—students, which is multi-refraction, so that the students are willing to learn, will learn and know how to learn, so as to achieve the purpose of self-realization.

The teaching method has its timing and scope of use and is constrained by its movement conditions. In the traditional technical teaching, the programmed teaching over-constrains the singularity of skill and ignores the characteristics of football sports, which results in the inconformity of ability and need. Because the football teaching emphasizes the teaching of teacher skill actions and does not care about how the students use the technology and technological innovation, therefore, how to use the teaching method which can adapt to the actual situation of the students more, it generally improves the skill within a certain time and smoothly develops the innovation ability of the students, take creative education method as the example, we will briefly introduce the teaching method reform and broaden the teaching organization forms.

71.3.3 Reform the Teaching Method; Expand the Organizational Form of Teaching

The teaching method has its timing and scope of use and is constrained by its movement conditions. In the traditional technical teaching, the programmed teaching over-constrains the singularity of skill and ignores the characteristics of football sports, which results in the inconformity of ability and need. Because the football teaching emphasizes the teaching of teacher skill actions and does not care about how the students use the technology and technological innovation, therefore, how to use the teaching method which can adapt to the actual situation of the students more, it generally improves the skill within a certain time and smoothly develops the innovation ability of the students, take creative education method as the example, we will briefly introduce the teaching method reform and broaden the teaching organization forms.

Create the situation closely related to the teaching contents, use various conditions to bring the students into the teaching situation, so that they will produce questions, problems, ideas and guide them to experience and explore new knowledge themselves, so as to develop their intellectual potential. For example: in the technical teaching of one two pass, we can design such a situation “if we are carrying out the class football match, the defense of opponent is very strict, what method can you take to break the defense”? Then arrange the one two pass practice with two attackers and one defenseman, in the practice process, some students adopt the wall pass, and some apply the forward slash one two pass, some apply the queypass straight cutting one two pass to break opposite’s defense. The teacher should let the well-performed students to demonstrate and guide beside them, so that the students can be more serious and interest, the class atmosphere can also be more active, and the students can quickly master the actions.

In the teaching process, as the organizer and instructor, the teacher should give full play with the subject of students, in cooperation and discussion exercises, the students will always be in a very democratic and relaxed learning atmosphere, and

they will have active thinking and discuss and decide their learning methods, it's easily to make creation beyond the textbook. For example: during the teaching of local frontcourt attack tactics, the students should organize the attack according to their own advantages, and the defense should apply man to man defense tactics, the attacker can apply the "cross-cover" and other means to break through the defensive through discussion and opinion exchange. Through the repeated process of "discussion—practice—application" to gradually improve the tactical level, this process applies a learning and practicing method of cooperative discussion and democratic planning, it can make the individuals give full play to the ingenuity and innovation ability in the group, and achieve the knowledge mastering and thinking development in the discussion.

71.3.4 Evaluation Standards for Innovation Performance

At present, most of the sports colleges adopt pure technical assessments and ignore the practical ability and comprehensive quality assessment in the student teaching, so it does not meet the implementation requirements of quality-oriented education. Therefore, the football class performance evaluation of sports colleges should explore scientific and innovative evaluation criteria. For example: In addition to technology assessment and theory in the assessment, increase the oral action tips telling item, in order to improve the comprehension and language skills of students; set and stimulate the classroom aspect to create teaching practice opportunities, it requires the students and the teachers conduct the comprehensive evaluation of the standard together, in order to improve the practical ability, observing ability as well as thinking and evaluation abilities of the students; in the form of homework, require the students writing research papers of football, in order to improve the innovation ability and research ability of students. At the same time, the teacher should make corresponding evaluations to the learning attitude, attendance, progress rate and interaction ability of the students, and finally and fairly give comprehensive assessment score to the students.

71.3.5 Innovate the Football Teaching Idea

Due to its own characteristics of football sports contain the comprehensive quality elements of the integrated development talent, so the football teaching activities should be an effective way to train high-quality sports talents. The traditional football teaching regards the learning techniques and tactics as the core parts, and in the textbooks defines the football sports as "football sports is mainly based on foot kicking ball, it's a sports item containing two teams conducting offensive and defensive purpose at the same venue. It penetrates the creative education into the football teaching to cultivate the noble morality and high-level wisdom, so as to

achieve the personnel with cultural literacy and whole development. The innovative football teaching is a sound education modeling “more complete person”, it is also a education creating a “whole personality” and the harmonious development of human, and it fosters new teaching idea for football, so as to comprehensively develop the basic quality of all aspects of the students, such as moral, cultural knowledge, physiological psychology, and labor skills, that is, high comprehensive quality, which is integrated general-purpose talents for a wide range of situation and works.

71.4 Conclusion

The traditional education thinking seriously affects the sports college football education results, and it ignores the culture of the students’ innovation ability and practical ability. Based on the basic football education situations of several sports colleges, we find the problem crux of improving the students’ comprehensive quality and teaching effect in the sports college football education, and design a creative education program meeting the current teaching situation reform.

References

1. Shi G (2008) On the application of creative education in sports colleges football teaching. *China Education Innovation Herald* 27:33–38
2. Liu J (2009) On the reform of creative education and high school sports. *Phys Educ Teaching* 12:99–105
3. Huang Jx (2007) On the “traditional teaching” and “innovative teaching” in physical education teaching. *Phys Educ Teaching* 12:221–228
4. Zhao Y (2008) On the implementation of our college creative education. *Phys Educ Teaching* 11:35–42
5. Hong Mz (2009) Creation of various teaching situations. *Phys Educ Teaching* 10:23–29

Chapter 72

Psychological Coping with Impact Response of Sports Materials

Jingwen Lu

Abstract To develop an innovative strategy for psychological coping with impact response of sports materials improved in competitive sport settings. Sports utensils exposed to impact loading frequently involves polymeric materials. The impact response tends to depend on large stress–strain hysteresis on polymeric materials. The samples were gained from balls of varying coefficient of restitution and stiffness. Total psychological coping would be with regard to the self-selected stressor in psychology. In particular, higher levels of psychological coping were associated with more problem-focused coping, but less emotion-focused and avoidance coping.

Keywords Psychological coping • Material characterization • Impact response

72.1 Introduction

Several researchers, recently, start drawing more attention to the strategies exercised by athletes with the purpose of managing the stressful needs in sport settings where athletes meet impact response of sports materials improved [1, 2]. Together with providing in-depth descriptions of athletes' coping actions when they meet impact response of sports materials improved in sport, these works have caused the identification of numerous clusters of homogeneous and distinct psychological coping strategies [3–5].

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This paper offers a vital outline of the psychological coping that have been used in psychology research when athletes meet impact response of sports materials improved in sport. Then, it addresses the development of novel descriptions for judging coping psychological strategies of athletes in competitive sport events where athletes meet sports materials improved.

72.2 Impact Response of Sports Materials

Polymeric materials frequently are used to make sports equipment that exposed to impact [6–8]. The impact response is inclined to be time reliant with big stress–strain hysteresis [9–11]. Reproducing impact in a managed laboratory environment for material characterization is challenging, but necessary if models are to precisely explain impact behavior [12–14]. Mechanical properties are normally developed for ball impacts. Quite a few models create instrumented ball impact response. The following describes a split Hopkinson pressure bar equipment to stimulate identical stress at controlled scales and rates in polyurethane foam test samples, for instance, the principle component of a softball). The bar equipment can explain the loading phase of the stress–strain impact response of the polyurethane at strain rates representative of softball impact response [15–17].

72.2.1 Sports Materials Properties

Many sports involve impacts response of sports that improve high strain rates in rate sensitive polymeric materials. Understanding how the impact of sports materials behave is critical to knowing and producing new optimized sports equipment. On sports materials, one area of interest is that of softball. In slow-pitch softball the relative bat-ball speed can be 49.2 m/s (110 mph). In sport, the impact response of the bat and ball leads to fast and swift twist in between the bat and the ball [18].

Limited and fixed component models have been yielded to know the bat and ball interaction. These softball models have been extended from high speed impact measurements. For speeds of the sport less than the impact response measurements of sports, for example, FEA models predict a stiffer performance than what is measured experimentally in sport (72.1). To improve statistical simulations better sport material characterization is depended in sport.

72.2.2 Impact of Sports Materials

The dynamic stiffness (DS) and coefficient of restitution (COR) are two significant factors that are accustomed to calculate the behavior of softballs. To quantify DS a solid, rigidly mounted cylinder is closely related to a ball. Load cells mounted

between the cylinder and rigid support calculate the impact peak force. The DS, k , is

$$k = \frac{1}{m} \left(\frac{F}{v} \right)^2 \tag{72.1}$$

found from an energy balance of the impact as where m is the mass of the ball, v is the ball speed before impact, and F is the peak impact force.

The ball COR is a calculation of the energy retained after a crash. The COR is found from the ratio of the rebound to inbound ball speed from an impact with a flat rigid wall. Different DS and COR in Table 72.1 are been reflected as the impact response of quite a few softball models. Because softballs have the comparatively simple, solid polyurethane foam construction, this research chooses softballs for this sample.

72.2.3 Impact Response of Sports Materials

The properties of polymeric materials, including softballs, are often dependent on the rate of deformation. The strain histories can be used to obtain the specimen strain, ε , and stress σ , as

$$\varepsilon = \frac{2C_v}{L} \int_0^1 \varepsilon_R(\tau) d\tau \tag{72.2}$$

$$\sigma = \frac{A}{A_s} E \varepsilon_t \tag{72.3}$$

where C_v is the wave speed in the bars, L is the specimen length, ε_R is the reflected strain history of the incident bar, ε_T is the transmitted bar strain history, A is the bar cross-sectional area, A_s is the specimen cross sectional area, and E is the bar

Table 72.1 Measured average ball properties. Values listed in parentheses are the standard deviation

Ball model	COR	DS (kN/m)	EL (MPa)	EH (MPa)	Modulus increase (%)
A	0.454 (0.006)	2152 (79)	52.5	84.0	38
B	0.425 (0.004)	952 (30)	13.3	29.0	54
C	0.442 (0.004)	1184 (28)	19.9	35.3	43
D	0.462 (0.005)	978 (30)	19.9	33.1	40
E	0.426 (0.004)	984 (30)	33.6	42.2	20

Source Andy Brysona, Lloyd Smitha. Impact Response of Sports Materials, Procedia Engineering, 2010, pp. 2962

modulus of elasticity. The sample must be in a state of uniform stress for the Eqs. (72.2, 72.3) to apply.

72.3 Psychological Coping and Impact Response of Sports Materials

The mental literature suggests that select and make of sports materials influence the type of certain psychological traits that are perceived as being stressful as well as psychological coping on the sport achievement. Psychological coping would also be associated with more emotional stability when experiencing a stressful event because of impact of sports materials [1].

72.3.1 Psychological Stress and Impact Response of Sports Materials

Several qualitative studies have suggested that mentally health athletes cope more effectively than less mentally health athletes [2]. For instance, certain individuals are more likely to experience psychological stress with higher levels of stress reactivity and negative affect because of impact response of sports materials [3]. The present study investigated the relationship between the impact response of sports materials improved and appraisal (stressor intensity and perceived control over the stressor) of a self-selected stressor, in sport. Based on improving the impact of sports materials it could be predicted that individuals high in mental health would perceive sport events as a challenge, something that can be influenced and acted upon and see themselves capable of doing so. This suggests that mentally health individuals appraise stressful events with lower levels of stress intensity and with higher perceptions of control over the event when the material impact response throughout the ball leads to the stressful events.

72.3.2 Psychological Coping Strategies and Impact Response of Sports Materials

The construct of psychological coping has been defined as the behavioral and cognitive efforts of an individual to manage the internal and external demands encountered during a specific stressful situation [4]. Psychological coping in sport has been defined as “a constantly changing cognitive and behavioral effort to manage specific external and/or internal demands that are appraised as taxing or exceeding the resources of the person” [5]. Coping responses in sport have been

categorized into three broad 'higher order' functions problem-focused coping, emotion-focused coping and avoidance coping [6].

First, Problem-focused coping describes strategies in sport ball accustomed to minimize distress and pain by falling or getting rid of the stressor. New balls are used to minimize environmental effects and ball wear on the test results. If the difficulties of soft materials use been minimized, a thin specimen was employed. Therefore, this result enhanced the magnitude of the transmitted wave, decreased the impact response of the elastic impedance, and advanced an identical stress distribution. Based on the study by Nicholls et al. [7], we predicted that higher levels of psychological characteristics would be relevant to more problem-focused coping and these strategies would be perceived as being effective in sport because athletes would be influenced the impact response of sports materials improved.

Second, emotion-focused coping involves strategies used to regulate emotional arousal and distress. The samples of the sport ball were taken from balls of varying COR and stiffness. The impact properties were constant to the desired impact response of the softballs, for instance, stiffer balls revealed higher modulus. We also predicted that athletes who may use, if necessary, more emotion-focused strategies scored higher due to the impact response of sports materials improved.

Finally, avoidance coping includes both behavioral and psychological efforts to disengage from a stressful situation. The small sample thickness had the negative impact response of limited the range of realizable strain rates. Unfortunately, results from mathematical simulations utilizing the controlled laboratory mechanical properties did not be of the same mind with experimental amounts. If material characterization could be carried out, the bulky energy absorption of the polyurethane limited the range in strain rates. So, athletes who score low would avoid stress and injure in sport due to the impact response of sports materials improved.

Indeed, the six professional soccer players in the Thelwell et al. [8] study felt that being mentally health always helped them to cope more effectively. Moreover, it is unclear whether mentally health athletes cope more effectively as a consequence of experiencing types of the impact response of sports materials improved, understanding these stressors in a different way that the impact response of sports materials improved, for instance, stress intensity variations or different perceptions of control over the event which the impact response of sports materials improved would lead to, use different coping strategies, or the same coping strategies, but more effectively than athletes who cope with the impact response of average ball.

72.4 Summary

The quasi-static and dynamic response of a number of polyurethane softball models was compared. The ball models were chose to have differing stiffness and COR. However, arithmetical simulations is likely to profit from results gotten employing a larger range in strain rate and an ability to calculate material

hysteresis than was possible here. The research demonstrated that there is a helpful link between the impact response of sports materials improved and psychological coping which involve Control, Stress and Challenge with Sport Achievement and Psychological Well-being, and these variables can predict the changes of Sport Coping and Psychological Achievement significantly. Future research could investigate psychological coping over time and multiple stressful events which the impact response of sports materials improved would lead to.

References

1. Horsburgh VA, Schermer JA, Veselka L and Vernon PA (2009) A behavioural genetic study of mental toughness and personality. *Personality Individ Differ* 46:100–105
2. Jones G, Hanton S, Connaughton D (2007) A framework of mental toughness in the world's best performers. *Sport Psychol* 21:243–264
3. Thelwell R, Weston N, Greenlees I (2005) Defining and understanding mental toughness within soccer. *J Appl Sport Psychol* 17:326–332
4. Suls J, Martin R (2005) The daily life of the garden-variety neurotic: reactivity, stressor exposure, mood spillover, and maladaptive coping. *J Personal* 73:1485–1510
5. Lazarus RS, Folkman S (1984) *Stress, appraisal and coping*. Springer, New York
6. Krohne HW (1993) Vigilance and cognitive avoidance as concepts in coping research. In: Krohne HW (ed) *Attention and avoidance*, vol 6. Hogrefe & Huber, Seattle, pp 19–50
7. Nicholls AR, Polman RCJ, Levy A, Backhouse SH (2008) Mental toughness, optimism, and coping among athletes. *Personality Individ Differ* 44:1182–1192
8. Thelwell R, Weston N, Greenlees I (2005) Defining and understanding mental toughness within soccer. *J Appl Sport Psychol* 17:326–332
9. Qi C, Shuting L, Dongyun F et al (2011) Survey on current situation of public sports service evaluation in Guangzhou and its Enlightenment. *J Shanghai Univ Sport* 35(4):26–31
10. Biskup C and Pfister G (1999) Mädchen können tangen. *Jungen Fussball spielen. Sportunterricht*, 48 Jg., Heft 1, pp 5–15
11. Chae JS (2005) The effect of personal characteristics and service areas on job satisfaction. *J Korean Soc Sport Leis Stud* 25:111–120
12. Chung HS, Kim GS, Won YS and Lee MP (2001) A survey on school girls' sports and physical activities and a promotion plan. *Minist Educ hum Resour Dev* 2:39–47
13. Linhu F (2001) *Sports education teaching theory*. People Education Press, Beijing, 2(4):58–64
14. Li Z (2004) Research on sports dance present situation and the countermeasure. *J Beijing Sport Univ* 2(3):20–25
15. Guanghong L (2005) Research on sport dancing effect on body fat. *J Wuhan Sports Inst* 10(10):290–297
16. Jianhua D (1999) Sports dance characteristic. *J Chengdu Sport Univ* 1(2):192–194
17. Yanhua X, Aihua Z (2004) *Education*. Science and Technology Press, Hebei
18. Lei L and so on (2003) Discussion on the value of sports dance and the necessity of its opening in universities. *J Beijing Sport Univ* 5(6):29–35

Chapter 73

Research on Family Sports and Its Enlightenment

Qing Lan

Abstract Using the method of document, the article studied on the process of family sports. The study results found that, although the concept of the family sports was only brought up in very late years, the family sports in bud state have been being from the primitive. The family sports went through five historical stages. They are stages of the primitive society, the slave society, the feudal society, the premodern times and modern times. And the article described the overview of family sports in each stage. On this basis, the article summarized the characteristics of family sports in each stage. As time goes, the family sports is revealing enormous role. It should be promoted to develop greatly.

Keywords Sports · Family sports · Develop · Historical review · Enlighten

73.1 Historical Review on the Family Sports

“There is education since there is human [1].” Physical education is one of the main contents of primary education. Physical education came into being with human being. It has been thousands of year’s history. It has made a great contribution for human civilization. The concept of family sports made late, but it has a very long development history as a practical activity [2]. Human society has gone through a very long stage which was divided three stages, savage era, barbarism and civilization era by Engels [3]. The corresponding forms of marriage were group marriage system, dual marriage system and monogamy, which formed

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families, known as the “punaluan family”, “pairing family” and “monogamous individual family”, only the individual monogamous family is the real families. There were family sports from the birth of the family. Family sports, which were contained in family education, went through five stages [4].

73.2 The Family Sports in Primitive Society

There have been original family sports since primitive society, which can be confirmed by ethnology information. (1) Ewenki which lived nearby Heilongjiang River in the northeast of China were still in the primitive society on the eve of the liberation. They had a custom, when a boy was teens, he began to study hunting techniques from Father and Brother and Father has an obligation to prepare a shogun to the new hunter. The education was carried through the games and sports (“Sports Daily”, August 24, 1961, the third edition) [5]. It includes archery games, skiing, high jump and wrestling and other activities, which are family sports in nature. (2) Some of tribes in the forest in West Africa have held a “into the Lai-Lei Ting” system. The lai-lei Ting in some tribes of Australia continued for several years. The basic contents of primary education were the beginning of physical education; all of these activities can be regarded as the original form of the family sport [6].

73.3 The Family Sports in Slave Society

The physical education was included in the family education in slave society. Slaves had no families; their children only could learn some labor skills. Confucius was born in the lower warrior family, under the influence of his family, he loved sports. According to the aims maintaining the dictatorship of needs of nobility, children of slave masters were received family education and then school education. Family education and school education was consistent with the content, mainly ritual, music, shooting, defense, and books, a few other “six arts” education and training. “Shooting” and “defense” were belonging to physical education [7].

In ancient Indian system of slavery, the slave aristocratic looked family as a venue for education for children. Father was a ruler of the family, attached great importance to the children’s family education, required children not only to memorize the Vedas, but to learn military sports in order to master the ability to suppress the slaves [8].

Freedmen in ancient Egypt attached great importance to physical exercise, safe delivery, infant conservation diseases and systematic knowledge. When babies began to toddlers, their parents let babies play in the air and sunny outdoors without clothes. Early childhood, parents gave children toys. Juveniles played masked guess people, hide and seek, riding troops, roll hoops, playing ball game

and other sports. From the growth process of ancient Egyptians, the family sports were the important content in their survival [9].

Sparta and Athens in ancient Greece gave great importance to the family sports. Sparta required parents to keep attention and enhance the children's health and physical exercise in order to prepare to accept more stringent, more brutal military sports training. After 7 years old, boys were sent to the nation's public educational facilities to carry out a variety military training. Girls continued to stay at home and received family, mostly sports, whose purpose was to train girls to be strong mother, for future fertility strong children. In Athens, family education focused on intellectual, moral, physical and aesthetic education to enable children from early age a comprehensive and harmonious development. Boys and girls received education, ball games and other sports training in the family before 7 years old.

Family education was the main form of education in ancient Rome and physical education was the most important content. In ancient Rome, children before 7 years were reared by mother. Children learned horse riding, wrestling, swimming and the use of weapons. Rome's education is mainly physical education.

73.4 The Family Sports in Feudal Society

There was a very strong sense of family in China's feudal society. Family education occupied a particularly important position. Culture education was valued; however, physical education was neglected. Only a few forms physical education, such as Wushu, Daoyi, and so on, were studied within the family. They trained apprentices in the form of using masters down from generation to generation. Many Wushu families were kept by this manner.

The education in Medieval European was called Knights Education. Its aim was to cultivate strong, pious God and loyalty to the emperor warriors. Its main contents were "Knights' skills", in which horse riding, swimming, casting spears, hunting and chess were sports. Knight education was secular feudal lords of the main forms of education, mainly through family education to implement.

73.5 The Family Sports in Premodern Times

Capitalist countries paid great attention to family education, comprehensive cared and focused on the children's physical health and exercise, moral quality of education and scientific and cultural knowledge. The famous British educator Locke, Spencer and France well-known educator Rousseau all believed that family sports was a fundamental part of family education and actively promoted family sports. Comenius was a bourgeois democracy educator, he believed that the time of a person from birth to adult could be divided into infancy, childhood, youth and adolescence, and each 6 years was a stage. There were four schools corresponding,

namely, maternal schools, Mandarin schools, Latin schools and universities. The original “maternal schools” were not ordinary schools, in which children from 0 to 6 years old were educated by the mothers. He considered that maternal school’s main task was to teach their children physical, intellectual and moral preliminary knowledge. In 1880, the Gymnastics Association in Fürth (Bavaria) of Germany held the family tennis competitions. Swimming Club in Berlin established a dedicated lane for the family members. The Stadium of Sports Association in Swabian opened only to the family every Saturday morning. Newburgh Postal Sports Association looked family sports as the center of contents. Solingen’s Gymnastics Association set up family time in 1888 for members with children to participate in training exercises specifically.

KMT Government formulated a series of laws and regulations to ensure the smooth progress of family education. In 1940, “implementation of family education approach” was promulgated. In 1941, KMT Government promulgated the “Interim Measures for Family Education Workshop”. All of the laws placed family in an important position.

73.6 Family Sports in Modern Times

In modern society, the family sports played an important role in education, health promotion, elimination of social diseases of civilization, and maintaining family stability. Family sports were paid great attention in the world. In 1970s, overseas research was on the family sports. In May 1981, the International Sports Training Congress, whose center topic was “sports and the family”, was held in Lausanne, Switzerland. The congress held that, the theory and practice had proved that physical activity was a very effective instrument to prevent the disintegration of the family, and make each family member gets a better development in health, education, psychology, and growth. The congress pointed out: sports organizations and administrative authorities should provide favorable conditions for family sports activities. Since the late 1980s, more than 80 countries worldwide have implemented public health activities aimed at developing a variety of projects in which sport is a key element.

Many states engaged a wide variety family sports activities. Italy called on its nationals to take part in “a family a kilometer” in 1976. Family games named “father, mother and me” were held in Bulgaria. German carried out the “family sports medal” system to mobilize the whole family to participate in sports activities. Belgian carried out the “each family 1000 m Scheme” to calling on each family member to participate in running. The United States established Presidential Sports Award which gave families who took part in sports activities a certificate shined by the president. There were many family sports activities, such as Finland’s “family skiing,” Egypt’s “Family Marathon,” Libya’s “family holiday”, “Family Recreation Week”, “family friendly games”. Singapore held the family sports festival to celebrate the 25th anniversary of National Day. Japan

and the United States established sport festivals whose main contents were family sports activities. Japanese studied the form and policies of family sports to revitalize the family sports. There were some countries (such as the United States) also developed a family sports policies to promote the rapid development of family sports.

Many modern educators in China took family sports as an important part of family education. Educator Chen Heqin placed the preschool children's family sports on a very important position. He discussed family sports three aspects: (1) the cultivation and training of health habits, (2) participation in the game exercises, (3) attention to mental health. Zhao Zhongxin, family education experts, took family sport as the first content of family education, and made a more systematic exposition in the "family education". Yang Baozhong held that sports were an important part of family education in his book "family education in great education vision".

The family sports have been accepted by most families and many sport families also have appeared since reform and opening. Family sports are in the ascendant. Many urban households have purchased home fitness equipment, such as automatic treadmill, vertical potential auto exercise bike, fitness chair and so on. Some wealthy families set up home gyms and have a private fitness venue. Some families drive their cars to carry out field sports. Especially in recent years, the results of research on family sports become more and more and research on family sports is becoming a research hotspot.

In the new century, a sport is not only an important way of life of people, but also an important way to improve the quality of life. Sports in the new century will give more respect for life, greater attention to health; enhance the sports culture and promotion people's physical and mental quality. Family sports will make greater progress.

73.7 The Enlightenment of the Process of Family Sports

Looking at the five stages of family sports development, the original purpose of family sports was to meet the survival needs of primitive people. In the slave society and feudal society, the family physical activity is the prerogative of the ruling class; its purpose is to safeguard the rule of the privileged class. The bourgeoisie Attach great importance to their children in family education and focus on physical health and exercise, physical, moral quality of education and scientific and cultural knowledge of the study in the capitalist period. Sports become an important means for them to cultivate people. In modern society, sports become a right of people, the family sports promote the overall development of people, the eradicate social diseases of civilization; maintain family harmony and stability, social harmony. The function of family sports is expanding and the family sports are wide attention in the world.

“Health is the greatest wealth” has become the consensus of the people in the twentyfirst century, while the sport is directly related to human health. Family sports, which is the combination of culture and sports, is an important factor to promote family health, to promote the harmonious development of body and mind, to ensure family harmony and stability. When the people share the material results of reform and opening, people pay more attention to and cherish the family peace and social stability. In this rapidly changing information age, the family sports along with the progress of time, from the individual to the family and then to society, is playing an increasingly important role. We should take a wider perspective to study the family and family sports. In accordance with the requirements of a socialist harmonious society to achieve good physical health, vigor, positive and progressive, the harmony of people and nature, the harmony of family and social, thus we promote family sports along the direction of healthy and harmony to develop, and build a harmonious socialist community to make greater contribution.

References

1. Chuanzhi Z (2001) Sociological studies on family sports in Wuhan, China. *Phys Educ Coll Wuhan* 58:128–133
2. Zhao Z (1989) Family education in China and foreign countries, vol 12. Higher Education Press, Beijing, pp 33–39
3. Yan L (1990) The history of sports, vol 55. People’s Sports Press, Beijing, pp 120–127
4. Zhao Z (1994) Pedagogy in the Family, vol 83. People’s Education Press, Beijing, pp 333–339
5. Gu S (2002) The history of sports in China, vol 192. Beijing Sports University Press, Beijing, pp 11–17
6. Yang B (2003) Family education in the great education perspective, vol 88. Social Sciences Academic Press, Beijing, pp 111–119
7. Hongtao L, Yong W, Jianping F (2006) Developing peasant family sports to promote national fitness. *J Jilin Inst Phys Educ* 4:99–104
8. Hongtao L (2007) Study on the development of family sports in the cities in China. *Jiangxi Norm Univ* 91:89–93
9. Shiyun C, Li B, Xuan H (2007) Study on functions and benefits of family sports in the construction of harmonious society. *China Sport Sci Technol* 6:22–27

Chapter 74

Characteristics Analysis of Satisfaction Degree of Sports Public Service

Dongyun Fan

Abstract By investigating 1200 inhabitants on degree of satisfaction with sports public service in Guangzhou, after analyzing the collected data, this study came to the following findings: (1) the inhabitant's degree of satisfaction with sports public service in Guangzhou is not high, it showed that the sports public service level needs to upgrade in accordance with the development of the economy and life, (2) female's degree of satisfaction with sports public service in Guangzhou was higher than male's, (3) the degree of satisfaction with sports public service was significant difference among different age stages, of which, the degree of satisfaction was divided into two categories by the age group 45 years old, and (4) the degree of satisfaction with sports public service was significant difference among different professions, of which farmer was the highest; Professional technical personnel in education, science, culture and health sector, the lowest.

Keywords Sports public service · Guangzhou · Survey · Characteristics analysis · Public sector

74.1 Introduction

Sports public service is a services which is provided by government to its citizens, either directly (through the public sector) or by financing private provision of services. The sports public service should be available to all, regardless of income. Even where sports public services are neither publicly provided nor publicly

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financed, for social and political reasons they are usually subject to regulation going beyond that applying to most sectors [1]. Sports public service, like the other public services, has the characteristics of a public good, such as being non-rivalrous and non-excludable, but most are merit goods. That is, services which may, according to prevailing social norms, be under-provided by the market. In most cases sports public service is a kind of service, i.e., they do not involve manufacturing of goods such as sporting bicycles or sporting shoes. The sports public service may be provided by local or national government or institution. The sports public service may involve outputs that are hard to attribute to specific individual effort and/or hard to measure in terms of key characteristics such as quality. The assessment of sports public service is a problem. It has been focused in many developed countries, for example United States [2]. So, in order to improve its function in China, the assessment on sports public service should be carried out.

Guangzhou is the capital and largest city of the Guangdong province in the People's Republic of China. It is located in southern China on the Pearl River, about 120 km north-northwest of Hong Kong, and the third largest city in China and southern China's largest city. As of the 2010 census, the city had a population of 12.78 million [3]. Guangzhou is the typical city in China. Therefore, this study took the inhabitants in Guangzhou as an example.

In this study, the authors made a survey and analyzed the data collected by survey, its aims is to provide some suggestion to related government and organization to make their decision better, and to attract people with a public service ethos who wish to give something more to the wider public or community through their work.

74.2 Subjects and Methods

74.2.1 Subjects

1200 inhabitants in Guangzhou participated in this survey. 1200 questionnaires were used. After sorting out and analyzing these questionnaires, the study got 1115 valid questionnaires, and the percentage of valid questionnaire was 92.9 %.

74.2.2 Contents of the Questionnaire

The questionnaire contained the fundamental information of interviewees such as gender, age, profession and eight questions concerning sports public service as follows [4]: degree of satisfaction with the existing sports laws and regulations; degree of satisfaction with the expense of sports undertaking for mass; degree of satisfaction with the sports equipments around you; degree of satisfaction with the

sports for mass; degree of satisfaction with the physical examination; degree of satisfaction with the sports societies and organization; degree of satisfaction with the training program for sports community instructor; degree of satisfaction with the offering of sports information.

74.2.3 Statistical Analysis

Data from the questionnaires were collected and analyzed with SPSS 16.0 for Windows. Descriptive statistic, independent sample *t* test, one-way ANOVA test, and multiple comparisons were used in this study. All significant level was set at 0.05.

74.3 Result and Discussion

74.3.1 General Characteristics

74.3.1.1 Overall Information About Participants in the Survey

The gender, age and profession distribution of participations in this survey are listed in Table 74.1.

74.3.1.2 Degree of Satisfaction with Sports Public Service in General

As shown in Table 74.2, the degree of satisfaction with sports public service in Guangzhou were middle, it demonstrated the sports public service in Guangzhou was not poor, but it was not ideal, it needs to improve further.

74.3.2 Difference of Degree of Satisfaction with Sports Public Service Between Female and Male

In order to analyze the difference of degree of satisfaction with sports public service between female and male, an independent sample *t* test has been used, the result was shown in Table 74.3. The degree of satisfaction with sports public service has significant difference between female and male in the two items: the expense of sports undertaking for mass, and sports equipments around you. The degree of satisfaction of both items showed that the female was higher than male. It demonstrated that the male has the higher requirement in the expense of sports

Table 74.1 Basic characteristics of participations

Variables	Sample size	Ratio (%)
Gender	1115	100
Male	508	45.6
Female	607	54.4
Age	1115	100
25 years or less	138	12.4
26–35 years	146	13.1
36–45 years	604	54.2
46–55 years	138	12.4
56–65 years	66	5.9
66 or above	23	2.1
Profession	1115	100
Worker	130	11.7
Farmer	22	2.0
Service Personal in Business	187	16.8
Privately or individually-owned business	109	9.8
Private entrepreneurs	76	6.8
Middle or senior Management in large-scale enterprise	107	9.6
Professional technical personnel in education, science, culture and health sector	109	9.8
Junior Administration Staff in Government, enterprise and public institution	117	10.5
Senior Administration Staff in Government, enterprise and public institution	47	4.2
Unemployed person	211	18.9

Table 74.2 Inhabitant's degree of satisfaction with sports public service in Guangzhou

Variables	Mean	Std. deviation
Sports laws and regulations	5.39	2.285
Expense of sports undertaking for mass	5.07	2.351
Sports equipments around you	5.09	2.402
Sports for mass	5.23	2.317
Offering of sports information	5.28	2.187
Sports societies and organization	5.24	3.139
Training program for sports community instructor	5.11	2.291
Physical examination	5.01	2.314

undertaking for mass and sports equipments. From the interview in this survey, the authors found out that the male enjoy football, basketball, volleyball, tennis etc. However, the sports fields or stadium were insufficient for them. The female enjoy dance, walking etc. These sports need less equipments and facilities. The other 6 items have no significant difference on gender. These phenomena was some familiar as other countries [5–7].

Table 74.3 Degree of satisfaction t test between female and male

Variables	Gender	Sample size	Mean	Std. deviation	T value	Sig.
Sports laws and regulations	Male	508	5.28	2.468	-1.36	0.174
	Female	607	5.47	2.118		
Expense of sports undertaking for mass	Male	508	4.86	2.495	-2.813	0.005
	Female	607	5.26	2.208		
Sports equipments around you	Male	508	4.93	2.571	-2.0471	0.042
	Female	607	5.23	2.244		
Sports for mass	Male	508	5.08	2.543	-1.900	0.058
	Female	607	5.35	2.104		
Physical examination	Male	508	5.00	2.492	-0.161	0.872
	Female	607	5.02	2.156		
Sports societies and organization	Male	508	5.19	4.012	-0.493	0.622
	Female	607	5.29	2.153		
Training program for sports community instructor	Male	508	4.98	2.484	-1.720	0.086
	Female	607	5.22	2.111		
Offering of sports information	Male	508	5.22	2.615	0.769	0.297
	Female	607	5.38	2.276		

74.3.3 Difference of Degree of Satisfaction with Sports Public Service by Ages

According to the output of one-way ANOVA test, the difference of degrees of satisfaction with sports public service by ages in Guangzhou were significant; the F values were 20.187, 18.292, 26.014, 16.641, 8.748, 8.486, 13.851, and 9.020, respectively ($p = 0.000 < 0.05$). By multiple comparisons, the result showed that the overall trend was the degree of satisfaction with sports public service of inhabitants who above 46 years old were lower than those below 45 years old, it had a significant difference.

74.3.4 Difference of Degree of Satisfaction with Sports Public Service by Professionals

As shown in Table 74.4, the score of degrees of satisfaction with sports public service by professions are as follows: The highest was farmer; the lowest was Professional technical personnel in education, science, culture and health sector.

After one-way ANOVA test, the output showed that all degrees of satisfaction with sports public service were significant difference ($p < 0.05$) but sports societies and organization among different professions ($F = 1.368$, $p = 0.198 > 0.05$).

Table 74.4 Score of degree of satisfaction with sports public service among different profession

Profession	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
P1	5.16	4.90	5.01	4.98	4.68	4.86	4.82	5.25
P2	6.86	6.41	6.64	6.95	7.14	6.68	7.05	7.45
P3	5.84	5.39	5.19	5.55	4.71	5.40	5.36	5.53
P4	5.83	5.30	5.50	5.56	5.36	5.50	5.61	5.94
P5	5.38	4.82	5.11	4.74	5.25	4.83	5.24	5.08
P6	5.14	4.80	4.84	5.10	4.85	5.20	4.93	4.99
P7	5.11	5.09	5.23	4.88	4.63	4.86	4.83	4.89
P8	5.62	5.95	5.20	5.78	5.51	5.48	5.17	5.42
P9	5.53	4.70	5.45	5.15	5.38	5.30	5.09	5.30
P10	4.85	4.46	4.61	4.86	4.93	4.95	4.80	5.00

Note P1, P2, P3, P4, P5, P6, P7, P8, P9 and P10 are worker, farmer, service personal in business, privately or individually-owned business, private entrepreneurs, middle or senior management in large-scale enterprise, professional technical personnel in education, science, culture and health, junior administration staff in government, enterprise and public institution, senior administration Staff in government, enterprise and public sector, and unemployed person, respectively. Q1, Q2, Q3, Q4, Q5, Q6, Q7 and Q8 are sports laws and regulations, the expense of sports undertaking for mass, sports equipments around you, sports for mass, physical examination, sports societies and organization, training program for sports community instructor, and offering of sports information, respectively

74.4 Conclusion

The inhabitant's degree of satisfaction with sports public service in Guangzhou is not high, it showed that the sports public service level need to upgrade according to the development of the economy and life.

Female's degree of satisfaction with sports public service in Guangzhou was higher than male's.

The degree of satisfaction with sports public service was significant difference among different age stage, of which, the degree of satisfaction was divided into two categories by the age group 45 years old, the above group has a lower degree of satisfaction, and the below has a higher degree of satisfaction.

The degree of satisfaction with sports public service was significant difference among different professions, of which farmer was the highest; Professional technical personnel in education, science, culture and health, the lowest.

Overall, Inhabitant's degree of satisfaction on sports public service in Guangzhou was not ideal, it needs to be improved, and more expense should be put on sports equipments and facilities.

References

1. http://en.wikipedia.org/wiki/Public_service
2. US Department of Health and Human Service (2000) Healthy people 2010. International Medical Publishing Inc., McLean, vol 1, pp 10–11
3. <http://www.citypopulation.de/world/Agglomerations.html>
4. Cheng Q, Lv S, Fan D et al (2011) Survey on current situation of public sports service evaluation in Guangzhou and its enlightenment. J Shanghai Univ Sport 35(4):26–31
5. Biskup C, Pfister G (1999) Mädchen können tanzen. Jungen Fussball spielen. Sportunterricht, 48 Jg., Heft 1, 5–15
6. Chae JS (2005) The effect of personal characteristics and service areas on job satisfaction. J Korean Soc Sport Leis Stud 25:111–120
7. Chung HS, Kim GS, Won YS, Lee MP (2001) A survey on school girls' sports and physical activities and a promotion plan. Ministry of Education and human Resource Development, vol 2, pp 39–47

Chapter 75

Efficient Education Scheme Based on Coupling and Confusion of Technology

Liang Li and Yitian Li

Abstract The origin of technology and education is the objective requirements of the society development; the coupling of the two is expressed in the technical logic of education and the educational value of technology. Education, in the process of adapting to the external rapid changing technology environment and transforming its own form, because of the “self-preservation” attribute and function, was leading into the confusion of conservation and innovation, insistence and change. Have correct understanding of education requirements and its “the survival of the fittest” relationship between technology, to fit the technology development through education self-renewal and use technology to promote education teaching reform and innovation has vital significance for education teaching reform in our country.

Keywords Technology · Education · Coupling · Confusion · Approach

75.1 Introduction

The famous British education theoretician Alfred North Wright once pointed out that, all means of education are meant to teach technology and intelligence. Education no longer exists independent of technology and technology itself is an

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important content of education. Education is a teaching activity that human being uses technology to achieve the educational purpose. The development of technology and its application in education is a result of choosing and fitting.

75.2 Coupling: The Educational Value of Technology and the Technical Logic of Education

75.2.1 Technology and the Educational Value of Technology

The Technology is a historical category; people have different explanation from different aspects about the understanding of technology. From the general sense, technology is the sum total of the tools, methods, skills, knowledge and experiences human understood and mastered in the process of doing practical activities of purposeful production activity, scientific experiment, education, management, art and other movements promoting the society development [1]. It includes three elements: entity form, experience form and knowledge form, and forms different technical structures. The entity technology is related to tangible and specific materials, tools and equipments, so it's called the materialized technology (i.e., general narrow sense of technology); Experience form is involved with knowledge form technology and invisible, intangible, intellective method, skills, knowledge and experience, so it can be called intelligent technology. Researches show that the development of technology has three fundamental development stages, the manual technology, mechanical and electrical technology, information technology. No matter what stage technology is in, it contains materialized technology and intelligent technology two respects [2]. The origin of technology and education is the objective requirements of the society development, is the starting point and purpose that technology applied in education. Analyse from this perspective, the educational value of technology reflected in two levels of direct and indirect influence that technological change have on education. The so-called direct influence means that technology directly involved in the education process, as a tool and information media of education process, lead to the change of learning and teaching method, and the relationship between teacher and students in the teaching process. Indirect influence means that technology does not directly involved in the teaching and learning process, it changes education by influencing other aspects of social life, such as influence education content, talent cultivation specifications, etc [3]. Seeing from the history of technology development, the formation, spread and application of technology in fact is a kind of education process. For example, along with the development and extensive use of computer and internet technology, all people who use computer were given different degrees of technical training (education), therefore, the computer and internet technology spreading process is also a process to train technology users. So, it promotes the education development while spreading and applying technology. Therefore,

technology is becoming a part of society, it not only becomes education content, but also constitutes the education environment, turns into the new ways of education method. Today's education has been marked with modern technology traces, and technology is now important content of education [4].

75.2.2 Education and the Technical Logic of Education

In Chinese and foreign education history, although people don't have identical understanding for education, but all of them have a common view: education is a social practice to cultivate people, education not only reflect society requests to human, but also promote people's physical and mental development, this is a unified activity process between educators and the educatees. Generally speaking, education includes three basic elements: educators, education object (educatees) and "education material" being the contact intermediary of educators and educatees [5]. Educator, being the education event organizers, is the leading factor. Education object, also called the learners, is the subject of study. Education material mainly manifested as education materials, education means and education organization forms, etc. Among them, teaching resources reflecting education content, relevant to textbook are called education materials; Education methods includes both teaching and learning mode and means, also contain the all utilized material and technical conditions, such as teaching aids, equipment, site, etc. Therefore, as a kind of social practice activity which cultivates people, education itself contains technologies of means, methods and equipments. "Technology" is embedded in education activity, if we extract "technologies" out from education, education activities will not be able to carry on [6]. Youliang Zha in the book *Education Modeling* points out: "education is science and it is philosophy; education is art and it is technology. Education is the comprehensive of science, philosophy, art and technology. Nowadays, with the highly developed science and technology, it is unimaginable if not to research education technology" [7]. So, speaking from the education process, education is an activity that human being use technology to achieve the purpose of teaching. In today's society, education is no longer independent of technology. In the technology education work, on the one hand, educations are the ways and means to realize technology impart, the purpose is to make the students master the technology. On the other hand technology education regard technology as the main content of education, it is a education form having technology as content. James Finn, an American education technology pioneer said: a country like the United States which has science and technology in the leading position in social life, its social system requires education continuously provide plenty of scientists and various technical personnel. In the process, technology inevitably enters into the education scope and become an organic part of education (such as vocational technology education) and education content (technical courses). JiaoJian Li thought, if the technical point of technology activity theory was put into use, then, education being human reproduction, itself is a kind of creative social practice activity cultivating people. In this

process, the technical features of education and education value of technology are rolled into one in education purpose and the expectation for education efficiency.

75.3 Confusion: Conservatism of Education and Hysteresis Quality of Technology Application

75.3.1 Conservative and “Self-Preservation” Attribute

In 1985, from the works recommended by UNESCO, such as “The World’s Education—To Survive Today and Tomorrow”, “The Great Education Problems”, Chinese scholars initially contacted with a strange proposition that schools have functional attributes of “self-preservation” and “self-preservation” [8]. “One of the basic functions of education is to repeat, repeat knowledge inherited from ancestors to following generations. Therefore, as in the past, education system has the responsibility of transferring the traditional value, this is a normal thing. This explains why education system tend to constitute a kind of sealing system of time and space, and why they are mainly concerned about their own survival and success. Therefore, the system seems to be introverted and regressive. So education itself is conservative” [9]. Education “self-preservation” attributes refers to the “repeatability”, “closure” and “conservatism”. “Repeatability” refers to that it has always been a tendency to repeat the existing knowledge experience and moral norm; “Closure” refers to the closed education (mainly school education) in time and space, especially separated with the developing society; “Conservatism” refers to that being a structure which service to the society and ruled by habits, it naturally tend to maintain and strengthen certain social and education system value [10]. Education “self-preservation” attribute rooted in the basic function of transmitting its inherent culture. Repeatability, closure and conservatism, these are not derogatory words, actually they refers to the stability of the education system. “ChuTing Zhang pointed out in the book *Education Philosophy*”: education conservatism gives expression to the human nature, human nature is the source of conscience and also is the resource of conservatism.” “An extremely important aspect of education conservatism is to keep human origin, education is trying to save human nature, and thus, that becomes the nature of education.” It is because of the function and influence of “self-preservation” property, education inevitably presents a conservative property.

75.3.2 The Hysteresis Quality of Technology in Education

Marx once pointed out that the development of technology will cause the change of the production mode and social relations. Seeing from the relationship history

between technology and education, the manifestation of the relationship problem between technology and education may be multitudinous: On the one hand, the progress and application of technology promoted the great development of education, for example: the transition of technology lead to the change of educational ideology; technical innovation enriched education organization methods; On the other hand, speaking of the changes of each field in society, education field is still relatively conservative and lag behind, the present application of information technique is far behind the technology development. As the futurologist Negroponte described in the book *Digital Life: a mid 19th surgeon magically traversed a time tunnel into a modern operating room. To him, everything is entirely new... modern technology has completely changed the face of surgical medicine. However, another 19th century teacher traveling on the same time machine into a modern classroom, can immediately take over from his 20th century peers, except for some detail changes of the course content there. In hundreds of years, the development of the information technology sparked other fields of great changes, but why modern technology doesn't change education so profoundly? This is a problem worth pondering. The essential attribute of education is to cultivate people, education do not belong to the physical material production activities, but belong to the reproduction and recreation of human beings. Look from the essential attribute of education, the level of talents is the key for the national survival and development. Education is not allowed to fail which doomed education to keep more than innovate and maintain more than change in the process of adapting to the rapid changes in the external environment and changing its own form. As a kind of social practice of training people, educations naturally become a field that use least technology and change the slowest. Seeing from the education process, on the one hand, educators are using the acquired technology, and not natural talent. That means, educators are having a risk of failure in the course of study there. On the other hand, the education object is people, and technology is a double-edged sword. Technology applied in the special field of education, is not only the transmission of knowledge, more importantly, it affects learners' emotions, attitudes and values. That make the development of technology and application inclined more to service the conservatism of education. Seeing from the results of education process, the inspection standards and process on education product is much more complex and long than material products. As the saying goes, "it takes 10 years grow trees, but one hundred to rear people". GuiSheng Chen said in the book *Education Principle* (second edition) that, education activities have a long cycle, the effectiveness of education can only be fully shown long after the education period, and personal achievements are highly and easily influenced by the subjective and objective aspects, so it is quite difficult to determine the education effect in the proportion of a person's success.*

75.4 Approaches: To Promote the Reform and Development of Education Teaching Using Technology

75.4.1 The Demand of Education and the “Survival of the Fittest” in Technology

Investigating the relationship process between technology and education, we can clearly understand that education conservatism is decided by the special culture of education and its own development regularity. Not every kind of technology can enter into the education field and acquire a wide range of recognition in the process of application. An important rule for technology development and popularity is that technology must fit the particularity of its field and users. Speaking from education function, it covers human development and social development two aspects, and education always choose those relevant technology who promote its function development; Speaking from the education process, education chooses those technologies which promote teaching and learning. Carnegie education committee once pointed out: “technology should serves for teaching but not the other way around. Using various kinds of technical means in teaching, we should not use technology for nothing; or scramble for it because of being afraid of falling behind when other schools adopted some new teaching technology. In that way, it will be difficult to achieve good effects. In fact, use certain complex teaching technology in teaching does not necessarily mean that it can improve teaching or the results. The key question is whether the educators understand the complex relationship between teaching technology and teaching process, or if the use of technology fits the characteristics of the subject.....” Seeing from the perspective of communication, education is an activity of information transferring and accepting process; and seeing from the angle of sociology, education is a process of educatees socialization process. We know that education chose technology, the prior process mainly focused on communication tools (media technology), the choice standard is whether they can effectively promote teaching. That means, requirements for media technology is that it needs to change the information carrier and methods, and strive to improve the transfer efficiency; the latter process mainly focused on technology effective application (intelligence technology), the choice standard is whether they can effectively promote the all-round development of human being. That means, requirements for intelligence technology is that it needs to change position while applying media technology, namely, strive for the comprehensive development of human being in the process of teaching–learning–socialization. Education needs have impact on technology “the survival of the fittest” that makes the development and application of technology inclined to serve for the education conservatism. While adhering to its natural at the same time, education needs innovation to accommodate the development and change of the society.

75.4.2 Through the Education Own Change to Adapt to the Technology Development

The occurrence, development and operation of education have a certain rule. This internal regularity reflects the nature and requirements of education and reveals many original properties of education activity, so, in a sense it means to insist, not to change easily or being violated by anybody at any time. Conservatism of education does not mean it is exactly machine-parsable; it is relative to the innovation of education. In the development course of education, on one hand it insists, on the other hand it changes, and it develops while insisting and changing. GuiSheng Chen think that the vitality of education lies in: its health depends on the various internal institutions, such as administrative department, teaching majors, coordination between a large number of young people existing as the education reason, and families gather surrounding education and observe education from different points of view. "Education can make its reappearance; also can make its update". Education's "self-renewal" rooted in the contradiction between education system and the social system. Education administration, teachers, students, families and contradiction of the society will inevitably impel them to maintain dynamic balance through coordination and change. In that case, education has to possess some kind of update nature. In today's society, information technology not only profoundly change people's way of working, living and learning, but also have significant influence on education concept, teaching patterns and so on. When information technology enters into education, this pesky complex humanity, its development met more fierce argument and obstacles than any other fields. But under the support of technology, directly or indirectly, education will lead to new scientific and cultural knowledge and values. The accumulation of new knowledge and concepts will cause the renewal of education and the society. XinMin Sang explicitly pointed out that, computers' "tragic fate" in the education field were not caused by technology itself but something outside technology. Old education notion, teaching concept, teaching system and teaching methods and others constraint the information technology application in education, inhibit the role of information technology and limit the application of information technology. In order to better promote education technology development, the most pressing thing is the reform of education ideas and teaching concepts. For this reason, education needs its own change to fit the information technology development, so as to reach the real coupling of technology and education.

75.5 Conclusions

In a word, this paper having a visual angle of the relationship between technology and education, explore using technology to improve reformation and development of education teaching, is just a tentative study. Its value does not exist in the

conclusions or results, but in the thinking during the process of researching the problem.

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References

1. Peng SD (2000) The definition and proposition of educational technology. *Audio-Vis Educ Program Res* 10:18–22
2. He KK (2009) *Education technology*. Beijing Normal University Press, Beijing, vol 38, pp 60–69
3. Shan MX (2008) *Technology education research in the vision of technological philosophy*. Nanjing Normal University, Nanjing
4. Jiao JL (2008) *The basic theories of education technology*. Guangdong Educational Press, Guangzhou, vol 140, pp 22–27
5. Chen GS (2001) *Educational principles (Second edn)*. East China Normal University Press, Shanghai, vol 10, pp 45–48
6. Wang SJ (2010) The research about the connotation of education technology from multi-perspectives. *e-Educ Res* 10:32–37
7. Zha YL (2001) *Education modelling*. Guangxi Education Publishing House, Nanning, vol 121, pp 35–40
8. Chen GS (2004) The re-understanding of “schools’ self-preservation”. *Jiangxi Educ Sci Res* 11:9–10
9. UNESCO (1996) International education development committee. *The education world learn to survive—today and tomorrow*. Educational Science Press, Beijing, vol 85, pp 99–103
10. Li XR (1994) Comments on the duality influence of education on social development. *J Sichuan Educ Inst* 10:9–15

Chapter 76

Comparative Analysis Anaerobic Ability Basketball Player in Vertical Leap and Linear Sprint

Shihong Liu and Hai Chen

Abstract The purpose of this paper is to compare the two sport-specific field test in common basketball training program, in order to test the athletes' anaerobic ability. Respondents are mainly 17 years old or so of the national youth basketball player, and field tests include vertical leap (CMJ), 15 s anaerobic jump test (APJT), and sprint tests to assess anaerobic kilometers power (linear). The results show that the vertical leap straight sprint and tests are acceptable field tests for a basketball player for specific anaerobic power.

Keywords Wingate test · Vertical leap · Sprint line · Kendall rank correlation analysis

76.1 Introduction

In modern sports, in addition to power and speed of the competition, there is also the comparison of the endurance, and athletes' anaerobic ability is one of the key elements to win the competition. At current many sports scientists and coaches widely believe that the adaptability of the athletes and performance testing are very important factors in athletes' designed training plan in the project of the athlete's progress analysis. Anaerobic ability is considered that athletes' working

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ability when the muscles do not provide enough oxygen for the body [1]. Generally speaking, in an anaerobic state and a short time period, athletes have shown the explosive force which is, the maximum speed and power meaning the speed of finishing the work. In basketball games, a successful performance mainly dependent on several fitness adaptability part (for example, speed, agility and vertical leap) [2]. The movement is in essence anaerobic properties, and these components must be repeated, with the lowest reduce competition for the performance. Currently there is no particular test that can be used as a measure of basketball player anaerobic power acceptance standards [3].

Wingate anaerobic test (WAnT) is the application of basic rotation based on laboratory tests, mainly to measure peak power (PP), average power (MP) and fatigue [4]. It is considered to be the most commonly used method in testing anaerobic adaptability [5]. But, muscle and activities related to the specificity of the model and the basketball athletes Wingate testing whether it is accessible are the problems that might block everybody's widely accepted notion and for most basketball teams in the experiment. Vertical leap of power for basketball player may be a more specific test. And if the basketball player can finish the test on the field will make him more appropriate than WAnT or more attractive. Linear sprint is a field test, which has already been planned as one of the athletes' anaerobic ability test measures. It has an advantage in testing basketball player: this test is a kind of common basketball practice drills, which can also be used to test several athletes [6]. Therefore, the purpose of this paper is to compare the vertical leap and linear sprint in the basketball movement in common training plan, in order to test the athletes' anaerobic ability [7].

76.2 Test Subjects and Research Methods

Nine players in the national youth basketball team are willing to accept the test. Characteristics of the test subjects of athletes are as follows (average \pm SD): Age, 17.0 ± 0.0 years; Weight, 66.1 ± 6.0 kg; Height, 179.2 ± 2.7 cm; Body fat (%), 10.1 ± 2.5 %. Subjects in the national team training received tests in the days before the testing; therefore we can assume that all of the subjects have very good basketball conditions. All the tests are executed as Wingate test.

Anaerobic ability is considered that athletes' working ability when the muscles do not provide enough oxygen for the body. Generally speaking, in an anaerobic state and a short time period, athletes have shown the explosive force which is, the maximum speed and power meaning the speed of finishing the work. In basketball games, a successful performance mainly dependent on several fitness adaptability part (for example, speed, agility and vertical leap). The movement is in essence anaerobic properties, and these components must be repeated, with the lowest reduce competition for the performance. Currently there is no particular test that can be used as a measure of basketball player anaerobic power acceptance standards.

Wingate anaerobic test is the application of basic rotation based on laboratory tests, mainly to measure peak power (PP), average power (MP) and fatigue. It is considered to be the most commonly used method in testing anaerobic adaptability. But, muscle and activities related to the specificity of the model and the basketball athletes Wingate testing whether it is accessible are the problems that might block everybody's widely accepted notion and for most basketball teams in the experiment. Vertical leap of power for basketball player may be a more specific test. And if the basketball player can finish the test on the field will make him more appropriate than WAnT or more attractive. Linear sprint is a field test, which has already been planned as one of the athletes' anaerobic ability test measures. It has an advantage in testing basketball player: this test is a kind of common basketball practice drills, which can also be used to test several athletes.

The Kendall rank correlation coefficient analysis method of test is used to do data processing. The test data are based on the average \pm SD to display. When there are significant level relations (p than 0.05), there is no significant relationship ($p > 0.05$). In the use of Kendall rank correlation coefficient of the test data in the process, for case $n \leq 30$, the Kendall level can be directly used to relevant statistics, and statistical analysis software can be directly obtained according to the table to corresponding companions probability value. In this study, there are nine test subjects, meaning we can directly use this form, and then use SPSS for analysis.

$$T = \frac{2P}{\frac{1}{2}n(n-1)} - 1 = \frac{4P}{n(n-1)} - 1 \quad (76.1)$$

76.3 Research Steps

Based on the laboratory (WAnT) and the field test (vertical leap and linear sprint), this paper can make anaerobic ability measurement. WAnT needs to use computer operation, to adjust to reserve seat height until there is a 90° ankle flexion, a complete extension knees and a fixed toe. The test subjects in the test requirements should remain in the seat.

The first test subject are doing in cycling 60–70 RPM speed of the 5 min warming up and then calculated the WAnT 20 % of the equivalent resistance. After two of the 5 s without load in the third stage of the final sprint and 5 min during the warm-up, we can record the sprint in the biggest cycling rate (RPM-max). And then in a minute rest, testers should use WAnT to test, and to pedal as quickly as possible. When the previous 75 % of RPMmax is recorded, the computer executive will use resistance. During the test, testers can keep a high-speed trample rates through the 30 s of the test of time. Steps are monitored in 0.025 RPM, and in every 1 s time interval it is recorded. The test of PP (sure to test the 5 s during the peak), MP (be sure to test for the 30 s average power) and fatigue

index (FIWAnT, the lowest during 5 s divided by the peak during 5 s). The data in each test will be calculated.

Vertical leap is measured with backward motion (CMJ) vertical leap of the maximum. All testers stand in the rubber contact platform (120 * 380 cm), and a cable is connected to a digital timer, to record jumping time in the testing. The timer for the test of the feet and then touching the ground namely stop recording. Jumping time is used to calculate the centre of the human body height change. We will record the highest CMJ height value. Anaerobic ability to jump over the experiment (APJT) also through the 15 s of vertical leap will make the measurement. Anaerobic ability will be calculated through the general jump time and the number of jumping movement.

Linear sprint is a common site test for basketball players, which can be used to measure individual anaerobic ability. Linear sprint is conducted in the normal basketball court for sprint. Firstly, the testers stand on the base, with the fastest speed in free throws to nearby line (5.8 m), a half line (14.3 m), far from (22.9 m), and far baseline (28.7 m) of separation of the cone position. They will reach the cone position, namely the sprint to return to the baseline, and reach the next line. Sprint line in three times (T1, T2 and T3), and in every time the sprint have 2 min to rest. Fatigue index (FILD) is produced by the slowest and the fastest record in those three times.

76.4 Statistical Analysis

The vertical leap and straight sprint will be recorded by Kendall rank correlation tables, with statistical analysis software to draw the following results, as is shown in Table 76.1.

The fastest sprint lines are F, G, I, and their average power output and vertical leap are also the highest. In addition, A, C, D in straight line sprint is the slowest. In addition, their average power output and vertical leap performance are not good. Kendall (τ) rank correlation analysis shows that there is a significant positive

Table 76.1 Test results of the testers

Testers	T1 (s)	T2 (2)	T3 (2)	FI _{LD} (%)	PP (W kg ⁻¹)	MP (W kg ⁻¹)	FI _{WAnT} (%)	CMJ (cm)
A	28.9	29.9	30.7	1.15	16.1	9.3	58.2	49.5
B	27.2	29.1	30.2	1.10	13.4	9.2	50.9	45.6
C	28.9	29.6	30.2	1.05	18.1	8.7	47.3	41.3
D	27.5	29.0	28.4	1.01	12.9	7.4	64.1	48.2
E	27.0	28.6	30.5	1.09	12.6	8.9	53.1	49.5
F	25.8	27.4	29.6	1.17	13.5	10.7	53.5	50.2
G	26.8	26.3	26.7	1.04	15.8	10.7	59.2	55.4
H	26.9	27.4	29.8	1.08	15.3	9.4	59.6	57.5
I	26.7	26.9	27.3	1.12	16.2	11.8	52.8	56.9

relationship between the CMJ and T1 ($\tau = 0.58$), T2 ($\tau = 0.78$) and between APJT and T2 ($\tau = 0.61$), and a positive correlation ($p < 0.05$) between APJT and T3 ($\tau = 0.61$). The relation between MP and T1 ($\tau = 0.61$), T2 ($\tau = 0.54$) is moderate, and PP and linear sprint of relevance is not significant.

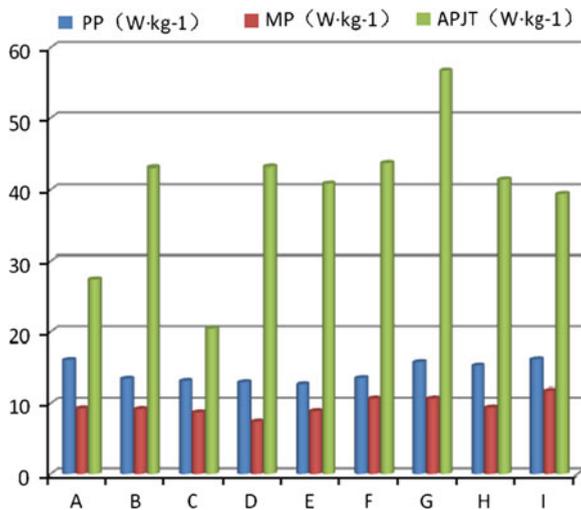
Nine players in the national youth basketball team are willing to accept the test. Characteristics of the test subjects of athletes are as follows (average \pm SD): Age, 17.0 ± 0.0 years; Weight, 66.1 ± 6.0 kg; Height, 179.2 ± 2.7 cm; Body fat (%), 10.1 ± 2.5 %. Subjects in the national team training received tests in the days before the testing; therefore we can assume that all of the subjects have very good basketball conditions. All the tests are executed as Wingate test.

The Kendall rank correlation coefficient analysis method of test is used to do data processing. The test data are based on the average \pm SD to display. When there are significant level relations (p than 0.05), there is no significant relationship ($p > 0.05$). In the use of Kendall rank correlation coefficient of the test data in the process, for case $n \leq 30$, the Kendall level can be directly used to relevant statistics, and statistical analysis software can be directly obtained according to the table to corresponding companions probability value. In this study, there are nine test subjects, meaning we can directly use this form, and then use SPSS for analysis.

CMJ and PP ($\tau = 0.59$), MP ($\tau = 0.76$) have a significant positive correlation. However, relationship between APJT and PP ($\tau = 0.20$), MP ($\tau = 0.28$) is not significant ($p > 0.05$). There is no significant correlation between FILD and FI-WAnT ($\tau = 0.22$, $p > 0.05$) (Fig. 76.1).

Linear sprint is an appropriate field test for the measurement of a basketball player's anaerobic adaptability. But later we will have to increase the sample size. Because of the widespread application of basketball coach, linear sprint as a basketball player anaerobic measurement is quite attractive. And the test is more

Fig. 76.1 Relationship between testers APJT and PP, MP



efficient and practical when several players are running the same test. Linear sprint and vertical leap tests are acceptable field tests to measure a basketball player's specific anaerobic power, though APJT and WAnT measure lower anaerobic ability. The difference is because the lower limbs ability is produced simultaneously or successively. And when the upper limbs muscle is active or passive, they will have better performance impact.

The fatigue index between WAnT and linear sprint doesn't have any relationship; this may be due to the fact that the two test movements are caused by different rules. WAnT is a separate movement for 30 s. But sprint also has the same three phases as WAnT, but there are 2 min to rest. Therefore, FIWAnT is to measure a single sports fatigue index, and FILD is to test the recovery probability. If we conduct multiple, discontinuous WAnT test in this study, perhaps the two sports fatigue index will be more similar.

76.5 Conclusion

Linear sprint is an appropriate field test for the measurement of a basketball player's anaerobic adaptability. But later we will have to increase the sample size. Because of the widespread application of basketball coach, linear sprint as a basketball player anaerobic measurement is quite attractive. And the test is more efficient and practical when several players are running the same test. Linear sprint and vertical leap tests are acceptable field tests to measure a basketball player's specific anaerobic power, though APJT and WAnT measure lower anaerobic ability. The difference is because the lower limbs ability is produced simultaneously or successively. And when the upper limbs muscle is active or passive, they will have better performance impact.

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References

1. Wang J (2009) Research progress in indirect measuring anaerobic ability. *Chin Sports Sci Technol* 6:11–14
2. Seminick D (1994) Testing protocols and procedures. In: Baechle T (ed) *Essentials of strength training and conditioning*. Human Kinetics, Champaign
3. Kai Kang (2010) Anaerobic ability analysis of Shandong elite free combat athletes. *Shandong Inst Phys Educ* 3:76–78

4. Hao Wu, Meiyun Feng (2006) Metabolic research of Wingate test method. *J Beijing Sport Univ* 20(1):30–37
5. Zhao Y (2010) College PE majors and ordinary university students and HUR Wingate force measurement without oxygen ability test machine analysis. *Zhejiang Sports Sci* 20(1):114–116
6. Zhang B, Wang L, Zhou J, Bai J (2008) Influence of strength training combination on basketball player vertical jumping ability. *J Hebei Sports Inst* 5(1):83–86
7. Li Y (2011) Analysis of the speed of the men's 1500 m athletes sprint ability. *J Chin Sci Technol Innov DaoKan* 30(14):25–28

Chapter 77

Simulation Analysis on Muscle Dynamics of Tennis Players

Hai Chen and Shihong Liu

Abstract Because the wrist and tendon strength of the tennis player will overload in the process of batting, long time exercises will result in ailments. Therefore, through studying the muscles of the tennis dynamics, this paper makes an in-depth analysis of the muscles of the athletes. At the same time the dynamic model equation is established, and the muscle state characteristics are analyzed from the angle kinematics. A wrist and tendon interaction relation model is also established to provide a reference analysis for tennis players to protect their muscles.

Keywords Self-management · Psychological adjustment model · Factor analysis · SPSS

77.1 Introduction

At present, tennis players often meet with pains in cubits lateral epicondylitis or the regional side of humerus [1]. Some studies found that athletes' repeated wrist movement on the ulnar wrist to stretch muscles trauma is the cause of the disease. After the survey, the rate of lateral epicondylitis in tennis players aged at about 30 is as high as 50 %. Through the kinematics experts' analysis and the application of the technology, it is concluded that backhand players use the position of the wrist

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produces stroke in the process of strike. And when the pressure increases, it will cause the feet side wrist extensor muscles phenomenon. And some researchers observed from wrist joint angle the damage tensor in tennis player wrist when motion through the eccentric contraction [2]. First of all, muscle contraction can cause muscle damage and muscle fiber denaturation. Second, injury characteristics of isometric muscles may exceed to a superior position digestion which is a big load during movement of muscle. Until now, muscle strength and internal muscle kinematics cannot be evaluated to prove or disprove the speculative nature of potential damage mechanism. Therefore, by using computer technology to monitor the muscles tennis player in computer control on the ulnar wrist extensor muscles, this paper has collected data and established the athletes' muscle dynamics model, which will be applied in analyzing muscle related characteristics [3].

77.2 Model Method and Movement Equation Establishment

Through athletes' electromyography detection and characteristics data of each player, this paper analyzes the specific factors of the model. Muscle models include CC series and two elastic components, a representative muscle fiber elastic (SECF) and other representatives of the tendons of flexibility. Component machinery in the body of the contraction is from measuring the performance evaluation, and from the nuclear magnetic resonance image based on feature representatives on the ulnar wrist extensor muscles expression. In mechanical properties test, we have determined the use of FPL torque motor device, and quickly provide muscle stretching to determine its muscle characteristics. First, make sure muscle tendon isometric, torque-angular velocity, muscle characteristics factors such as the use of continuous cross-sectional magnetic resonance imaging (5 mm thickness) right forearm muscles point figure results identify muscle origin, length, volume, tendons length [4]. At the same time, it will be transformed into FPL dynamic linear equations, describing the mechanics properties of the FPL and then representing wrist extensor muscle characteristics.

According to the above established model system and the movement equation of dynamics, the dynamic equations of tendon can be set for a two-dimension model equations:

$$m\ddot{x} = \frac{\partial}{\partial x} (U_a + U_s) + F_x(t) - \alpha\dot{x} \quad (77.1)$$

$$m\ddot{y} = \frac{\partial}{\partial y} (U_a + U_s) + F_y(t) - \beta\dot{y} \quad (77.2)$$

At the same time, the tendon motion equation of a tennis player is established as follows:

$$M\ddot{x}_2 = \frac{\partial}{\partial x_2} U_a + F_{x_2}(t) - \eta\dot{x}_2 \tag{77.3}$$

Among them, “m” and “M” are muscle keys and muscle protein quality respectively.

77.3 Principle Analysis

77.3.1 Wrist Kinematics

Time series data description and advanced electromyography (EMG) connection for kinematics can form a backhand motion model of a tennis player. The advanced mode can observe the wrist joint motion situation and activate [5]. Although the amplitude activation and angular position were significantly different, when the impact to the bending angle of the wrist peaks about 10°, muscles can rapidly expand their movement. Wrist angle position will increase muscle movement influence due to a sharp bend [6]. After the bending moment of the wrist, impact strength is obviously better than the state before and is greatly reduced. And the deviation angles to the influence of the radial shaft shows the wrist and tendon interactions. When athletes began to exercise cubit, their feet deviation angle position will increase quickly. Immediately after batting, tendon angular position will suddenly slow down and increase the deviation peak at about 24°. Under impact, in the short period of change of direction, deviation from the radial size continued to grow to about 15°, as shown in Figs. 77.1 and 77.2.

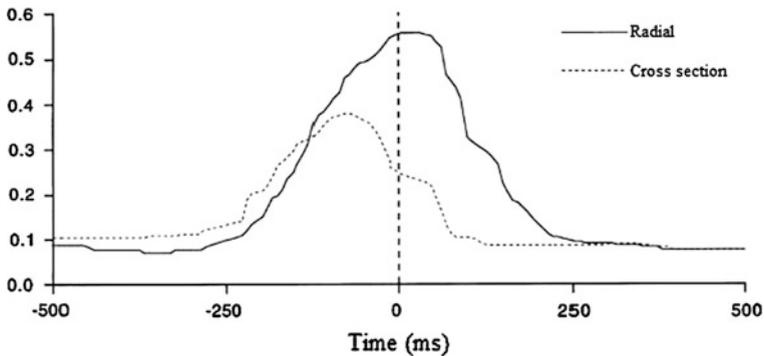


Fig. 77.1 Electromyography (EMG) and wrist kinematics

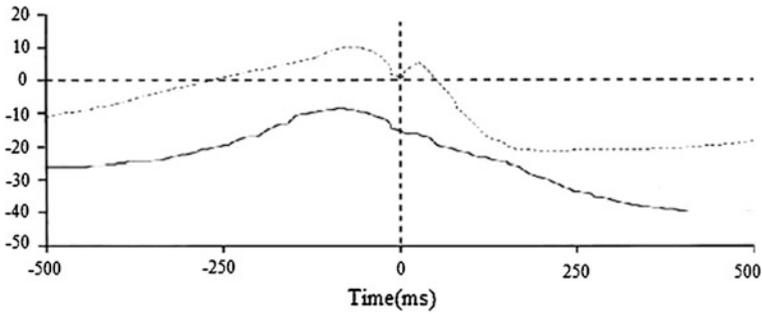


Fig. 77.2 Electromyography (EMG) and wrist movement bending angle

77.3.2 Feet Side Wrist Extensor Muscles Dynamics

According to the forecasted model of advanced muscle dynamics, influence occurred at (128 ms) peak strength, but the influence on athletes happened after 32 ms muscles peak force. This shows that better muscle strength can be used to predict tendon stimulation (EMG) influence degree. However, this also shows kinematics can also play an important role in determining the muscle strength, as shown in Fig. 77.3 below.

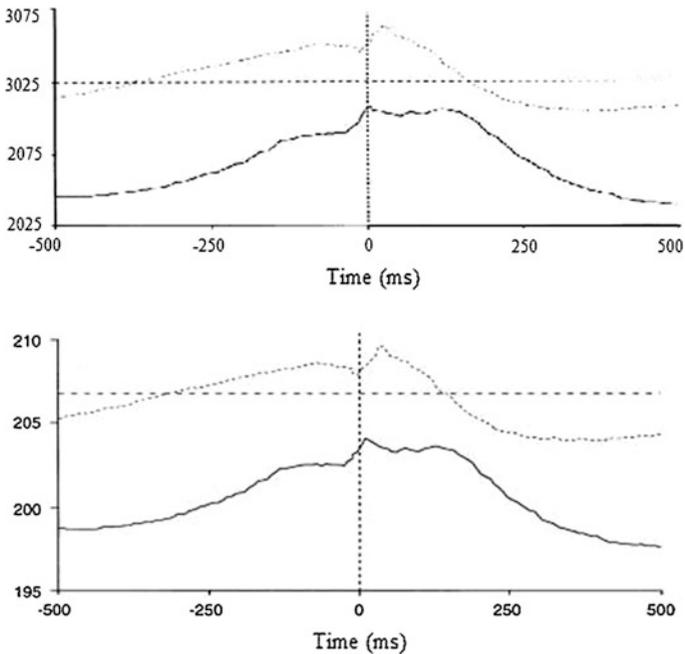


Fig. 77.3 Effect of tendon stimulation (EMG) on peak figure

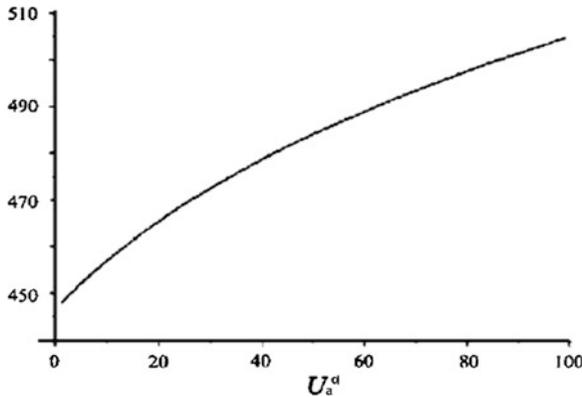


Fig. 77.4 Stretch length of muscles and tendons variation

Table 77.1 Tennis player forehand muscle power value

Temporalitaet of muscles	EMG/mv·s ⁻¹
5	0.552
6	0.392
7	0.549
8	0.368
9	0.364
10	0.189
11	0.058
12	0.227
13	0.123
14	0.234
15	0.442
16	0.436

77.3.3 Feet Side Wrist Extensor Muscles Kinematics

In wrist kinematics analysis, we know although muscles extend can lead to shock after shortening the track of the ball movement, the ulnar wrist extensor muscles received impact through the wrist movement in the process. By furthering the analysis, we can use side wrist extensor muscles length change muscles movement to determine the length distribution model tendon. Muscle is a part of CC and fiber series elastic components (SECF) composition. Similarly, the two ingredients are equal to the length of the muscle fibers, which makes muscle movement lead to the muscles and tendons' slow stretch and the change of the length of the small movement, which can be seen in Fig. 77.4. Table 77.1 is tennis player forehand muscle power value.

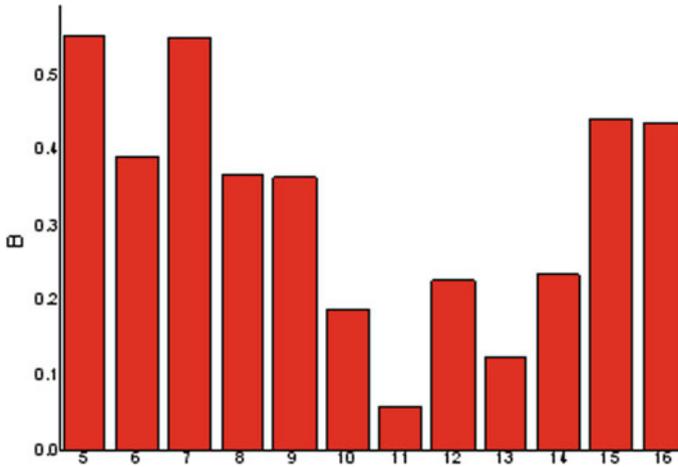


Fig. 77.5 Tennis player forehand time EMG

77.4 Conclusion

Our survey results confirm when tennis player is batting; the muscles will generate centrifugal contraction. It is also concluded the mechanism and process of the ulnar wrist extensor muscles and wrist flexion and the dynamics in the process of impact. On the other hand, through the establishment of muscle kinematics model, we can put the theory into power of movement and tendons angle and find the mutual relationship between them. Therefore, we can use EMG on muscle position of the degree of interaction to predict the muscle of the state. In theory, it provides the dynamics of muscle factors for a tennis player in the process of batting. This method can provide a good state and ego to protect the basis for the athletes (Fig. 77.5).

References

1. Zhixiang T, Bing Q, Jianjian L (2008) Comparative analysis of technique features in Roger Federer v.s. Rafael Nadal. *J Beijing Sport Univ* 31(11):1560–1562
2. Liying Z (2006) Experimental study on forehand and backhand teaching orders. Wuhan institute of physical education degree thesis 12(05):215–218
3. Yajun L (1995) EMG of table tennis basic techniques. *J Tianjin Sports Inst* 10(3):18–21
4. Zhigang Y, Li W (2008) EMG of the server technology of tennis player in our country. *J Cap Inst Phys Educ* 5:86–89
5. Zhixiong S, Zhijian H (2010) Experiment on rhythm central control strategy. *China J Sports Med* 29(1):8–13
6. Yongzhi L (2002) Experiment on two different biological mechanics of starting. *Chin Sports Sci Technol* 38(5):57–58

Chapter 78

Body Composition Analysis of Female Basketball Players in Chinese Universities

Hongwen Xue, Guoqing Yang and Yong Yu

Abstract The purpose of the study was to determine the physique and body composition of female basketball players in Chinese universities and to examine these variables in relation to their playing position. Thirteen females of the Chinese Basketball teams were measured on thirteen different anthropometric sites. Including: females' PBF (24.65 ± 2.73). Females' BMI (22.98 ± 2.32). Females' FFM (55.69 ± 7.58) and STD W (70.72 ± 5.93). At nutrients, females' protein (11.33 ± 1.49), minerals (4.26 ± 0.65) and TBW (40.09 ± 5.46). Females' body age (20.31 ± 2.06). On basal metabolism, females' BMR (1426 ± 90) and TEC (2196 ± 138). Females' WHR (0.74 ± 0.03).

Keywords Body composition · Female basketball players · Universities

78.1 Introduction

Physical abilities of players exert marked effects on the skill of the players themselves and the tactics of the team, because ball games demand repeated maximum exertion such as dashing and jumping [1–3]. Therefore, Body

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composition is very important for basketball players who are easy to pass, dribble, shooting, defend, attack, confrontation, etc [4–7].

Body composition analysis is a physical test that measures the proportion of the various components of a person's body. The human body is comprised of water, protein, fat, and minerals—but for most purposes, it is the level of fat compared to lean mass that is of interest. In general, most body composition analysis tests measure the ratio of fat to lean tissue. Body fat, or adipose tissue, has chemical and physical properties that allow for a number of analytical methods, each with its own advantages and limitations. The most common forms of body composition analysis are the body mass index (BMI), skin fold caliper testing, bioelectrical impedance, and hydrostatic weighing [8].

In this study, to provide a reference for improving the competitive level of senior school players and to clarify conditions to be top athletes, we evaluated characteristics of physical abilities of the members of the male and female basketball teams that won the championship in the Chinese Inter- senior School Meeting.

78.2 Materials and Methods

78.2.1 Materials

The subjects were 13 females in Chinese universities, aged (20.69 ± 2.24), high (179.13 ± 7.66), weight (74.13 ± 11.59). The players participated in two compulsory physical education lessons per week at school. Additionally, they took part 5–6 times per week in basketball training activities.

78.2.2 Methods

Body composition was analyzed using a dual energy x-ray (DPX-L; Lunar Radiation Corporation, Madison, Wisconsin, USA). Total and regional fat and lean body mass were determined using a total body scan. Including high, weight, percentage of body fat (PBF), BMI, fat-free mass (FFM), standard weight (STDW), protein, minerals, total body water (TBW), body age (BA), basal metabolic rate (BMR), total energy consumption (TEC), waist-hip ratio (WHR).

The latest addition to the Tania Body Composition professional product line, the SC-331S now includes body fat ranges for children and new Healthy Range Indicators which automatically compare several key measurements to their respective healthy range. Print out total body composition readings including: Weight, Fat %, Fat Mass, Total Body Water, Muscle Mass, Basal Metabolic Rate, Bone Mass, a unique Visceral Fat indicator, Body Mass Index, and much more.

The Wrestler Mode option helps determine a wrestler’s minimum wrestling weight based on established guidelines. Preset with both Collegiate and High School minimum body fat percentile standards, the SC-331S gives you the ability to use the same machine for any weight class of wrestlers. Using the USB data interface, users are able to program the SC-331S remotely as well as output the data for EMR applications.

Data analysis was performed using SPSS 18.0 for Windows (Chicago, IL). Standard statistical methods were used to calculate mean and standard deviation (SD). Data for the unilateral and bilateral groups were then expressed as z scores using the mean and standard deviation of the corresponding score from the control group. Analysis body composition of basketball players in Chinese universities.

78.3 Result

Body composition variables of the players are presented in Table 78.1. Females’ PBF (24.65 ± 2.73). Females’ BMI (22.98 ± 2.32). females’ FFM (55.69 ± 7.58) and STD W (70.72 ± 5.93). At nutrients, females’ protein (11.33 ± 1.49), minerals (4.26 ± 0.65) and TBW (40.09 ± 5.46). Females’ body age (20.31 ± 2.06). On basal metabolism, females’ BMR (1426 ± 90) and TEC (2196 ± 138). Females’ WHR (0.74 ± 0.03).

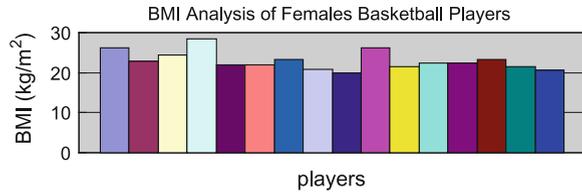
BMI is a simple index of weight-for-height that is commonly used to classify underweight, overweight and obesity in adults. BMI can be used to indicate if you are overweight, obese, underweight or normal. It will, however, overestimate fatness in people who are muscular or athletic. Because of these problems, this body mass index calculator shows extra statistics to help you be informed and judge your own body compared to others of the same height and age. Also offered are average weight and height charts and Body Mass Index charts, which show data you just can’t find anywhere else.

BMI Analysis of Females Basketball Players are presented in Map 1. female basketball players’ BMI is the general level (Fig. 78.1).

Table 78.1 Male, female basketball players body composition indicators

G	PBF	BMI	FFM	STD W	Protein	Minerals
F	24.65 ± 2.73	22.98 ± 2.32	55.69 ± 7.58	70.72 ± 5.93	11.33 ± 1.49	4.26 ± 0.65
TBW	BA	BMR	TEC	WHR		
40.09 ± 5.46	20.31 ± 2.06	1426 ± 90	2196 ± 138	0.74 ± 0.03		

Fig. 78.1 BMI analysis of females basketball players



78.4 Discussion

Total body fat percentage was measured by dual-energy X-ray (DXA) using a DPX-IQ densitometer (Lunar Corp., Madison, USA). Additionally, fat percentage, fat mass and lean mass of the right hand were used. A person's body fat percentage is the total weight of the person's fat divided by the person's weight and consists of essential body fat and storage body fat. Essential body fat is necessary to maintain life and reproductive functions. The percentage of essential body fat for women is greater than that for men, due to the demands of childbearing and other hormonal functions. The percentage of essential fat is 3–5 % in men, and 8–12 % in women. Storage body fat consists of fat accumulation in adipose tissue, part of which protects internal organs in the chest and abdomen. The minimum recommended total body fat percentage exceeds the essential fat percentage value reported above. A number of online tools are available for calculating estimated body fat percentage.

Some regard the body fat percentage as the best measure of an individual's fitness level since it is the only body measurement which directly calculates the particular individual's body composition without regard to the individual's height or weight. The widely used BMI provides a measure that allows for the comparison of individuals of different heights in terms of their weight. Due to differences in body composition, the BMI is not necessarily an accurate indicator of body fat; for example, individuals with greater muscle mass will have higher BMI. The thresholds between "normal" and "overweight" and between "overweight" and "obese" are sometimes disputed for this reason.

In Chinese universities, female basketball players' PBF is nice.

BMI is defined as the weight in kilograms divided by the square of the height in meters (kg/m²). This is a numerical value of your weight in relation to your height. BMI are good indicators of healthy or unhealthy weights for adult men and women, regardless of body frame size. The BMI, is a heuristic proxy for human body fat based on an individual's weight and height. BMI does not actually measure the percentage of body fat. It was devised between 1830 and 1850 by the Belgian polymath Adolphe Quetelet during the course of developing "social physics". Body mass index is defined as the individual's body weight divided by the square of his or her height. The formulae universally used in medicine produce a unit of measure of kg/m². BMI can also be determined using a BMI chart, which displays BMI as a function of weight (horizontal axis) and height (vertical axis)

using contour lines for different values of BMI or colors for different BMI categories.

In Chinese universities, female basketball players' BMI is the general level.

FFM is a parameter that reflects the muscle mass. The value of FFM is largely dependent on the physique including the height and body weight. For this reason, we calculated FFM per 1 m of the height to evaluate the muscle mass relative to the skeleton, which is the framework of the body. To gain lean body mass and get more muscles you have to eat. A scenario that you frequently hear about is to go on a bulk mass diet and then you cut calories out to get that lean body workout. You need more protein and food than what you burn on a daily basis without exercising to build muscle. If you do not ingest enough nutrients you will not gain any muscle or body mass and you might even lose some, even if you are working out. So while it is true that you need a certain amount of protein and amino acids to build muscles, there are still a few things to consider before bulking up.

The more you eat, the more you grow is true. However, it won't be all muscle mass. Everyone got a limit of how much food that can get synthesised to muscle mass. You can eat loads of food, but you cannot change the limit to synthesis proteins. Adding more food will help until you reach your physical limit of how fast you can turn nutrition into lean body mass, after that it will just add fat.

When you gain fat the fat cells in your body grows and fills up. If you continue to eat and bulk you will produce more of those cells to fill up. However, going into a cutting diet and losing the weight will only make you lose the fat inside the cells. The cells will never go away. Another fact is that it's easier for the body to put fat into already existing cells than to produce new once. So while bulking will make you gain body mass you will mostly improve the capacity for you to gain fat in the future.

The conclusion, bulking will not get you any lean body mass. Yes, you have to eat more calories than you burn per day to add muscle. But eating too much will only get you over the limit of what your body can process and will make you fat.

In Chinese universities, female basketball players' FFM and STD W both are bad.

Proteins are contained in the body as important parts of tissues, blood hormones, and enzymes. Animal protein and vegetable protein probably have the same effects on health. It's the protein package that's likely to make a difference. A 6-ounce broiled porterhouse steak is a great source of protein—about 40 g worth. But it also delivers about 38 g of fat, 14 of them saturated. That's more than 60 % of the recommended daily intake for saturated fat. The same amount of salmon gives you 34 g of protein and 18 g of fat, 4 of them saturated. A cup of cooked lentils has 18 g of protein, but under 1 g of fat. The structural components of the body that contain these amino acids are continually undergoing a process of breakdown and replacement. At nutrients, females' protein, minerals and TBW are the general level.

BMR measures the inherent composition and utilization of carbohydrates, fats and proteins as they are converted to energy substrate units that can be used by the body as energy. Studies conducted by Spinney in 1990 found strong

correlations between lean mass and metabolism based on indirect calorimetric measurements. BMR and RMR are measured by gas analysis through either direct or indirect calorimetry, though a rough estimation can be acquired through an equation using age, sex, height, and weight. Studies of energy metabolism using both methods provide convincing evidence for the validity of the respiratory quotient (R.Q.), which measures the inherent composition and utilization of carbohydrates, fats and proteins as they are converted to energy substrate units that can be used by the body as energy. Penney discovered that lean tissue in men and women required approximately 16 calories per pound per day. Thus, once a lean mass was known it could be multiplied by 16 to reveal daily caloric needs based on the activity level of the individual. This method has been used in many health club environments to determine daily caloric needs. Females' BMR and TEC are higher than female basketball players in Chinese universities.

Waist-hip ratio (WHR) is the ratio of the circumference of the waist to that of the hips. The WHR has been used as an indicator or measure of the health of a person, and the risk of developing serious health conditions. According to the World Health Organisation's data gathering guidelines ("STEPS") the waist circumference should be measured at the midpoint between the lower margin of the last palpable rib and the top of the iliac crest, using a stretch-resistant tape that provides a constant 100 g tension. Hip circumference should be measured around the widest portion of the buttocks, with the tape parallel to the floor. For both measurements, the subject should stand with feet close together, arms at the side and body weight evenly distributed, and should wear little clothing. The subject should be relaxed, and the measurements should be taken at the end of a normal expiration. Each measurement should be repeated twice; if the measurements are within 1 cm of one another, the average should be calculated. If the difference between the two measurements exceeds 1 cm, the two measurements should be repeated. Chinese basketball female players' WHR is lower.

References

1. Tsai AG, Thomas A (2005) Systematic review: an evaluation of major commercial weight loss programs in the United States. *Ann Intern Med* 142:56-66
2. Westrop N, Rankin W, Ahern M (2004) Measuring grip strength in normal adults: reference ranges and a comparison of electronic and hydraulic instruments. *Hand Surg* 29A:514-519
3. Clin J (2006) Expert panel on the identification, evaluation and treatment of overweight in adults. *Executive Summ* 68:899-917
4. Nevill A (2002) Modelling hand grip strength in the presence of confounding variables: results from the Allied Dunbar National Fitness Survey. *Advances in sport*, pp 291-302

5. Sahlin K, Soderlund K (1998) Energy supply and muscle fatigue in humans. *Acta Physiol* 162:261–266
6. Nicolay C, Walker A (2005) Grip strength and endurance: influences of anthropometric variation. *Hand Dominance* 35:605–618
7. Heredia E, Pena G, Galiana J (2005) Handgrip dynamometer in healthy adults. *Clin* 24:250–258
8. Sartorio A, Lafortuna C, Pogliaghi S (2002) Body dimension and body composition on hand grip strength in healthy children. *Impact Gend* 25:431–435

Chapter 79

Research on Awareness of After-School Physical Exercises

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Abstract This paper adopts questionnaire and use sports-related subject knowledge as a guide by the research College of Anhui Province after-school sports activities in college students on the consciousness, we can analysis the existing problems and try to find a solution. At the same time it can provide suggestions and recommendations for the reform and management of Anhui university sports Research shows that, overall 54 % of the students have a positive attitude in the after-school physical activities. And 91.6 % of students have a strong physical exercise desire. Male and female students participate in extracurricular physical activity distribution of different motives; some students had an aversion to the emotional after-school physical activity, so they lack the knowledge of physical exercise.

Keywords College students · After-school physical activity · Sense of physical exercise · Awareness

79.1 Introduction

Collage sports as an important component of a comprehensive of physical education, it is important, all-round development of human culture. After-school physical exercise is an important part of school physical education and it is also an effective way to improve their physical fitness, It produce a profound significance of college students [1]. Which they develop lifelong physical habits and lifelong

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sports sense. After-school physical activity consciousness is awareness of people for after school sports, and the attitude and the emotion of physical activity, and the regulation of exercise behaviour [2]. It is a conscious reflection. By the essence of sports, features, value, role, sports and people, the relationship between sports and other things. Awareness of the matter is a reflection of a dynamic, strong and weak awareness of physical activity behavior of physical exercise plays a role in promoting or inhibiting [3]. This paper tries to pass a certain number of surveys, and systematic understand students to participate in the sense of after-school physical activity and analyze the main problems, in order to further improve the work of Physical Education and curriculum reform for reference. Person's body is close friends, will participate in regular pattern Refined [4].

Extracurricular sports activities in school students after school life is an important content. 1982 Issued by the ministry of education in primary and middle school students about guarantee every day for 1 h sports activities Notice, asked schools to carry out various extracurricular sports activities, to ensure that every student Every day there are 1 h of sports activities, and put forward for school after school sports teaching Practice and improve students' sports technology and achievement. The current "the People's Republic of China Article 20 the law of specified" the school shall organize various kinds of extracurricular sports activities, "carry out the after school training and sports competition" For after school sports widely develops provides a strong legal guarantee, for the development of the sports after school is pointed out [5].

Most students participate in sports exercise after school of a positive attitude, quite the general attitude points, and rarely a small part of the negative treat [6]. The product of the boys polarity and slightly higher than the girls. We learned from the survey, general each boy all there will be a very attention sports league, and most girls to sports league is known nothing less. So it seems that the interest is the power of physical exercise, there is some university living not willing to take part in physical exercise after school is one of the reasons for the lack of interest [7].

79.2 Subject and Methods

The reprehensive object in different regions of AnHui province, such as Hefei University of Technology, University of Science and Technology of China, Anhui Agricultural University, Anhui University of Science and Technology, Bengbu Medical College, Huainan Normal College, the 1683 college students in total of six universities as the main research object. Meanwhile, colleges and universities surveyed by the Ministry of Sports and physical education teachers and students were part of a conversation and asked to understand the issues related to after-school physical activity, physical exercise and activities of university students conducted field visits According to the needs of this research, we conducted a questionnaire to different gender, different grades of college students. We grant 1800, and 1706 recovery, recovery 94.8 %, the effective number is 1683, 93.5 %

recovery efficiency. We recover these questionnaires and use Office 2003 Spss 11.5 related software to do some mathematical statistics. Validity: Evaluated by experts, that the questionnaire design can achieve the requirements with effectiveness of the research task. Questionnaire reliability test, we adopt the “split-half reliability” method, obtained by $R = 0.93$. This reflects the internal consistency of survey questions and also prove that the survey is higher reliability [8].

79.3 Results and Analysis

79.3.1 Investigate About the Attitude of College Students Before and After School Physical Activity

Attitude of physical exercise adjust the physical exercise participation in a college’s behavior choice and behavioral responses, it also affect the effect of physical exercise [9]. Through the attitude of college students before and after on the after-school physical activity, it has been found, the number of pre-admission “like” and “very much like” account for total number of 51.2 %. And after admission, “like” and “very much like” are accounted for 55.5 %, an increase of 4.3 percentage points, while in the middle of the “normal” number of places rise from 40.6 to 36.3 %, down 4.3 percentage points, while others attitude did not change (Table 79.1).

It can be seen, after a period of university life and learning, college students after-school physical activity have a certain change in attitude, though did not change significantly, but that certain problems, a certain amount of physical education through the study and the Kinds of sports activities, some people can understand on the after-school physical activity improved to a certain extent, on the other hand also shows that the attitude of the students have a certain stability, requires a certain amount of influence can be changed [10].

In other words, that our university students in physical education dose not changed the attitude of their physical exercise compared before school with after school, especially those students whose attitude for physical exercise is dislike or hate [11].

Table 79.1 College students’ physical activity attitude before and after school

Attitude before	Number of people	Proportion	Attitude after	Number of people	Proportion
Very much	242	14.4	Very much	247	14.6
Like	619	36.8	Like	688	40.9
General	683	40.6	General	610	36.3
Dislike	127	7.5	Dislike	119	7.1
Hate	12	0.7	Hate	19	1.1

79.3.2 A Survey on College Student's Subjective Participation in Orientation of They After School Sports Activities

Overall, 91.6 % of the students have the desire to participate in after-school physical activity, which was “very willing” and “willing” students accounted for 68.7 %, while only 8.4 % of the student's attitude does not show the positive side. It means that most of the students are involved in after-school physical activity behavioral tendencies. Students of different gender's subjective tendencies about exercise exit significant difference, although both have a high tendency to participate in the subjective exercise, but reflected in the boys in the “very willing” the proportion of nearly 10 percentage points higher than girls, while in the “willing” Option, girls by 10 percentage points higher than boys, the proportion of other options in the gender gap have little difference (Table 79.2). The results show that the desires of the boys tend to participate in the subjective exercise is stronger then the girls' showed a strong desire to exercise. Survey of students in different grades showed that with the increase of grade, the students' subjective tendency to after-school physical activity gradually reduces. That the largest proportion of “very willing” and “do” are in fresh men, on the contrary the “reluctant” and “indifferent” option the third grade show the worst performance, although the proportion of the number is small, but it showed significant downward trend. So we should consolidate and improve the enthusiasm of these part students [12].

79.3.3 A Survey on College Student's Motivation of They After School Sports Activities

The motivation of after-school physical activity is students' will that use the after school time for physical activity. That's a state of mind about students initiating and sustaining their actions [13]. The question use multiple-choice and it is limited selection three main factors. On the whole the motivation of students attending after-school physical activity was development with the trend of diversification,

Table 79.2 College students to participate in the school sports exercise subjective trend survey (%)

	Total	Boy	Girl	First year	Second years	Third years
Very much	28.3	32.7	21.8	30.7	28.5	25.5
Be willing	38.4	34.0	44.7	40.9	37.8	36.5
General	24.9	25.1	24.6	23.3	24.8	26.2
Unwillingness	4.3	4.0	4.4	2.9	3.9	6.0
Just as well	4.1	3.8	4.5	1.2	4.0	4.8
		x2 = 34.654, p < 0.01		x2 = 19.364, p < 0.05		

the proportion of different options were significant differences and embodied in “keeping fit”, “entertainment” “emotion control”. Male and female students used the “keep fit” to participate in after-school physical activity as the primary motivation; on the one hand it reflects the university students have fully subjective perception about the physical fitness value of physical exercise. And they recognize that physical exercise play the important role during they grow up, on the other hand it also reflects the nature of the function of school physical education, showing the purpose of college students participate in physical exercise and school physical education is a convergence of purpose. Boys play “entertainment” in second place, reflecting boys have a lot bias on “entertainment”, hyperactivity is boys’ nature characteristic, sports are male students main content of their party time life. Boys ranked “emotion control” to third location, indicating that physical exercise’s role on psychological adjustment, meeting the psychological needs been had generally recognized. Correspondingly girls put “emotion control” in second place, indicating girls had more desire on psychological adjustment. Girls put “body weight” in third place. The reason of per suiting to body shape by girls. Girls more concerned with the questions such as body weight, shape and weight. And they hope to achieve weight loss and fitness purposes through participating in physical exercise [14].

79.3.4 The Investigate About Physical Exercise Knowledge Level of Students

See from Table 79.3, most people on how to carry out physical exercise scientifically are in the “know some” level. Nearly 20 % of the students are in the “almost do not know” and “do not know” state. This tells us that students haven’t grasped the knowledge of physical perfect. Students have physical education for over 10 years. However, there are still many students do not understand how to do physical exercise scientifically, which has a direct relationship with only focus on teaching techniques during the exercise movement and neglects or neglect of sports and physical health awareness theory course between learning. Gender comparison shows, “know some” has the largest proportion, boys and girls accounted for 72.6 and 72.2 %. The results suggest that most students to acquire knowledge is not comprehensive enough physical exercise. Understanding the physical training of boys in the proportion of knowledge is better than girls. Help boys master the knowledge of physical exercise more than girls.

This survey about three grade levels tell us Three grades have “high in the middle two low” phenomenon, second-year master of science the highest level of physical exercise. Explore the main reasons for this, the effort and attention is the extent of the decision, second-year physical education for 2 years of study, the accumulation of a certain knowledge, means and methods, it is apply their knowledge when the time students plenty of time, effort Strong, can spend more

Table 79.3 The survey about how to grasp scientific physical exercise knowledge

	Total	Boy	Girl	First year	Second year	Third year
Know and understand	7.7	9.0	5.7	5.6	9.6	7.9
Know some	72.5	72.6	72.5	73.8	74.7	69.2
Almost don't know	16.8	16	17.5	17.6	12.9	20
Don't know	3.0	2.4	4.3	3.0	2.8	2.9
		$\chi^2 = 16.383, p < 0.05$		$\chi^2 = 20.551, p < 0.01$		

time on physical activity and enthusiasm in. Although first-year students after a year of life and learning, accumulated some experience but not yet mature and perfect. But the third-grade students do not set up the basic training in a large degree of concern is not high physical education.

79.4 Conclusions and Recommendations

79.4.1 Conclusions

Overall, 54.9 % of the students have a positive attitude toward physical activity after school, in the awareness of the importance of physical exercise on the identification of students is 87.9, 91.6 % of students have physical exercise desire. Students clearly understand physical exercise. Have the stronger desire to participate in after-school physical activity. About 8 % of the students showed after-school physical activity aversion, subjective tendency to increase, the student who do not want to exercise and feel it does not matter are increase with the grad increasing. The desire to participate in after-school physical activity more strongly with a clear point of their motivation, but it also showed a trend of diversification. Male and female students participate in extracurricular physical activity distribute of the different motives. Body weight of female students is particularly clearly pointing. College students are lack of the knowledge of physical exercise. Most students are at the level of know something. Almost 20 % of the students do not know how to conduct scientific extracurricular physical exercise.

Although the universities in recent years have stepped up sports venues and facilities Construction, but because the school enrollment expansion, school toll has soared, relative to character the body.

The education sports equipment and facilities, the old behind cannot have satisfied students the demand of extracurricular physical exercises, which has been a block extracurricular body One of the main factors and activities. The school sports professional field and facilities Limit, the students had to choose some campus space to place as exercise. Most students participate in sports exercise after school of a positive attitude, quite a general attitude points, and rarely a small part of the negative treat. The product of the boys Polarity and slightly higher than

the girls. We learned from the survey, general each boy all There will be a very attention sports league, and most girls to sports league is known Nothing less. So it seems that the interest is the power of physical exercise, there is some university Living not willing to take part in physical exercise after school is one of the reasons for the lack of interest. School sports, positive for track and field Games, all kinds of ball games, GuangBoCao game, all kinds of friendship match, small Games, sports knowledge competition, etc., so as to enhance the students' physical quality and meaning Volunteer quality, improve the students' physical health, and rich campus sports culture life, for students after school life into the vitality.

Optimization sports education environment, teacher should guide students to set up the correct sports value. Be the university sports extracurricular the main carrier of activities. Learn more about student sports organization, organize activities and way more accord with the characteristics of the students in the activity time more flexible, the project can free choice, Is the embodiment of the student's independency, play sports class community in meet the student movement The role of demand.

After school physical exercise is an important part of the school sports, college students' healthy way of life is an important content. By Chinese provinces and cities of the university of 18 September 2365 college students' investigation, the paper analyses the current situation of college students after school sports exercise, and in the light of the problems found by proposed. Research shows that: the current, after school physical exercise has become quite part of college students after school life is one of the important activities way. College students after school physical exercise on the whole nationality is higher, but activity relative shortage, exercise way, place and exercise program are more obvious concentration trend, most college students after school to an interest in sports exercise, exercise the value orientation have diversity feature, location equipment lack, the lessons burden overweight other external factors is to participate in sports exercise after school still restraining factors, in after school sports exercise rate, weeks exercise, each exercise time, interest in exercise, there are more obvious gender differences.

79.4.2 Advice

1. We should guide the part of the students who have a weak sense of after-school physical activity or who aversion of physical activity, and let them know the importance of physical exercise for human growth. And we encourage them into the after-school sports to enable them exercise in self-understanding, self-practice and self-perfection.
2. We should take more consideration of the difference of male and female students physical exercise motivation. Qualified schools can open many different programs targeted PE. Actively construct different forms of organized after-school physical activity.

3. School strengthens the right direction of physical exercise and increase physical theory of course content in the proportion of physical education teaching. And they can increase physical health knowledge and physical knowledge of teaching content. Strengthen the communication of students and teachers to build the strong teacher-student interaction platform, and through the relevant departments to establish the school after-school sports module, so they can interact with each online under class.
4. School should focus on strengthening high school students after-school physical exercise to consolidate and enhance the awareness of exercise, and School can develop students lifelong physical habits and life-long sports consciousness, The strengthening of the students direct education of physical activity promote the awareness of university students physical exercise into practical activities as soon as possible. To greatly improve the organization of exercises after class university degree, strengthen the guidance of college students after school to stimulate their enthusiasm for physical exercise, in order to provide time for students after-school physical activity, physical and organizational guarantee and improve the Students to the effectiveness of physical exercise .
5. Establish fitness instructor system. Each of the department, sports association and class in the organization carries out students' extracurricular sports activities, sports teacher is the guidance to the outside, so as to ensure that all sports extracurricular activities Develop smoothly. At present, the school sports education reform gave extracurricular sports activities in the new post Travel. College students in most of the time is spent school, the school is to develop sports Exercise habits of important place, so, the school guidance work is very heavy Want. Schools should strengthen extracurricular sports activities in the human, material and time Investment, help students form good exercise habits, and improve the students' comprehensive grain The quality, and take the extracurricular sports activities into a new stage of development, the revitalization of the whole A school sports.
6. Pay much attention to college students' extracurricular sports interests and hobbies of the students. The school should attach great importance to the cultivation of the students' interest and the guidance, guidance and group. Woven students extracurricular sports activities, to fully exploit the students of the movement within Potential and fun. To strengthen the teaching of the basic sports knowledge, broaden the students' view, and let the students to participate in the activities and competition of the organization, scheduling, the referee work. Teach students to the with knowledge of the methods and skills of science fitness method, strengthen the students' self exercise ability, these are to cultivate students to participate in training the interest. Can also according to a student's interests and carry out the second classroom activities, the establishment of various sports association, Make up for students to the requirements of the sport, so that the students can not only enhance the movement techniques, and Exercise the body, enhance the physique, learned to scientific exercise methods, for Student lifelong sports lay a good foundation.

References

1. Hongcheng Z (2004) Practice and research of implementing in the student physical health standard of Jiangsu University. *Sports Sci* 5:17–25
2. Zhang H (2003) After school physical exercise and the realization of the target of the school sports. *Guizhou Norm Univ J* 2:35–37
3. Chao L (2003) Investigation and analysis of extracurricular sports activities present situation after college expansion. *Sichuan Sports Sci* 2:19–24
4. liren F (2002) The research of students across the country to participate in extracurricular sports activities in the current situation. *Sports Sci* 2:10–14
5. Jianxiang H (2004) College sports should pay attention to the cultivation of the students' capability. *Hunan Ind Vocat Coll J* 1:9–14
6. Shulin C (2003) Try to talk about the sports teaching and students' ability training. *J Sports Adult Educ* 2:81–84
7. Dongqiang W (2009) Rural left-behind children education research problems. *Ji'nan Univ* 09:113–117
8. Xiaojun S (2009) Research of rural left-behind children education problems. *Cent China Norm Univ* 06:32–39
9. Yong D (2008) Rural left-behind children thinking about the problems of education, and puts forward some counter measures. *Sichuan Univ* 05:30–37
10. Xianli Z (2009) Children education research problems in rural left-behind. *Hunan Norm Univ* 10:231–236
11. Lei W (2011) To strengthen college students' extracurricular sports activities in the guide, and improving The students' comprehensive quality. *DaJia* 24:121–126
12. Yumei R (2010) Suihua college students' physical exercise behavior and the winter the investigation of the factors affecting. *Ice Snow Sports* 4:74–79
13. Qing YX, Qing YG, Kun WA, Lei XZ, Meng G (2010) Study of different extracurricular physical exercising behavior of the college students'. *Gen Self-efficacy Comp Sports Sci* 1:87–93
14. Yu CQ, Wei ZJ (2010) Influence college independent college students in guang zhou of extracurricular physical exercises. *Attrib Anal Sports* 2:17–24

Chapter 80

Experimental Research on the Cooperative Study in Physical Education

Xuemin Wang and Ruihong Wu

Abstract This paper has made analysis and summary of the cooperative study in the physical education by adopting investigation method and experimental method. The research shows that the cooperative study is favorable for improving the students' learning interest and sports skills, motivating the relationship between the teachers and students, and establishing harmonious competitive consciousness and team spirit. Therefore, in the physical education, it is necessary to push forward the application of cooperative study.

Keywords Cooperative study · Physical education · Experiment

80.1 Introduction

“Cooperative study” is a form of self learning. By adopting the interactive factors of the material, it encourages the students to study and takes the achievements of the team as the standard of assessment, in order to achieve the goal of common learning activities [1].

The only child is unsociable, lacking competitiveness. Besides, he is not good at cooperating with other students, for that they lack independence, innovation and they are poor in social adaptability [2]. As for this phenomenon, the cooperative study can play a facilitating role in it. Meanwhile, it can bring about great improvement as the education form is single. This paper, adopting demonstration

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method, makes analysis towards the practical application of the cooperative study in the physical lessons, which provides reference and guiding signification of the popularization of the cooperative study [3].

80.2 Research Object and Methods

80.2.1 Research Object

The girls of Class 1 of Hengshui No. 1 Middle School in Hebei province

80.2.2 Research Methods

80.2.2.1 Questionnaire Method

It is to issue 200 questionnaires to the girls of 18 classes of Class 1 by questionnaire method. Collect 196 effective questionnaires.

80.2.2.2 Experimental Method

It is to randomly divide the girls of the same class into two groups. The control group adopts traditional teaching method [4]. And the experimental group adopts “group cooperation” teaching method and appoints a student as the group leader with good harmony and good health quality to form “group learning” [5]. Then the teachers put forward specific requirements and mutual learning method to the students of the experimental group, which can enable the group to strengthen exchange and mutual understanding, discuss the problems, help and learn from each other, and create good study atmosphere during the study. At the end of the semester, the teacher checks the students’ basic motivation of martial arts according to the same condition and standards [6].

80.3 Research Results and Analysis

80.3.1 Results of Questionnaire

80.3.1.1 Spirit of Mutual Assistance and Learning in the Physical Lessons

From the statistic results of Table 80.1, 86 % students hold that the physical lesson is favorable for cultivating students’ spirit of mutual assistance and learning. No one think it cannot. And 14 % students feel uncertain about it. Besides, mutual

Table 80.1 Whether the physical lessons can cultivate students’ spirit of mutual assistance and learning

	Can	Can’t	Uncertain
Spirit of mutual assistance and learning	169	0	27
Percentage %	86	0	14

Table 80.2 Whether the failure or success of the team event depends on the personal ability of the sportsman

	Completeness	A great extent	Collective cohesion
Number of people	9	51	136
Percentage %	4	26	70

Table 80.3 Cooperation in the middle school physical lesson is spontaneous or supervised by the teachers

	Spontaneous	Supervising
Number of people	168	28
Percentage %	86	14

assistance and learning performs well in the physical lesson. It reflects that the students take the competition under the circumstance of grouping. The competition in the same group represents the common goal achieved in the same group through mutual assistance and learning.

80.3.1.2 Personal Influence of the Success or Failure of the Team Event

From the statistical result of Table 80.2, 4 % students hold that it completely depends on the personal ability of the sportsman, 26 % a great extent, 70 % collective cohesion, which indicates a great majority of students attach important to the team event and the team spirit is superior to the individual.

80.3.1.3 Cooperation Expectation in the Physical Lessons of Middle School

From the statistical result of Table 80.3, the number of students who shows cooperation expectation accounts for 86 %, and that of supervision people accounts for 14 %. The cause is that the physical lesson is involved in cooperation through teachers’ giving lecture and explanation in class.

Table 80.4 Whether to improve my interpersonal communication skills through sports activities

	Yes	No
Number of people	157	39
Percentage %	80	20

80.3.1.4 Sports Activities and Interpersonal Communication Skills

From the statistical result of Table 80.4, the number of students who hold that it can improve the interpersonal communication accounts for 80 %, and that who hold it cannot make the improvement is 20 %. It reflects that most students are only child, and they are unsocial, so they are unwilling to communicate with others and teachers, so that they cannot establish good relationship with the teachers. Besides, from the table, there is no doubt that only by cooperating with others can the students' interpersonal communication be improved. During the cooperation, offering cooperative study atmosphere to the students can improve their good interpersonal communication.

80.3.1.5 Status Survey of Students' Self Performance in the Physical Lesson

From Table 80.5, 95.4 % students hold that they can solve the difficulties and problems with the partners during the sports activities, while 4.6 % hold that they cannot do the same, which shows that the students' cooperative consciousness is relatively strong. With regard to the problem of whether you can clarify the relation between your role and the team, 97 % students say yes, and only 3 % say no, for that they do not have strong collective spirit. However, a great majority of students can consider and analyze the problem from the viewpoint of collective interest. As for the problem of whether you can comply with the restraints of the team, 94 % students say yes and the rest say no, which indicates that most students possess team consciousness. It is to the benefit of launching the cooperative

Table 80.5 Survey statistical table of self performance in the physical lesson

Self-performance	Yes		No	
	Quantity	Percentage %	Quantity	Percentage %
Can you solve the difficulties and problems with your partner?	187	95.4	9	4.6
Can you clarify the relation between your role and the team?	190	97	6	3
Can you comply with the restraints of the team and the group?	184	94	12	6
Can you analyze the cause of the failure?	166	84.7	30	15.3
Can you speak highly of your opponents instead of haggling over the failure or success?	181	92.3	15	7.7

Table 80.6 Comparison of the interest degree of form, spirit and boxing

	Experimental group		Control group	
	Number of people	Percentage (%)	Number of people	Percentage (%)
Extremely like	4	17.4	0	0
Like	8	35	7	31
Not quite like	9	39	14	61
Not interested	2	8.6	2	8

teaching. Moreover, as for the problem of whether you can seriously analyze the cause of failure instead of complaining others in the physical lesson, 87.4 % students say yes, and they hope to make progress together, while the 15.3 % say no. In addition, with regard to the problem of whether you can speak highly of your opponents instead of haggling over the failure or success, 92.3 % students say yes, and only 7.7 % say no. The reason is that the young students have strong self-esteem and emulative mentality so that some will have inner contradiction. In order to lead the students to praise their opponents instead of haggling over the failure or success, the teachers should offer correct guidance and incentive to them through assessment, so that the students will realize the principle, and then they learn and communication with others.

80.3.2 Experimental Results

80.3.2.1 Interest Degree of Form, Spirit and Boxing

From Table 80.6, it indicates that the teaching method of group learning can improve the students' interest in participating in form, spirit, and boxing, and have good impact on cultivating students' mutual assistance and learning in the same group. Before the experimental teaching appeared, no student shows interest in it. On the contrary, after it appears, 17.4 % students show great interest in it. The number of people who like practicing it is increased from 31 to 35 %, which represents that the experimental teaching method improves students' learning interest.

80.3.2.2 Testing Situation of Grasping the Technique Movement of Form and Spirit

Table 80.1 indicates the students of the experimental group do better in grasping the technique movement of form and spirit than that of the control group. The experiment result shows that the teaching effect of adopting "group work" is more superior to the traditional teaching method.

80.4 Discussion

80.4.1 The Relation between Cooperative Study and Learning Interest

Through the analysis of Tables 80.6 and 80.7, it can be seen that group-work cooperative study can arouse students' learning interest, and the cooperative study method is more likely to improve students' learning effect than the traditional teaching method. On one hand, based on the students' interest, sex, characteristics and superiority, the cooperative study can divide groups to make cooperative practice, which can fully arouse students' learning initiative, get the students involved in the whole activity and teaching process completely, bring their initiative into full play and put it into practice. On the other hand, the cooperative study can adopt the models of teachers' guidance in the same group, students' mutual assistance and learning, encouraging, assessment. In addition, the teachers can design and organize the teaching link according to the status of the students of the same group, so that students can help and learn from each other, and make assessment towards each other, which can supplement the teachers' deepening teaching effect, and improve students' learning efficiency with the help of the cohesion formed by the students.

80.4.2 Relation Between Cooperative Study, and the Grasping and Application of the Sports Skills

In Table 80.7, the analysis of the assessment results of basic martial art of form, spirit, and boxing shows that there are ten excellent students in experimental group and 6 in the control group. A half of students become excellent after receiving the experimental teaching. It indicates that the students of the experimental group grasp the movement technique better than the ones of the control group.

From Table 80.3, 86 % students hope to cooperate with others spontaneously, which shows that they can take initiative to study according to their own status and solve the problems and get improvement together through discussion, analysis, and assessment in the same group. Through teachers' organization, guidance, giving

Table 80.7 Testing situation of grasping the technique movement of form and spirit

	Basic foot shape, footwork, technique			Testing the whole series		
	Excellent	Good	Pass	Excellent	Good	Pass
Experimental group (number of people)	10	12	1	11	10	2
Control group (number of people)	6	13	4	4	8	11

directions, and then through differentiation—generalization—consolidation and improvement—studying the sports skills together by adopting the process, students begin to know much about the skill movement so that their practice ability can be improved and the boring practice will become vivid and interesting. Therefore, they will feel relaxed and happy when learning. They will reach the goal of improving the movement technique, which is favorable for the grasping and application of the sports skills.

80.4.3 Relation Between Cooperative Study, and Students and Teachers

The process of physical education is the process of teachers and students, and also the bilateral process of participating and improving together of the teachers and students. In order to create good, relaxed, joyful learning atmosphere, the teachers and students should respect each other, and cooperate with each other to make progress, so that the correct relation between them can be formed.

From Table 80.1, the physical lesson can cultivate students' spirit of mutual assistance and learning. However, the sustainable mutual assistance and learning is determined by the teachers' teaching ability and attitude. That the teachers possess solid teaching organization and practice ability is the premise for enabling students to help and learn from each other. In general, the teachers not only should possess solid theory and technique teaching methods, but also should have good practice organization ability that differs from person to person and changes with the group, and create good cooperative learning atmosphere for the students so as to make the students do exercise under unrestrained status. The teaching attitude is the lubricant for the students to help and learn from each other. Moreover, teachers' humorous and sincere teaching language can enable them to get along well with the students. They should guide each student patiently and encourage the students to express their own ideas and make discussion, which can unite the teachers and students as one.

From Table 80.4, cooperative study can improve students' interpersonal communication skill and the relation between the students and teachers. Some students are not willing to communicate with others due to their personality, academic achievements, etc. Therefore, the teachers should help them to establish friendship with other students through proper language. Moreover, teachers can make necessary heart communication and exchange so as to help these students involved in the whole cooperative study. And they should help students establish confidence by improving their academic achievements, which is favorable for the students to make analysis towards the improvement of academic achievements and tell it to others, and demonstrate and explain the wrong doings. It can encourage them to establish inward basis of interpersonal communication and good relation between them, and also it can practice students' language expression and analysis ability. In addition,

teachers can organize some students to help them with proper methods, such as skill assistant, achievement communication, etc. By doing so, it not only enhances the relationship between the teachers and students, but also accelerates the communication among them.

80.4.4 Relation Between Cooperative Study, and Competitive Consciousness and Team Spirit

From Table 80.2, the highlight problem is the competitiveness and team spirit among the teams. It can be seen that the significance of the team cooperation is greater than that of the competitiveness. At present, the school environment is a competitive place. The students face competition in various aspects, while the collective and cooperative activities are quite few. The cooperative study enables the cooperation, competition and personal behavior to be combined together, which can be represented by developing the competition among individuals to that among groups through experimental teaching and group instruction. When the new pattern of “the members of the same group cooperate with each other, and members of different groups cooperate with each other” is formed, the students can improve their learning interest and academic achievements during the mutual competition.

From Table 80.5, 95.4 % students can undertake and conduct the difficulties and problems of the sports activities with their partners. Besides, it turns out that the students rely on the mutual guidance, help, exchange, assessment and solve the problems together to reach the final goal during the process of group-work study. In addition, 97 % students can clarify the relation between their own roles and the team during the sports activities and competition. And that the collective interest is more important than the personal interest reflects the importance of the team spirit.

94 % students can comply with the restraints of the team and group. 84.7 % can seriously analyze the reason of failure and do not complain others in the physical lessons. They can forgive others. Moreover, 92.3 % speak highly of the opponents' good performance instead of haggling over success and failure. From the above three charts, it turns out that it is the basic condition of cultivating team spirits of the students.

80.5 Conclusion

Cooperative study not only can improve the disadvantage of the traditional teaching method, but also can push forward the reform of teaching model.

Cooperative study is to the benefit of improving students' learning interest and sports skills, pushing forward the relationship between the teachers and students, and establishing harmonious competitive consciousness and team spirit.

With view to the achievements and positive effect gained by the cooperative study through the questionnaire and experiments, it is advisable to further study its application in the physical lessons.

References

1. Yingming Z (2003) Application of the teaching model of cooperative study in physical education. *J Phys Educ Inst Shanxi Norm Univ* 12(18):38-43
2. Xiangguo H (2004) Getting students to participate in the teaching. *China Sch Phys Educ* 1:09-14
3. Qiongjing Y (2003) Experimental research on small-group teaching model in physical education. *J Guangzhou Phys Educ Inst* 1:78-84
4. Min S (2003) Construct and application of physical structure model of "cooperative study". *J Nanjing Phys Educ Inst* 2:18-24
5. Tao L (2003) Analysis of cooperative study model in calisthenics teaching. *Guizhou Sport Sci Technol* 4:172-176
6. Peiwen L Necrosis experimental research on "cooperative teaching" in martial art teaching. *Sichuan Unite University Publishing House* 12(3):22-25

Part IV
Information Computing and Applications

Chapter 81

Automation and Singular Differential Equations Based on Drazin Inverse of Block Matrices

Li Guo, Mingji Liu and Yue Lv

Abstract In this paper, we investigate representations of the Drazin inverse of a 2×2 block matrix. The Drazin inverse of a matrix is very important in various applied mathematical fields like machinery and automation, singular differential equations. We use recent some results to obtain a explicit representation of the Drazin inverse of a block matrix.

Keywords Block matrix · Drazin inverse · Index

81.1 Introduction

Let $C^{n \times n}$ denote the set of $n \times n$ complex matrices. The smallest nonnegative integer k such that $\text{rank}(A^{k+1}) = \text{rank}(A^k)$, denoted by $\text{ind}(A)$, is called the index of A . The Drazin inverse is the unique matrix $A^d \in C^{n \times n}$ satisfying $AA^d = A^dA$, $A^dAA^d = A^d$, $A^{k+1}A^d = A^k$, where $k = \text{ind}(A)$. We denote by $A^\pi = I - AA^d$. For $A \in C^{n \times n}$ we define $A^0 = I_n$, the identity of order n , even if $A = 0$.

The Drazin inverse of a matrix is very important in various applied mathematical fields like machinery and automation, singular differential equations,

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singular difference equations, Markov chains, iterative methods and so on [1, 2]. We introduce briefly an application of the Drazin inverse of a block matrix [3].

Let E and F are $n \times n$ complex matrices, where E is singular. If there exists a scalar μ such that $\mu E + F$ is nonsingular, then the general solution of the singular system of differential equations

$$Ex'(t) + Fx(t) = 0, \quad (t \geq 0) \tag{81.1}$$

is given by $x(t) = e^{-\hat{E}t} \hat{E}^d \hat{E}x(0)$, Where $\hat{E} = (\mu E + F)^{-1}E, \hat{F} = (\mu E + F)^{-1}F$

The following a second-order system

$$Ex''(t) + Fx'(t) + Gx(t) = 0, \quad (t \geq 0) \tag{81.2}$$

Where E is singular. It is reasonable to assume that there exists λ such that $\lambda^2 E + \lambda F + G$ is nonsingular. Let $x(t) = e^{\lambda t}y(t)$, then (81.2) is equivalent that

$$(\lambda^2 E + \lambda F + G)^{-1}Ey''(t) + (\lambda^2 E + \lambda F + G)^{-1}(2\lambda E + F)y'(t) + y(t) = 0. \quad (t \geq 0) \tag{81.3}$$

Furthermore, let $w(t) = y'(t)$, then (81.3) is equivalent that

$$\begin{pmatrix} \tilde{E} & \tilde{F} \\ -I & 0 \end{pmatrix} \begin{pmatrix} y(t) \\ w(t) \end{pmatrix}' + \begin{pmatrix} I & 0 \\ 0 & I \end{pmatrix} \begin{pmatrix} y(t) \\ w(t) \end{pmatrix} = 0 \tag{81.4}$$

Where $\tilde{E} = (\lambda^2 E + \lambda F + G)^{-1}(2\lambda E + F), \tilde{F} = (\lambda^2 E + \lambda F + G)^{-1}E$.

In order to express the explicit representation of (81.4) in terms of \tilde{E}, \tilde{F} , we need give a representation of the Drazin inverse of \hat{E} in terms of \tilde{E}, \tilde{F} , where

$$\hat{E} = \begin{pmatrix} \mu\tilde{E} + I & \mu\tilde{F} \\ -\mu I & I \end{pmatrix}^{-1} \begin{pmatrix} \tilde{E} & \tilde{F} \\ -I & 0 \end{pmatrix}.$$

Let $M = \begin{pmatrix} A & B \\ C & D \end{pmatrix}$ be a 2×2 block complex matrix, where A and D are square matrices. Campbell and Meyer [1] posed the following open problem: establish an explicit representation for the Drazin inverse of M in terms of the blocks of the partition. Until now, there has been no explicit formular for the Drazin inverse of M . However, several representations have been obtained under some additional conditions. For example, the following conditions are considered.

- $BC = 0, DC = 0$ (see [2])
- $BD^\pi C = 0, BD^d = 0, DD^\pi C = 0$ (See [4]);
- $BD = 0, D^\pi CA = 0, D^\pi CB = 0$ (See [4]);
- $A^2 A^\pi B = 0, CAA^\pi B = 0, BCA^\pi B = 0, D = CA^d B$ (See [5]);
- $A^\pi B = 0, CA^\pi = 0, D = CA^d B$ (See [6]). $A = 0, D = 0$ (See [7])

In this paper, representations for the Drazin inverse of 2×2 block matrix M , under the following conditions that $ABC = 0, BD^i C = 0, i = 1, \ominus, n$ and the conditions, and so several results are generalized.

Lemma 1.1 Let $A \in C^{m \times n}$ and $B \in C^{n \times m}$ then $(AB)^d = A[(BA)^2]^d B$.

Lemma 1.2 Let $A \in C^{m \times n}$, then $(A^2)^d = (A^2)^2$

Lemma 1.3 (see [8],) Let $M = \begin{pmatrix} A & B \\ C & D \end{pmatrix}$ be a 2×2 block complex matrix, where $A \in C^{m \times n}$ and $D \in C^{n \times n}$ with $ind(A) = r, ind(D) = s, k \geq \text{Max}\{ind(M), ind(D)\}$. If $BD^i C = 0, i = 0, 1, \dots, n - 1$ then

$$M^d = \begin{pmatrix} A^d & X \\ Y & D^d + Z \end{pmatrix} \tag{81.5}$$

Where

$$\begin{aligned} X &= \sum_{i=0}^{s-1} (A^d)^{i+2} BD^i D^\pi + A^\pi \sum_{i=0}^{r-1} A^i B (D^d)^{i+2} - A^d B D^d \\ Y &= \sum_{i=0}^{r-1} (D^d)^{i+2} CA^i A^\pi + D^\pi \sum_{i=0}^{s-1} D^i C (A^d)^{i+2} - D^d C A^d \\ Z &= YAX + \sum_{i+l+j=k-2} ((D^d)^{k+1-i} CA^l B D^j D^\pi + D^\pi D^i CA^l B (D^d)^{k+1-j}) \\ &\quad + \sum_{i=0}^{k-1} ((D^d)^{i+2} CA^i (AX + BD^d) + (YA + D^d C) A^i B (D^d)^{i+2}). \end{aligned}$$

Lemma 1.4 (see [8],) Let $M = \begin{pmatrix} A & B \\ C & D \end{pmatrix}$ be a 2×2 block complex matrix, where $A \in C^{m \times m}$ and $D \in C^{n \times n}$ with $ind(A) = r, ind(D) = s$. If $BD^i C = 0, i = 0, 1, \dots, n - 1$, then $r \leq ind(M) \leq r + 2s$.

Lemma 1.5 (see [9],) Let P and Q be complex square matrices such that $PQ = 0$, then $(P + Q)^d = \sum_{n=0}^{k-1} (Q^d)^{n+1} P^n P^\pi + Q^\pi \sum_{n=0}^{k-1} Q^n (P^d)^{n+1}$, where $\text{Max}\{ind(P), ind(Q)\} \leq k \leq \{ind(P) + ind(Q)\}$.

81.2 Main Results

Theorem 2.1 Let $M = \begin{pmatrix} A & B \\ C & D \end{pmatrix}$ be a 2×2 block complex matrix, where $B \in C^{m \times n}, C \in C^{n \times m}$ and $D \in C^{n \times n}$ with $ind(D) = s, ind(BC) = t$ and $k \geq \text{Max}\{ind(M), t + 2s\}$. If

$$BD^i C = 0, i = 1, \dots, n$$

Then

$$\begin{aligned} (CB + D^2)^d &= (I + U_1)(CB)^d + (D^2)^d(I + U_1) + (CB)^d V_1 D^2 + V_1 D D^d \\ &\quad + U_1((CB)^d V_1 + (CB)^\pi \sum_{i=0}^{t-1} (CB)^i (D^d)^{2i+4} D^2 + (D^d)^2 W_1 D^2 + W_1 D D^d, \end{aligned} \tag{81.6}$$

Where

$$U_1 = \sum_{i=0}^{t-1} (D^d)^{2i+2} (CB)^{i+1} (CB)^\pi + D^\pi \sum_{i=0}^{s-1} D^{2i+2} ((CB)^d)^{i+1} - DD^d (CB)(CB)^d,$$

$$V_1 = \sum_{i=0}^{s-1} ((CB)^d)^{i+1} D^{2i} D^\pi + (CB)^\pi \sum_{i=0}^{t-1} (CB)^{i+1} (D^d)^{2i+4} - (CB)(CB)^d (D^d)^2,$$

$$W_1 = U_1 V_1 + \sum_{i+l+j=k-2} ((D^d)^{2k-2i} (CB)^{l+1} D^{2j} D^\pi + D^\pi D^{2i+2} (CB)^{l+1} (D^d)^{2k+2-2j}) \\ - \sum_{i=0}^{k-1} ((D^d)^{2i+2} (CB)^{i+1} (V_1 + (D^d)^2) + (U_1 + DD^d) (CB)^{i+1} (D^d)^{2i+4}).$$

Proof By Lemma 81.1, we have

$$(CB + D^2)^d = ((C, D) \begin{pmatrix} B \\ D \end{pmatrix})^d = (C, D) \left(\begin{pmatrix} BC & BD \\ DC & D^2 \end{pmatrix}^d \right)^2 \begin{pmatrix} B \\ D \end{pmatrix} \quad (81.7)$$

Since $BD^i C = 0$, $i = 1, \ominus, n$, by Lemma 81.3, we have

$$\begin{pmatrix} BC & BD \\ DC & D^2 \end{pmatrix}^d = \begin{pmatrix} (BC)^d & X' \\ Y' & (D^2)^d + Z' \end{pmatrix},$$

Where

$$X_1 = \sum_{i=0}^{s-1} ((BC)^d)^{i+2} BD^{2i+1} D^\pi + (BC)^\pi \sum_{i=0}^{t-1} (BC)^i BD (D^d)^{2i+4} - (BC)(BC)^d BD^d,$$

$$Y_1 = \sum_{i=0}^{t-1} (D^d)^{2i+3} C(BC)^i (BC)^\pi + D^\pi \sum_{i=0}^{s-1} D^{2i+1} C((BC)^d)^{i+2} - D^d C(CB)^d,$$

$$Z_1 = Y_1 (BC) X_1 + \sum_{i+l+j=k-2} ((D^d)^{2k-2i+1} C(BC)^l BD^{2j+1} D^\pi + D^\pi D^{2i+1} (BC)^l B (D^d)^{2k+1-2j}) \\ - \sum_{i=0}^{k-1} ((D^d)^{2i+3} C(BC)^i (BC X_1 + BD^d) + (Y_1 (BC) + D^d C) (BC)^i B (D^d)^{2i+3}).$$

By $BD^i C = 0$, $i = 1, \ominus, n$, we can obtain that

$$X' Y' = 0, X' Z' = 0, Z' Y' = 0, (Z')^2 = 0.$$

Furthermore,

$$\left(\begin{pmatrix} BC & BD \\ DC & D^2 \end{pmatrix}^d \right)^2 = \begin{pmatrix} ((BC)^d)^2 & (BC)^d X' + X'(D^d)^2 \\ Y'(BC)^d + (D^d)^2 Y' & Y'X' + (D^d)^2 Z' + Z'(D^d)^2 \end{pmatrix}. \tag{81.8}$$

Substituting (81.8) into (81.7), by the conditions of $BD^i C = 0, i = 1, \ominus, n$, we can prove the theorem.

Theorem 2.2 Let $M = \begin{pmatrix} A & B \\ C & D \end{pmatrix}$ be a 2×2 block complex matrix, where $A \in C^{m \times m}$ and $D \in C^{n \times n}$ with $ind(A) = r, ind(D) = s, ind(BC) = t$ and $k \geq \text{Max}\{ind(M), t + 2s\}$. If

$$ABC = 0, BD^i C = 0, i = 1, \ominus, n$$

Then

$$M^d = \begin{pmatrix} (A^2 + BC)^d A & (A^2 + BC)^d B + X_1 D \\ Y_1 A + (CB + D)^d C & Y_1 B + (CB + D^2)^d D + Z_1 D \end{pmatrix} \tag{81.9}$$

Where $(CB + D^2)^d$ is as in (81.7) and
(HTML translation failed)

$$\begin{aligned} Y_1 = & \sum_{i=0}^{r-1} ((CB + D^2)^d)^{i+2} (CA + DC)(A^2 + BC)^i (A^2 + BC)^\pi \\ & + (CB + D^2)^\pi \sum_{i=0}^{s-1} (CB + D^2)^i (CA + DC)((A^2 + BC)^d)^{i+2} \\ & - (CB + D^2)^d (CA + DC)(A^2 + BC)^d, \end{aligned} \tag{81.10}$$

$$(A^2 + BC)^d = (BC)^\pi \sum_{i=0}^{t-1} (BC)^i (A^d)^{2i+2} + \sum_{i=0}^{r-1} ((BC)^d)^{i+1} A^{2i} A^\pi. \tag{81.11}$$

$$\begin{aligned} Z_1 = & Y_1(A^2 + BC)X_1 + \sum_{i+t+j=k-2} (((CB + D^2)^d)^{k+1-i} (CA + DC)(A^2 + BC)^i \\ & (AB + BD)(CB + D^2)^j (CB + D^2)^\pi + (CB + D^2)^\pi (CB + D^2)^i (CA + DC) \\ & (A^2 + BC)^i (AB + BD)((CB + D^2)^d)^{k+1-j} + \sum_{i=0}^{k-1} (((CB + D^2)^d)^{i+2} (CA + DC) \\ & (A^2 + BC)^i ((A^2 + BC)X_1 + (AB + BD)(CB + D^2)^d) + (Y_1(A^2 + BC) \\ & + (CB + D^2)^d (CA + DC))(A^2 + BC)^i (AB + BD)((CB + D^2)^d)^{i+2}, \end{aligned}$$

Proof It is easy to see that

$$M^2 = \begin{pmatrix} A^2 + BC & AB + BD \\ CA + DC & CB + D^2 \end{pmatrix}. \tag{81.12}$$

Noting that $ABC = 0$, by Lemma 81.5, we have

$$(A^2 + BC)^d = (BC)^\pi \sum_{i=0}^{r-1} (BC)^i (A^d)^{2i+2} + \sum_{i=0}^{r-1} ((BC)^d)^{i+1} A^{2i} A^\pi. \tag{81.13}$$

By $BD^iC = 0, i = 1, \ominus, n$ and Theorem 2.1, we have $(CB + D^2)^d$ is as in (81.7).

Since $ABC = 0, BD^iC = 0, i = 1, \ominus, n$, Lemma 81.2, we get

$$(M^2)^d = \begin{pmatrix} (A^2 + BC)^d & X_1 \\ Y_1 & (CB + D^2)^d + Z_1 \end{pmatrix}, \tag{81.14}$$

where X_1, Y_1 and Z_1 are correspondingly X, Y and Z_1 in Lemma 81.2 with A, B, C, D replaced by $A^2 + BC, AB + BD, CA + DC, CB + D^2$, respectively. Noting that $X_1C = 0, Z_1C = 0$ and $M^d = (M^2)^d M$, we have

$$M^d = \begin{pmatrix} (A^2 + BC)^d A & (A^2 + BC)^d B + X_1 D \\ Y_1 A + (CB + D)^d C & Y_1 B + (CB + D^2)^d D + Z_1 D \end{pmatrix}. \tag{81.15}$$

References

1. Campbell SL, Meyer CD (1979) Generalized inverses of linear transformations, vol 1. Pitman Press, London, pp 147–152
2. Cvetkovic-Ilic DS, Chen J, Xu Z (2009) Explicit representation of the Drazin inverse of block matrix and modified matrix. *Linear Multi-linear Algebra* 57:355–364
3. Campbell SL (1983) The Drazin inverse and systems of second order linear differential equations. *Linear Multi-linear Algebra* 14:195–198
4. Dopazo E, Matrinez-Serrano MF (2010) Further results on the representation of the Drazin inverse of a 2×2 block matrix. *Linear Algebra* 43:1896–1904
5. Matrinez-Serrano MF, Castro-Gonzalez N (2009) On the Drazin inverse of block matrices and generalized Schur complement. *Appl Math Comput* 215:2733–2740
6. Miao J (1989) Results of the Drazin inverse of block matrices. *Shanghai Norm Univ* 18:25–31
7. Catral M, Olesky DD, Driessche PVD (2009) Block representations of Drazin inverse of a bipartite matrix. *Electr J Linear Algebra* 18:98–107
8. Guo L, Xiankun D (2010) Representations for the Drazin inverses of 2×2 block matrices. *Appl Math Comput* 217:2833–2842
9. Djordjevic DS, Wei Y (2002) Additive results for the generalized Drazin inverse. *J Aust Math* 73:115–126

Chapter 82

Almost Periodic Type Solutions of First Order Delay Differential Equations with Piecewise Constant Argument

Qiujie Zhang

Abstract In present paper, first order delay differential equations with piecewise constant argument are considered. By means of properties of almost periodic, asymptotically (pseudo) almost periodic systems and almost periodic, asymptotically (pseudo) almost periodic sequences, the existence of almost periodic and asymptotically (pseudo) almost periodic solutions are studied.

Keywords Almost periodicity · Asymptotically (pseudo) almost periodicity · Piecewise constant argument

82.1 Introduction and Preliminaries

Differential equations with piecewise constant argument (in short, PCA), which were considered by Cooke and Wiener in describes hybrid dynamical system and have applications in certain biomedical models. Over the years, great attention has been paid to the study of the existence of almost periodic type solutions of this type of equations [1, 2]. There are many remarkable works on this field (see [3, 4] and references therein). In this paper, by means of properties of almost periodic type systems and almost periodic type sequences, the existence of almost periodic type solutions of first order delay differential equations with piecewise constant argument are studied [5, 6]. Throughout this paper, $C(R, R^n)$ denotes the Banach space of bounded continuous functions from R to R^n with the norm $\|f\| = \sup_{t \in R} |f(t)|$.

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$AP(R)(AP(R \times \Omega))$ denotes the set of all (uniformly) almost periodic functions [7]. $AAP(R)$ or $AAP(R \times \Omega)$ ($PAP(R)$ or $PAP(R \times \Omega)$) denote by the set of all asymptotically(pseudo) almost periodic functions. In fact, asymptotically (pseudo) almost periodic function f can be decomposed into $f = f_0 + f_1$, where $f_1 \in AP(R)$ or $AP(R \times \Omega)$, $f_0 \in C_0(R) = \{f \in C(R) : \lim_{|t| \rightarrow \infty} f(t) = 0\}$, or $f_0 \in C_0(R \times \Omega) = \{f \in C(R \times \Omega) : \lim_{|t| \rightarrow \infty} f(t, x) = 0, \forall x \in \Omega\}$, ($f_0 \in PAP_0(R) = \{f \in C(R) : m(|f|) = \lim_{T \rightarrow \infty} \frac{1}{2T} \int_{-T}^T |f(t)| dt = 0\}$ or $f_0 \in PAP_0(R \times \Omega) = \{f \in C(R \times \Omega) : m(|f|) = \lim_{T \rightarrow \infty} \frac{1}{2T} \int_{-T}^T |f(t, x)| dt = 0, \forall x \in \Omega\}$.) Instead of $C(R)$ by Lévesque measurable in the space $PAP_0(R)$, a new space are obtained, denote it by $P\dot{A}P_0(R)$. For almost periodic type sequences, $AP(Z)$ denote the set of all almost periodic sequences. $AAP(Z)$ ($PAP(Z)$) Denote the set of all asymptotically (pseudo) almost periodic sequences, in fact, asymptotically (pseudo) almost periodic sequences x can be decomposed into: $x = x_1 + x_2$ where $x_1 \in AP(Z)$, $x_2 \in C_0(Z) = \{x : |x(n)| \rightarrow 0, |n| \rightarrow \infty\}$, ($x_2 \in PAP_0(Z) = \{x : \frac{1}{2k} \sum_{j=-k}^{j=k} |x(j)| \rightarrow \infty \text{ as } k \rightarrow \infty\}$). For almost periodic type function and almost periodic type sequence, the following propositions hold (see [8]).

Proposition 1.1 A necessary and sufficient condition for a sequence $\{\alpha_n\}$ to be in $AP(Z)(AAP(Z), PAP(Z), \text{ or } PAP_0(Z))$ is that there exists a function f to be in $AP(R)(AAP(R),$ uniformly continuous $PAP(R)$, or uniformly continuous $PAP_0(R))$ such that $f(n) = \alpha_n, n \in Z$.

If $\{x(n)\} \in AP(Z), f \in AP(R)$, then $T(f, \varepsilon) \cap Z$ and $T(x, \varepsilon) \cap T(f, \varepsilon)$ is relatively dense in Z , where $T(f, \varepsilon) = \{\tau \in R, \|R_\tau f - f\| < \varepsilon\}$, $T(x, \varepsilon) = \{\tau \in Z, \|R_\tau x - x\| < \varepsilon\}$.

82.2 The Main Results

Consider the following differential equation with PCA

$$\frac{dx}{dt} = f(t, x(t), x([t - p])) \tag{82.1}$$

Where p is any positive number, $[\cdot]$ denotes the greatest integer function, $f \in C(R \times \Omega, R^n), \Omega$ denotes open set in R^{2n} . A continuous function $x : R \rightarrow R^n$ is called a solution of Eq. (82.1) if the following conditions are satisfied:

The derivative $x'(t)$ exists everywhere, with possible exception of the point $[t], t \in R$, where one-side derivatives exist;

x satisfies Eq. (82.1) on each interval $[n, n + 1), \forall n \in Z$. Besides, function g satisfies Lipchitz condition means

$$|g(t, x_1, y_1) - g(t, x_2, y_2)| \leq L(|x_1 - x_2| + |y_1 - y_2|) \tag{82.2}$$

where $L > 0, (t, x_i, y_i) \in R \times R^n \times R^n, i = 1, 2$

Theorem 2.288 Let $f \in AP(R \times \Omega)$ in Eq.(82.1) satisfied (82.2). If the equation

$$\begin{cases} \frac{dx}{dt} = f(t, x(t), x([t - p])) \\ x(j) = x_j, j = [-p], [-p + 1], \dots, 0. \end{cases} \tag{82.3}$$

Has a unique solution to initial value problems and $\varphi(t)$ is the solution with $\varphi(R)^2 \subset \Omega$, then $\varphi(\cdot) \in AP(R)$ if and only if $\{\varphi(n)\}_{n \in \mathbb{Z}} \in AP(\mathbb{Z})$.

Proof If $\varphi(\cdot) \in AP(R)$, from Proposition 82.1, we know $\{\varphi(n)\}_{n \in \mathbb{Z}} \in AP(\mathbb{Z})$.

Conversely, if $\{\varphi(n)\}_{n \in \mathbb{Z}} \in AP(\mathbb{Z})$, then $\{\varphi([n - p])\}_{n \in \mathbb{Z}} \in AP(\mathbb{Z})$. For any $\varepsilon > 0$, take $\varepsilon_0 = \frac{\varepsilon}{e^L(2+L)}$, it follows from Proposition 82.1 that $\tau \in T(\varphi([n - p]), \varepsilon_0) \cap T(f(t), \varepsilon_0)$ and $t \in [n, n + 1]$, we have

$$|\varphi(t + \tau) - \varphi(t)| \leq |\varphi(n + \tau) - \varphi(n)| + L \int_n^{t+\tau} |\varphi(s + \tau) - \varphi(s)| ds + (L + 1)\varepsilon_0 \tag{82.4}$$

By Gromwell inequality, we know $|\varphi(t + \tau) - \varphi(t)| \leq e^L(2 + L)\varepsilon_0 = \varepsilon$, hence, $\varphi(t) \in AP(R)$. the proof is completed.

Lemma 2.2 Suppose $f_0(t, x) \in PAP_0(R \times \Omega)$ satisfied condition (2). If R^n is a bound function from R two R^n with $\varphi(R)^2 \subset \Omega$, then $f_0(\cdot, \varphi(\cdot), \varphi[\cdot - p]) \in P\bar{A}P_0(R)$.

Proof By compactness of $\overline{\varphi(R) \times \varphi(R)}$, there exist m open balls $B_j((x_1^j, x_2^j), \frac{\varepsilon}{6L})$, $(x_1^j, x_2^j) \in \varphi(R) \times \varphi(R), j = 1, 2, \dots, m$, such that $\bigcup_{j=1}^m B_j((x_1^j, x_2^j), r) \supset \overline{\varphi(R) \times \varphi(R)}$. Let $S_j = \{t \in R, (\varphi(t) \times \varphi([t - p])) \in B_j\} j = 1, 2, \dots, m$, then $R = \bigcup_{i=1}^m S_i$. Since $f_0(\cdot, x_1^j, x_2^j) \in PAP_0(R)$, we have $\lim_{T \rightarrow \infty} \frac{1}{2T} \int_{-T}^T |f_0(t, x_1^j, x_2^j)| dt = 0$, there exists $T_0 > 0$, for all $T > T_0$:

$$\begin{aligned} & \frac{1}{2T} \int_{-T}^T |f_0(t, \varphi(t), \varphi([t - p]))| dt \\ & \leq \frac{1}{2T} \sum_{j=1}^m \int_{S_j \cap [-T, T]} |f_0(t, \varphi(t), \varphi([t - p])) - f_0(t, x_1^j, x_2^j)| dt \\ & + \frac{1}{2T} \sum_{j=1}^m \int_{S_j \cap [-T, T]} |f_0(t, x_1^j, x_2^j)| dt \leq \frac{1}{2T} \int_{-T}^T \left(L \frac{\varepsilon}{6L} + L \frac{\varepsilon}{6L} \right) dt + \frac{\varepsilon}{3} < \varepsilon \end{aligned} \tag{82.5}$$

This inequality shows that $f_0(\cdot, \varphi(\cdot), \varphi([\cdot - p])) \in P\bar{A}P_0(R)$. The proof is completed.

Similarly as above, we can obtain:

Lemma 2.3 Suppose $f_0(t, x) \in C_0(R \times \Omega)$ satisfied condition (2), $\varphi(t)$ is a bounded function with $\varphi(R)^2 \in \Omega$, then $\lim_{|t| \rightarrow \infty} f_0(t, \varphi(t), \varphi([t - p])) = 0$.

Lemma 2.4 Suppose $f \in PAP_0(R \times \Omega)(C_0(R \times \Omega))$ in Eq. (82.1) satisfied condition (2). If $\varphi(t)$ is a solution of Eq. (82.1) with $\varphi(R)^2 \subset \Omega$, then $\varphi(\cdot) \in PAP_0(R)(C_0(R))$ if and only if $\varphi(n) \in PAP_0(Z)(C_0(Z))$.

Proof Since $\varphi(t) \in PAP_0(R)$ is a solution of Eq. (82.1), $\varphi(t)$ is uniformly continuous. By Proposition 82.1, we can get $\varphi(n) \in PAP_0(Z)$.

Conversely, Eq. (82.1) is equivalent to $\varphi(t) = \varphi(n) + \int_n^t f(s, \varphi(s), \varphi([n - p]))ds$, $t \in [n, n + 1)$. So, $\varphi(t)$ is a continuous bounded function? By Lemma 2.2, $f(\cdot, \varphi(\cdot), \varphi([\cdot - p])) \in \bar{P}AP_0(R)$. For any $T, T \in [n, n + 1]$:

$$\frac{1}{2T} \int_{-T}^T |\varphi(t)|dt \leq \frac{1}{2n} \sum_{j=-(n+1)}^{n+1} \left(|\varphi(j)| + \int_j^{j+1} \int_j^t |f(s, \varphi(s), \varphi([s - p]))|dsdt \right)$$

Since $\varphi(n) \in PAP_0(Z)$ and $f(\cdot, \varphi(\cdot), \varphi([\cdot - p])) \in \bar{P}AP_0(R)$, for any $\varepsilon > 0$, there exists a T_0 , for any $T > T_0$, $\frac{1}{2T} \int_{-T}^T |\varphi(t)|dt < \varepsilon$, so $\varphi(t) \in PAP_0(R)$. When $f \in (C_0(R \times \Omega))$, similarly, we can easily prove that $\varphi(t) \in C_0(R)$ if and only if $\varphi(n) \in C_0(Z)$. The proof is completed.

Theorem 2.5 Suppose $f \in PAP(R \times \Omega) AAP(R \times \Omega)$ in Eq. (82.1), its component f_0 and almost periodic component f_1 satisfy condition (2). If $\varphi(t)$ is a solution of Eq. (82.1) with $\varphi(R)^2 \subset \Omega$, then $\varphi(\cdot) \in PAP(R)(AAP(R))$ if and only if $\{\varphi(n)\}_{n \in Z} \in PAP(Z)(AAP(Z))$.

Proof If $\varphi(t) \in PAP(R)$ is the solution of Eq. (82.1), by the boundary of f , we known $\varphi(t)$ is uniformly continuous on R . Hence, from Proposition 1.1, we know that $\{\varphi(n)\}_{n \in Z} \in PAP(Z)$.

Conversely, if $\{\varphi(n)\}_{n \in Z} \in PAP(Z)$, $\varphi(n) = \varphi_1(n) + \varphi_0(n)$, $\{\varphi_1(n)\}_{n \in Z} \in AP(Z)$, $\{\varphi_0(n)\}_{n \in Z} \in PAP_0(Z)$. The boundedness of $\varphi(t)$ can be obtained by the same way as above. According to the theory of ordinary differential equation, for every $n \in Z$, the following initial value problem:

$$\begin{cases} \frac{dx}{dt} = f_1(t, x(t), \varphi_1(n - p)) \\ x(n) = \varphi_1(n), t \in [n, n + 1) \end{cases}$$

Has a unique solution $\bar{\varphi}_{1,n}(t)$, which satisfies $\bar{\varphi}_{1,n}(t) = \varphi_1(n) + \int_n^t f_1(s, \bar{\varphi}_{1,n}(s), \varphi_1([n - p]))ds$, $t \in [n, n + 1)$.

As f_1 satisfy condition (2), for any $\varepsilon > 0$, take $\tau \in T(\varphi_1(n), \varepsilon/(2 + 2Le^L)) \cap T(f_1(t), \varepsilon/(2 + 2Le^L))$, it follows from Gronwall inequality that

$|\bar{\varphi}_{1,n+\tau}(t + \tau) - \bar{\varphi}_{1,n}(t)| < \varepsilon, \quad t \in [n, n + 1]$. In particular, $|\bar{\varphi}_{1,n+\tau}(n + 1 + \tau) - \bar{\varphi}_{1,n}(n + 1)| < \varepsilon$, which implies that the sequence $\bar{\varphi}_{1,n}(n + 1) \in AP(Z)$. Let $\bar{\varphi}_{0,n}(t)$ be the solution of the following initial value problem:

$$\begin{cases} \frac{dx}{dt} = f(t, x(t) + \bar{\varphi}_{1,n}(t), \varphi(n - p)) - f_1(t, \bar{\varphi}_{1,n}(t), \varphi_1(n - p)) \\ x(n) = \varphi_0(n), \quad t \in [n, n + 1] \end{cases} \tag{82.6}$$

Then $\bar{\varphi}_{0,n}(t)$ is uniquely determined. Set $\bar{\varphi}_1(t) = \bar{\varphi}_{1,n}(t), \bar{\varphi}_0(t) = \bar{\varphi}_{0,n}(t), t \in [n, n + 1]$. Notice f_0 satisfy condition (2) and Lemma 2.2, by the similar analysis as above, we can get $\{\bar{\varphi}_{0,n}(n + 1)\} \in PAP_0(Z), \bar{\varphi}_0(t) \in P\dot{A}P_0(R)$. Clearly, for every $n \in Z, t \in [n, n + 1], \varphi(t) = \bar{\varphi}_0(t) + \bar{\varphi}_1(t)$. Since $\varphi(t), \bar{\varphi}_0(t), \bar{\varphi}_1(t)$ are continuous on $[n, n + 1]$, we have $\varphi_0(n + 1) + \varphi_1(n + 1) = \lim_{t \rightarrow (n+1)^-} \bar{\varphi}_{0,n}(t) + \bar{\varphi}_{1,n}(t) = \bar{\varphi}_{0,n}(n + 1) + \bar{\varphi}_{1,n}(n + 1)$. It follows from Proposition 1.2 that $\varphi_0(n + 1) = \bar{\varphi}_{0,n}(n + 1), \bar{\varphi}_{1,n}(n + 1) = \varphi_1(n + 1)$, which implies that $\bar{\varphi}_0(t), \bar{\varphi}_1(t)$ are continuous on R . Thus, $\bar{\varphi}_0(t) \in PAP_0(R)$ and $\bar{\varphi}_1(t) \in$.

$AP(R)$, i.e., $\varphi(t) \in PAP(R)$. Similarly, we can obtain when $f \in AAP(R \times \Omega), \varphi(t) \in AAP(R)$ if and

Only if $\{\varphi(n)\}_{n \in Z} \in AAP(Z)$. The proof is completed.

82.3 Summary

Differential equations with piecewise constant argument have applications in certain biomedical models. It is meaningful to consider the almost periodic type solutions of this type equation. In this paper, the existence of almost periodic type solutions of first order delay differential equations with piecewise constant argument are studied by mean of the properties of almost periodic type systems and almost periodic type sequences.

References

1. Cooke KL, Wiener J (1984) Retarded differential equations with piecewise constant delays. *J Math Anal Appl* 99:265–297
2. Shah SM, Wiener J (1983) Advanced differential equations with piecewise constant argument deviations. *Int J Math Math Soc* 6:671–703
3. Alonso AI, Hong JL, Obaya R (2000) Almost periodic type solutions of differential equations with piecewise constant argument via almost periodic type sequences. *Appl Math Lett* 13:131–137
4. Lin GJ, Yuan R (2007) Pseudo almost periodic solutions of a singularly perturbed differential equation with piecewise constant argument. *Acta Mathematica Sinica, Engl Ser* 23:423–438

5. Akhmet MU (2008) Stability of differential equations with piecewise constant arguments of generalized type. *Nonlinear Anal* 68:794–803
6. Akhmet MU, Yilmaz E (2010) Impulsive hopfield-type neural network system with piecewise constant argument. *Nonlinear Anal* 11:2584–2593
7. Zhang LL, Li HX (2011) Weighted pseudo almost periodic solutions of second order neutral differential equations with piecewise constant argument. *Nonlinear Anal* 74:6770–6780
8. Zhang C (2003) Almost periodic type function and ergodicity, vol 1. Science Press Kluwer, Academic Publishers, Dordrecht, pp 148–152

Chapter 83

Research of Incremental Learning Algorithm Based on the Minimum Classification Error Criterion

Bo Wen, Ganlin Shan and Xiusheng Duan

Abstract Incremental learning is widely used in artificial intelligence, pattern recognition and other fields. It is an effective method to solve the system, where samples are less in the beginning of training, but over time its performance reduces. In this paper, based on the analyses of support vector machine and the characteristics of incremental learning, we proposed incremental learning method which is based on the minimum classification error criterion. Moreover, the validity and feasibility of this algorithm is verified through experiments.

Keywords Analog circuit · Fault diagnosis · Support vector machine

83.1 Introduction

Support vector machine (SVM) is a kind of pervasive machine learning model which is put forward by Vapnik et al., based on the statistical learning theory [1]. It uses the kernel function mapping nonlinear, thereby enhancing the learning machine performance [2, 3]. At present, the international research gets more and more attention [4, 5]. Machine learning is the basic problem in the field of artificial intelligence. Many learning system get few samples at the early stage of learning. As time goes by, samples accumulate ceaselessly [6, 7]. But the efficiency of the system is reduced. Then we need the new samples get into training to improve the system's performance [8]. If we process the new samples together with the old ones, the difficulty of learning will increase, and will consume too much time and

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storage space because sample set is too large. An effective method is to add, modify or the delete the part of original learning results which is only relevant to the new samples. Other irrelevant parts are untouched. This is the incremental learning. However, the learning results of support vector machine are support vector set. It is usually a small part of the whole sample sets, but can represent the feature of the entire sample set. This suggests that SVM incremental learning method based on support vector machine is feasible. By anglicizing support vector, this paper proposed incremental learning algorithm of support vector based on the minimum classification error criterion [9].

83.2 Problem Description

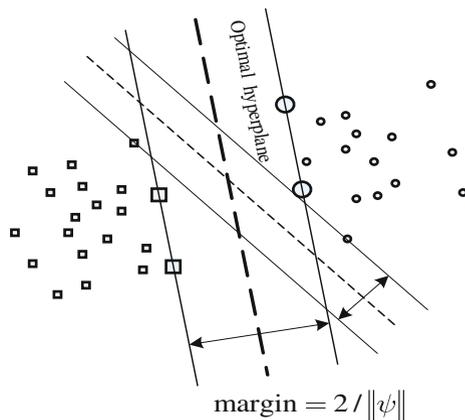
83.2.1 The Function of Support Vector Machine and Support Vector

Support vector machine is originated from classification problem under the linear case. The goal of using a support vector machine classification is to find the optimal hyperplane. Optimal hyperplane is the maximum-margin hyperplane, i.e., two kinds of samples are correctly classified, and at the same time, makes their classification interval biggest, as shown in Fig. 83.1 [10]:

As to the training sample set $(y_1, x_1), \dots, (y_l, x_l)$, $x \in R^n$, $y \in \{-1, 1\}$, classification hyper plane's two optimization problem is

$$\begin{aligned} \min_{\psi, b} & \frac{1}{2} \|\psi\|^2 + C \sum_{i=1}^l \xi_i \\ \text{s.t.} & y_i((\varphi(x_i) * \psi) + b) \geq 1 - \xi_i, \\ & \xi_i \geq 0, \quad i = 1, \dots, l \end{aligned} \tag{83.1}$$

Fig. 83.1 Optimal separating hyperplane diagram



Its Lagrange function is

$$L(\psi, b, \alpha, \beta) = \frac{1}{2}(\psi * \psi) + C \sum_{i=1}^l \xi_i - \sum_{i=1}^l \alpha_i [y_i((\varphi(x_i) * \psi) + b) - 1 + \xi_i] - \sum_{i=1}^l \beta_i \xi_i \quad (83.2)$$

Its dual problem is

$$\begin{aligned} \max W(\alpha) &= \sum_{i=1}^l \alpha_i - \frac{1}{2} \sum_{i,j=1}^l y_i y_j \alpha_i \alpha_j (\varphi(x_i) * \varphi(x_j)) \\ &= \sum_{i=1}^l \alpha_i - \frac{1}{2} \sum_{i,j=1}^l y_i y_j \alpha_i \alpha_j K(x_i, x_j) \\ &s.t. \quad C \geq \alpha_i \geq 0 \\ &\quad \sum_{i=1}^l y_i \alpha_i = 0 \end{aligned} \quad (83.3)$$

Here, $K(x_i, x_j) = \varphi(x_i) * \varphi(x_j)$ is a kernel function.

Finally, we can get the decision function.

$$f(x, \alpha) = \text{sign} \left(\sum_{\text{support vector}} y_i \alpha_i^0 K(x_i, x_j) + b \right) \quad (83.4)$$

The learning machine which constructs the decision function is called support vector machines (SVM). In the classification learning, only the support vector samples make contributions to optimal hyperplane and decision function. In general, X_i , which corresponds to the Lagrange multiplier α_i 's value $0 < \alpha_i < C$, is called general support vector. But X_i , which corresponds to $\alpha_i = C$, is called boundary support vector. The former one represents all the samples which cannot be correctly classified; while the latter one represents the classification features of most samples. They together determine the form of the final classifier. That is to say, the support vector set can fully describe the features of training sample set. Its division is equivalent to the division of the entire sample set. In most cases, support vector set accounted for only a small part of training samples, therefore we can use support vector set to replace the training sample set for learning, if it does not affect the classification accuracy and reduce training time and memory space.

83.2.2 The Criterion of Minimum Classification Error

The simplest way of classification error measure is Bayes Discriminant which can be used to classify two kinds of problems. Its classification error measure can be defined as:

$$d(x) = P(C_2|x) - P(C_1|x) \tag{83.5}$$

Here, we assume that $P(C_2|x) (i=1, 2)$ is a known posteriori possibility. This formula gives the possibility that observational samples of class 1 would be mistakenly classified into class 2. Its optimal decision boundary is the solution of $d(x) = 0$. For many such cases ($N > 2$) of unknown distribution, they are different from Bayes Discriminant which classifies two kinds of problems and defines a classification error measure. Amari defines another classification error measure:

$$d_k(x) = \sum_{x \in S_k} \frac{1}{m_k} [g_i(x; \Lambda) - g_k(x; \Lambda)] \tag{83.6}$$

Here, $S_k = \{i | g_i(x; \Lambda) > g_k(x; \Lambda)\}$ is a confusion class set. m_k Is confusion number of S_k . S_k Is uncertain and it changes with the parameter set Λ and sample x . Therefore, this formula is discontinuous to ... It can't work out any derivative, so it's not suitable for gradient operation. There are many methods to define the Λ continuous classification error measure. One of them is:

$$d_k(x) = -g_k(x; \Lambda) + \left[\frac{1}{N-1} \sum_{j, \eta \neq k} g_j(x; \Lambda)^\eta \right]^{\frac{1}{\eta}} \tag{83.7}$$

In this formula, the second term on the right is the geometric average of all the other competing kinds. Parameter η can be regarded as a coefficient which adjusts the other competing kinds' contributions to the whole discriminant function. In the process of searching for the classifier parameter, many potential classifications can be found through the change of η . An extreme situation is that when $\eta \rightarrow \infty$, the discriminant function of the biggest competing kind in the second term plays a leading role. That is:

When $\eta \rightarrow \infty$, then

$$\left[\frac{1}{N-1} \sum_{j, \eta \neq k} g_j(x; \Lambda)^\eta \right]^{\frac{1}{\eta}} = \max_{j, \eta \neq k} g_j(x; \Lambda) \tag{83.8}$$

Classification error measure changes into:

$$d_k(x) = -g_k(x; \Lambda) + g_j(x; \Lambda) \tag{83.9}$$

Here, C_i , except C_K , is the kind which has the biggest discriminant value among all other kinds. This is because $(N-1)^{1/\infty} \cong 1$. Obviously, under this

circumstance, $d_k(x) > 0$ is a classification error. $d_k(x) \leq 0$ is the right classification. In this way, decision rule is changed into a problem of judging the scalar value.

83.3 Algorithm Design and Experiment Analysis

83.3.1 Algorithm Design

Assuming that the initial training sample set is $A = \{x_1, x_2, \dots, x_M\}$, every $x_m (m = 1, 2, \dots, M)$ is a K vector, and belongs to a certain category in $C_i (i = 1, 2, \dots, N)$. As to a classifier which usually contains a set of parameters and a decision rule, the task of minimum classification error classifier design is: based on the given initial training sample set A find out the classifier parameters set and the associated decision rules, in order to get the minimum probability of any classification error sample $x_m (m = 1, 2, \dots, M)$. Generally, the probability of classification error is approximated by error rate. If the cost of the related classification error exists, the goal of this kind of classifier is changed into: find out the suitable classifier parameter set Λ and the related rules to achieve the minimum expected cost.

The algorithm is as follows:

1. Initialize parameters Λ , set $t = 1$, select historical sample set A and new sample set I_t . Calculate the respective class center and sample forgetting factor $d(x_k)$ of the two kinds of sample in A . Determine the minimum classification error criterion collection B . Training B received initial support vector set SV^0 and decision function f^0 .
2. If $I_t \neq \emptyset$, the algorithm will terminate. Otherwise, turn to 3.
3. Find out the samples I_t that violate the *KKT* conditions of decision function f^{t-1} , and determine set I_t^v .
4. If $I_t^v = \emptyset$, set $SV^t = SV^{t-1}$, $f^t = f^{t-1}$, $t = t + 1$, then turn to 2; or else turn to 5.
5. Through the incremental learning of $T = SV^{t-1} \cup I_t^v$, get a new decision function f^t support vector set SV^t , set $t = t + 1$, and turn to 2.

83.3.2 Experiment Analysis

This paper contains 3678 calibration samples. In order to verify the effectiveness and the feasibility of this algorithm, we apply incremental learning algorithm in the experiments of automatic classification of these samples based on the above research. In the test, we selected 643 samples as test sample set and 781 samples as the initial training set (H_1). The rest of the samples were randomly divided into five groups (H_2, H_3, H_4, H_5, H_6), which make up five incremental training sample

Table 83.1 The comparison between results of the new SVM incremental learning algorithm and the traditional SVM learning method

Training set	The number of incremental samples	The new SVM learning method		The traditional SVM learning method	
		Time/s	Precision (%)	Time/s	Precision (%)
H_1	781	98.7	93.5	171.5	92.7
H_2	398	76.4	96.9	232.6	95.1
H_3	113	118.5	93.4	328.4	92.8
H_4	407	136.3	94.8	487.3	93.4
H_5	282	103.8	96.5	546.2	93.8
H_6	1254	97.2	95.1	659.7	94.6

set. We have conducted comparative experiments between the new SVM Incremental Learning Algorithm and the Traditional SVM Learning Method. The experimental results are shown in Table 83.1 (SVM training nuclear function is using Gauss function. Software environment is MATLAB7.0. Hardware environment is Pentium 4/256 MB memory) [4].

From the results, compared with the Traditional Learning Algorithm, the classification accuracy of the SVM Incremental Learning Algorithm is improved, and its training speed is obviously improved.

83.4 Conclusion

Based on the characteristics of vector machine, we work out the SVM Incremental Learning Method. Furthermore, we put forward Incremental Learning Algorithm which is based on the minimum classification error criterion. This algorithm, in each round of the incremental training of training sample set, effectively keeps the former training samples which contain important information. It also simplifies the current incremental training sample set, and keeps those that are most likely to become the support vectors of training sample set for SVM incremental training. The experimental results show that this learning method is superior to the traditional incremental learning algorithm in both accuracy and time consumption.

References

1. Vapnik V (1995) The nature of statistical learning theory, vol 1. Springer Press, New York, pp 147–149
2. Zhu HB, Cai Y (2009) Text categorization based on active learning support vector machines. *Comput Eng Appl* 45(2):134–136

3. Kong R, Zhang B (2005) A fast incremental learning algorithm for support vector machine. *Control Decis* 20(10):1129–1136
4. Cao J, Liu Z (2007) Incremental learning algorithm based on SVM. *Appl Res Comput* 24(8):48–52
5. Ye S, Wang X, Liu Z, Qian Q (2011) Power system transient stability assessment based on support vector. *Mach Increm Learn Method* 35(11):15–19
6. Zhe X, Zhizhong M (2010) Incremental learning of support vector machine based on hyperspheres. *J Northeastern Univ (Nat Sci)* 1:16–19
7. Xiao R, Wang J (2001) An incremental SVM learning algorithm a-ISV. *J Softw* 12(12):1818–1823
8. Li D, Du S, Wu T(2006) Fast Incremental learning algorithm of linear support vector machine based on hull vectors. *J Zhejiang Univ (Eng Sci)* 40(2):203–215
9. Jiqing Han (2001) Discriminative learning method based on minimum classification error criterion. *Electron Eng* 27(2):1–12
10. Xiusheng Duan (2009) Research on fault diagnosis technology for a fire control system based on SVM. *Shijiazhuang Mech Eng Coll* 9:112–120

Chapter 84

Efficient Environmental Air Quality Evaluation Scheme Based on the Fuzzy Mathematics Method

An Li and Jiyan Liu

Abstract Purpose Comprehensive evaluation 2010 jilin city environmental air quality. Method The application of the fuzzy mathematics method of 2010 air environmental quality in jilin city being affected by many factors that work together comprehensive assessment. Result 2010 jilin city each regional environmental air quality monitoring sites for I level. Jilin city each monitoring sites of pollutants in a PM10 primarily, PM10 pollution on the quality of ambient air in jilin city overall impact assessment is the largest. Conclusion Using the fuzzy mathematics method comprehensive evaluation 2010 jilin city environment air quality for I level.

Keywords Fuzzy mathematics method • Comprehensive evaluation • Environmental air quality

84.1 Introduction

Jilin City lies in the central eastern area in Jilin province, one of the main industrial cities in Jilin province, which occupies an important position in the old industrial bases in northeast China [1, 2]. Due to a variety of reasons, China's large heavy industry and chemical industry enterprises are also located in this city. The

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waste gas produced by the large number of chemical enterprises has been emitted directly to the environment, which seriously affects the air quality of the Jilin city. How to evaluate the environmental air quality in Jilin is a very important problem. At present, there are many evaluation methods of environmental air quality [3]. Comprehensive pollution index method is in common use among them, which ignores the statistical differences between the monitoring concentration data, determines the pollution levels and the classes of pollution with a hard rule, seeming not to be a very objective measure of environmental air quality pollution condition.

The key to how to reflect the environmental air quality condition and the changing laws in Jilin City more accurately and objectively lies in the reasonable choice and establishing the evaluation method and mathematical model. In this paper, the fuzzy mathematics is used to evaluate air environmental quality in Jilin City of 2010, which is affected by many comprehensive factors.

84.2 Materials and Methods

84.2.1 Monitoring Point Distribution

In jilin city, the continuously automatic monitoring system is used in environmental air monitoring, and the entire system in the city consists of six monitoring points [4], including a background points (Fengman) and five pollution monitoring points, which are cultural area (Jiangnan park), industrial zone (Hadad bay), residential area (Dongjuzi), commercial traffic residents of the mixed zone (Northeast Dianli University) and general industrial zone (Chemical college).

84.2.2 Monitoring Project

84.2.2.1 Source Material

According to the monitoring material of Jilin city environmental protection monitoring stations in 2010, the monitoring projects of the environmental air automatic monitoring system are PM10, SO₂ and NO₂ gas. Routine monitoring projects are the dust and the sulfuric acid salinization rate. On the basis of 365 days a year and 8760 data of each pollution indicators, the total number of monitoring data is 26280.

84.2.2.2 Evaluation Method, Analysis Method and Evaluation Standard

The method of monitoring analysis is executed according to the standard method of the provisions of the national environmental protection administration [5].

84.2.3 Level Standards and Contestant Indexes

The evaluation classification standards are listed in Table 84.1.

84.3 Fuzzy Comprehensive Evaluation Method and Model

84.3.1 Establish Evaluation Space and Confirm Evaluation Sets and Factor Sets

Firstly, the number of influence factors of air environmental quality is set to n. The subset U of comprehensive evaluation consists of the n factors and is expressed as follow: $U = \{u_1, u_2, \dots, u_n\}$

Then, the subset A is made up of the weights of the n factors and is showed as follow: $A = \{a_1, a_2, \dots, a_n\}$

Lastly, the number of judgment level is set to m and they form the subset V, which is signified as follow: $V = \{v_1, v_2, \dots, v_m\}$

Therefore, the subset B of comprehensive evaluation model can be obtained as follow: $B = \{b_1, b_2, \dots, b_n\} = A \circ R$.

$$b_j = \bigvee_{i=1}^n (a_i \bullet r_{ij}) = \max [(a_1 \cdot r_{1j}, a_2 \cdot r_{2j}, \dots, a_n \cdot r_{nj})] \quad (j = 1, 2, \dots, m)$$

In the formula: B is the fuzzy subset of V; A is the fuzzy subset of U; “ \circ ” is expressed as the compound operation of fuzzy matrix; R is the fuzzy matrix of

single factor and showed as follow: $R = (r_{ij})_{n \times m} = \begin{pmatrix} r_{11} & r_{12} & \wedge & r_{1m} \\ r_{21} & r_{22} & \wedge & r_{2m} \\ M & M & M & M \\ r_{n1} & r_{n2} & \wedge & r_{nm} \end{pmatrix}_{n \times m}$

In the matrix: r_{ij} can be obtained by membership function.

Table 84.1 Evaluation classification standards (mg/m3)

Factor	Evaluation level		
	I level	II level	III level
SO ₂	0.02	0.06	0.10
NO ₂	0.04	0.04	0.08
PM10	0.04	0.10	0.15

Three factors ($n = 3$) are selected to evaluate for the research of Jilin city' air quality. Therefore,

$$\begin{aligned}
 U &= \{u_{SO_2}, u_{NO_2}, u_{PM10}\} \\
 A &= \{a_{SO_2}, a_{NO_2}, a_{PM10}\} \\
 B &= A^OR = \{b_1, b_2, b_3\} \\
 b_j &= \bigvee_{i=1}^3 (a_i \bullet r_{ij}) (j = 1, 2, 3)
 \end{aligned}
 \tag{84.1}$$

84.3.2 Establish Membership Function

According to the environmental air quality level standards, the membership degree of a certain factor to all levels of environmental air quality can be ascertained by taking the method of linear function, the equation is showed as follow:

$$\left\{ \begin{array}{ll}
 1 & x_i \leq d_{ij} \neq d_{i(j-1)} \\
 \frac{(x_i - d_{i(j-1)})}{d_{ij} - d_{i(j-1)}} & d_{i(j-1)} < x_i < d_{ij} \\
 r_{ij} = 1 - \frac{(x_i - d_{ij})}{d_{i(j+1)} - d_{ij}} & d_{ij} < x_i < d_{i(j+1)} \\
 \frac{1}{j+h} & d_{ij} = d_{i(j-1)} = d_{i(j+1)} = \wedge = d_{i(j+h)} \\
 0 & x_i \geq d_{i(j+1)} \neq d_{ij}
 \end{array} \right.
 \tag{84.2}$$

In the formula: r_{ij} is the membership degree of the i th kind of pollutants to the j th level; d_{ij} is the highest concentration limits of the i th kind of pollutants to the j th level standard; x_i is the measured value of the i th kind of pollutants.

84.3.3 Weight Calculation

The method of weight calculation is based on that the larger each single factor exceeds the standard, the larger the weight, which has a stronger effect on the air environmental quality. Therefore, the weight is calculated by the contribution of various pollutants, and is normalized. The equation is showed as follow:

$$a_i = (x_i / \bar{d}_i) / \sum_{i=1}^3 (x_i / \bar{d}_i)
 \tag{84.3}$$

In the formula: \bar{d}_i is the mean of standard at all levels of the i th kind of pollutants; x_i is the measured value of the i th kind of pollutants; a_i is the weight of the i th kind of pollution factors.

84.3.4 Monitoring Data

In accordance with the data from the Jilin city's environmental monitoring sites, the day average numeric of the Jilin city' environment air pollutants in 2010 are listed in Table 84.2.

84.4 The Results and Discussion

84.4.1 Single Factor Evaluation Results

The membership degree of all kinds of pollution factors in each area can be obtained by the above formula (1–2) and the calculation results are listed in Table 84.3. In addition, the single factor evaluation results are listed in Table 84.4.

It is can be seen from the Tables 84.3 and 84.4: the five monitoring sites of SO₂ meet I level standard; the five monitoring sites of NO₂ are in line with I-II level standard; the PM10 of Hadad bay accords with III level standard, the PM10 of Northeast dianli University and chemical college meet II level standard, and the PM10 of Dongjuzi and Jiangnan park are in line with I level standard. Comprehensively, it is most likely that the membership degree of PM10 belongs to the I-II level is maximum. Therefore the PM10 accords with I-II level standard most probably.

84.4.2 Comprehensive Evaluation Results

The weights of all kinds of pollution factors in every region can be obtained by the above formula (1–3), and the subset of the comprehensive evaluation for each monitoring site is able to be acquired by the above formula (1–1). The single factor weights and the comprehensive evaluation results are listed in Table 84.5.

From the Table 84.5, under the common influence of SO₂, NO₂ and PM10 of the Jilin city' each monitoring site in 2010, the membership degree range of I level, II level and III level of environmental air quality are 15.6–40.4, 14.9–40.2 and 0–30.6 %. According to the principle of maximum membership degree, the membership degree off I level of environmental air quality standards is the largest,

Table 84.2 Day average numerical of environment air pollutants in Jilin City (mg/m³)

	Hadad bay	Dongjuzi	Northeast Dianli University	Chemical College	Jiangnan park
SO ₂	0.0279	0.0105	0.0172	0.0140	0.0163
NO ₂	0.0325	0.0166	0.0294	0.0133	0.0221
PM10	0.1278	0.0549	0.0868	0.0775	0.0597

Table 84.3 The membership of the various pollution factors from Jilin city' monitoring sites in 2010

Monitoring sites	SO ₂			NO ₂			PM10		
	r I	r II	r III	r I	r II	r III	r I	r II	r III
Hadad bay	0.803	0.198	0.000	0.500	0.500	0.000	0.000	0.444	0.556
Dongjuzi	1.000	0.000	0.000	0.500	0.500	0.000	0.752	0.248	0.000
Northeast Dianli University	1.000	0.000	0.000	0.500	0.500	0.000	0.220	0.780	0.000
Chemical college	1.000	0.000	0.000	0.500	0.500	0.000	0.375	0.625	0.000
Jiangnan park	1.000	0.000	0.000	0.500	0.500	0.000	0.672	0.328	0.000

Table 84.4 Single factor evaluation results

Monitoring sites	SO ₂	NO ₂	PM10
Hadad bay	I level	I-II level	III level
Dongjuzi	I level	I-II level	I level
Northeast Dianli University	I level	I-II level	II level
Chemical college	I level	I-II level	II level
Jiangnan park	I level	I-II level	I level

Table 84.5 Single factor weights and comprehensive evaluation results

Monitoring sites	Weights			Fuzzy comprehensive evaluation results		
	a_1	a_2	a_3	I level	II level	III level
Hadad bay	0.194	0.256	0.550	0.156	0.244	0.306
Dongjuzi	0.166	0.297	0.537	0.404	0.149	0.000
Northeast Dianli University	0.165	0.320	0.515	0.165	0.402	0.000
Chemical college	0.182	0.196	0.623	0.234	0.390	0.000
Jiangnan park	0.209	0.320	0.472	0.317	0.160	0.000

so the conclusion can be obtained: the environmental air quality of Jilin city' each monitoring site in 2010 belongs to I level. In addition, the membership degree of the environmental air quality of the monitoring sites except the Hadad bay belonging to III level is zero. Among the pollution factor weights of the different monitoring sites, the PM10 has a larger share, whose range reaches to 47.2–62.3 %. This shows that the primary pollutant in Jilin City is PM10. Therefore, the pollution of PM10 has the largest influence on the overall evaluation of environmental air quality in Jilin City.

84.5 Conclusion

Based on the membership functions of fuzzy mathematics method to make comprehensive evaluation of the environmental air quality, we can reflect the status of environmental air quality more objectively. This method takes the fuzziness of the

boundaries of the environmental air quality level and the different weights of various factors into consideration. In addition, it has a more simple operation and a better effect, which is the valid approach for the comprehensive evaluation about the air environmental quality. The result of the comprehensive evaluation of the Jilin city' environment air quality in 2010 is Ilevel by using the fuzzy mathematics method.

References

1. Zhongchen W, Huichun W (1998) Fuzzy mathematics method in pension finance system control of China. *Chin J Manag Sci* (4):52–58
2. Fang Y (2007) A comprehensive evaluation of gas-transporting capacity through faults of large and medium gas fields in China. *Acta Geoscientica Sinica* 4:123–129
3. Tiejun L, Xiaorong L (2001) The inhomogeneity of petroleum migration in clastic carrier beds. *Scientia Geologica Sinica* 04:223–234
4. Guang L, Jia L, Jing-ming L, Xiao Z (2005) The controls and the assessment method for the effectiveness of natural gas migration and accumulation process. *Nat Gas Geosci* 1:211–220
5. Fu XL, Yanfang FG, Wen H (2004) Quantitative simulation experiment and evaluation method for vertical seal of overthrust. *Chin J Geol* 02:25–36

Chapter 85

Computation of 2D Manifold Based on Generalized Foliation Condition

Meng Jia, Yi Ru and JunJie Xi

Abstract Stable and unstable manifolds play an important role in revealing the dynamics of dynamical systems. They form boundaries of different attractors and separate the whole space into different subspaces. Intersections of stable and unstable manifolds will lead to complexed dynamics, and homoclinic intersections are the source of chaos. A new algorithm for computing 2D stable and unstable manifolds of hyperbolic fixed points of maps is presented in this paper. A generalized Foliation Condition is used to guarantee that the 2D manifold is growing uniformly along the orbits of 1D sub-manifold in different directions. By foliation condition, the manifold has been better computed.

Keywords Dynamical system · Map · Stable manifold · Unstable manifold

85.1 Introduction

The computation of 2D manifold can be viewed as a collection of 1D manifold computation. The algorithm proposed for 1D manifold is the foundation of 2D manifold algorithm, and the only thing need to concern about is controlling the growth rate in different directions on the 2D manifold [1, 2].

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Foliation Condition is first presented in reference, the original description is: “In each leaf of the linear foliation there is a unique curve of intersections with the unstable manifold. In other words, the unstable manifold intersects each leaf transversally.”

The Foliation Condition is a priority definition of the mesh, and it is used to guarantee that the 2D manifold is growing uniformly in different directions. The linear foliation is defined as a hyper plane which is perpendicular to the last circle of computed manifold. The next mesh point is selected in the curve of intersections at a prescribed distance away from the last circle. 2D manifold is topological equivalent to a plane, so when the 2D manifold is “flattened”, it is clear that Foliation Condition is somewhat using the idea of drawing a round circle to control the growth of the manifold in different directions. The circle is centered at the hyperbolic fixed point with the radius growing stepwise.

85.2 The Procedure of 2D Manifold Computation

As mentioned above, 2D manifold is a collection of 1D sub-manifolds. So the first step is to compute enough 1D sub-manifolds to cover the 2D manifold. During the computation, the Foliation arc-length of mesh points on the 1D sub-manifold is labeled [3, 4].

Take a round circle centered at hyperbolic fixed point x_0 on the 2D local manifold, then select N mesh points on the circle uniformly. The Foliation arc-length of the 1D sub-manifold is ARC . Label the 1D sub-manifold as L_1 and take it as a reference line. Then compute another 1D sub-manifold L_2 through the next point on the circle up to Foliation arc-length ARC and check the distance between L_2 and the reference line. The distance is measured by the greatest distance between two mesh points of the same Foliation arc-length with one point taken from L_1 and the other taken from L_2 . If the distance is greater than $SIZE_{max}$ (the maximum size of the mesh), a new 1D sub-manifold need to be inserted between them. The new 1D sub-manifold is through the midpoint of the two mesh points corresponding to L_1 and L_2 on the circle. Then evaluate the distance between the new 1D sub-manifold and the reference line, if the distance is still greater than $SIZE_{Max}$, go on to insert new 1D sub-manifold with the method mentioned above. Otherwise, take the new 1D sub-manifold as the reference line and compute the next 1D sub-manifold through the next point on the circle.

After the forementioned process is completed, we need to check the distance between neighboring 1D sub-manifolds again to remove those who lie too close to each other. For three adjacent 1D sub-manifolds L_i , L_{i+1} and L_{i+2} , if the distance between L_i and L_{i+1} is smaller than $SIZE_{min}$ (the minimum size of the mesh) and the distance between L_i and L_{i+2} is less than $SIZE_{max}$, L_{i+1} is deleted.

In the next step, the result is visualized. For every 1D sub-manifold that has been computed, pick out the points whose Foliation arc-length is $k * step$ ($k = 1, 2, \dots$) to represent the original 1D sub-manifold. Mesh size is defined by the value of $step$.

Fig. 85.1 The triangulation between two neighboring circles

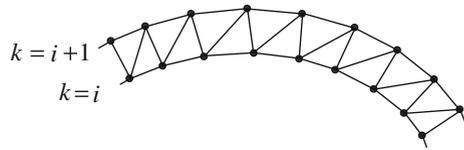
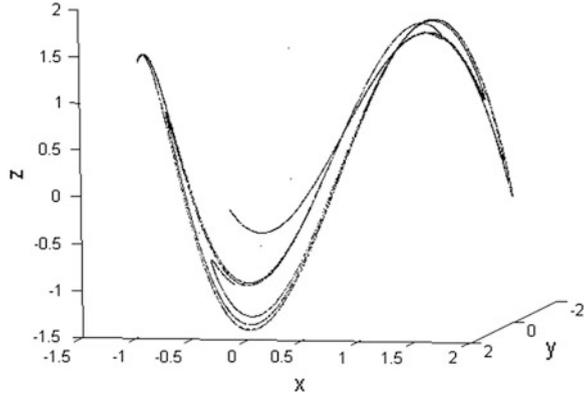


Fig. 85.2 Chaotic attractor of 3D Hénon map



Because the Foliation arc-length of mesh points of the original 1D sub-manifold is not exactly an integer multiple of *step*, linear interpolation is required to get the expected points. Connect the mesh points who have the same Foliation arc-length on all the reconstructed 1D sub-manifolds successively with line segments to visualize the 2D manifold as circles, that is to say, the foliation arc-length of the mesh points on the same circle is identical. We can also represent the 2D manifold as a surface by covering it with triangular grids. The triangulation between two neighboring circles is depicted in Fig. 85.1.

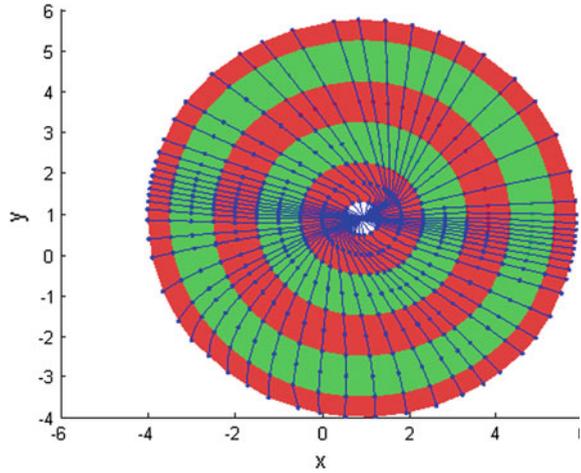
85.3 Numerical Examples

The 2D stable manifold of 3D Hénon map
 3D Hénon map [5] is defined by

$$F \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} y \\ z \\ M_1 - Bx + M_2y - z^2 \end{pmatrix} \tag{85.1}$$

When $M_1 = 1.4$, $M_2 = 0.2$ and $B = 0.1$, the map has a chaotic attractor (shown in Fig. 85.2), which is similar to that of the well known 2D Hénon map.

Fig. 85.3 Stable manifold of the 3D Hénon map, with $ARC = 5$



$x_0 = (x^*, y^*, z^*)$ is a fixed point of the map, where $x^* = y^* = z^* = 0.8839$. The Jacobian matrix of F^2 at x_0 is

$$A = \begin{bmatrix} 0 & 0 & 1 \\ 0.1 & 0.2 & -1.7678 \\ -0.1768 & -0.2536 & 3.3251 \end{bmatrix} \tag{85.2}$$

It has three real eigenvalues, $\lambda_1 = 3.4106$, $\lambda_2 = 0.0386$ and $\lambda_3 = 0.0759$, so x_0 is hyperbolic. Because two of the eigenvalues are less than 1, the map has 2D stable manifold.

The following parameters are used during the computation: $\delta = 0.1$, $\beta_{\max} = 0.15$, $\alpha_{\max} = 0.15$, $\alpha_{\min} = 0.05$, $\Delta_{\max} = 0.2m$, $\Delta_{\min} = 0.05$, $S = 1.4$, $SIZE_{\max} = 1$, $SIZE_{\min} = 0.5$ and $step = 0.5$.

In order to demonstrate that the generalized Foliation Condition can control the growth of the 2D manifold in different directions, only a small piece of 2D manifold is computed first, and the Foliation arc-length is 5. The result is plotted in Fig. 85.3. The distance between different bands of colors is 1. The solid lines in the figure is the 1D sub-manifolds, and the dots on them is the selected mesh point whose Foliation arc-length is an integer multiple of $step$. It is clear from the figure that the 2D manifold is growing uniformly in different directions.

In Fig. 85.4, a larger piece of 2D stable manifold is computed, with $ARC = 30$. The distance between different bands is 1. The shape of the 2D stable manifold is like a piece of paper that is folded twice. Obviously the 2D stable manifold grows uniformly when the Foliation arc-length of the manifold increases.

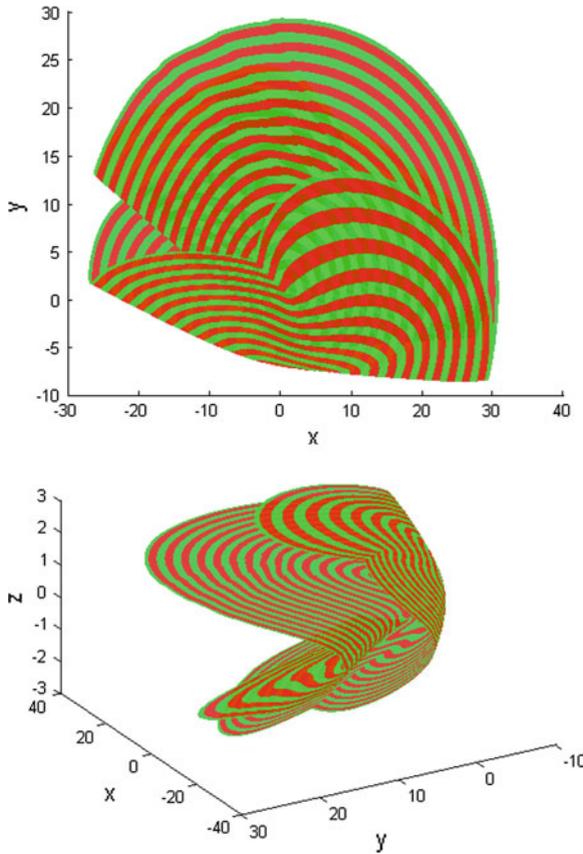


Fig. 85.4 Stable manifold of the 3D Hénon map, with $ARC = 30$

85.4 Conclusion

Compared to the algorithm in reference, it is clear that our algorithm does better in controlling the growth of the 2D manifold. What's more, the algorithm in reference only computes 2D unstable manifold of a map while our algorithm is capable of computing both 2D stable and unstable manifold [3].

The weak point of our algorithm is too much mesh points are generated at the inner part of the 2D manifold, and it is a promising key point where the algorithm can be revised in the future.

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References

1. Fundinger D (2008) Toward the calculation of higher-dimensional stable manifolds and stable sets for noninvertible and piecewise-smooth maps. *J Nonlinear Sci* 18(25):391–413
2. Krauskopf B, Osinga HM (1998) Globalizing two-dimensional unstable manifolds of maps. *Int J Bifur Chaos Appl Sci Eng* 8(3):483–503
3. Li QD, Zhou L, Zhou HW (2010) Computation for two-dimensional unstable manifold of map. *J Chongqing Univ Post Telecommun (Nat Sci Edition)* 22(3):339–344
4. Palis J, Melo WD (1982). *Geometric theory of dynamical systems*, vol 45(23). Springer, New York, pp 24–27
5. Gonchenko SV, Ovsyannikov II, Simo C, Turaev D (2005) Three-dimensional Hénon-like maps and wild Lorenz-like attractors. *Int J Bifur Chaos Appl Sci Eng* 15(11):3493–3500

Chapter 86

Compute 2D Stable and Unstable Manifolds of Nonlinear Maps

Zhong Wu, Meng Jia and QingHua Ji

Abstract By using the fact that Jacobian transports derivative along the orbit of the invariant manifold, a new algorithm for computing 1D manifold is proposed first. The new mesh point is located with a Prediction-Correction scheme which reduces the searching time and at the same time gives rise to a simplified accuracy condition. Two dimensional manifold is computed by covering it with orbits of 1D sub-manifold. A generalized Foliation Condition is used to guarantee that the 2D manifold is growing uniformly along the orbits of 1D sub-manifold in different directions. The performance of the algorithm is demonstrated with hyper chaotic 3D Hénon map and Lorenz system.

Keywords Derivative transportation · Lorenz system · Chaotic attractor

86.1 Introduction

The elementary method for computing 1D manifold of a map is iterating a fundamental domain, but the separation of mesh points under iteration will worsen the result. A dozen of algorithms are raised to cope with the problem, see Ref. [1].

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The algorithm in reference uses the idea of growing the manifold, one point is added at each step and the distances between consecutive points are adapted according to the local curvature. The preimage of the new point is located by searching along the manifold and it reduces the efficiency of the algorithm. The computation of 2D manifold of a map is much more difficult than that of continuous dynamical system. For the dependence of mesh points on the manifold of a map, when a new mesh point is interpolated, the mesh points before it on the same trajectory need to be interpolated too. And the preimage of the interpolated point is hard to locate because the searching space is a surface rather than a line when concerning 2D manifold. Only a few algorithms are proposed to compute 2D manifold of a map [2]. Dellnitz and Hobmann present a subdivision method which uses boxes to cover the whole space. A similar idea is used by Danny Fundinger in Refs. [3, 4]. The computation expense is very great when computing 2D manifold by using subdivision algorithm [5]. The algorithm in reference uses Foliation Condition to define the quality of the 2D manifold and it is actually the same algorithm with that of Ref. [6]. The potential risk is that the algorithm assumes that the preimage of the new mesh point lies on the boundary of the manifold, which is not true for all systems and the application range of the algorithm is restricted. In reference a new algorithm for computing 1D manifold is presented first, then 2D manifold is computed by covering it with the trajectories of 1D manifold [7, 8]. But the algorithm is not capable of controlling the growth rate along different directions of 2D manifold [9].

86.2 Computing 1D Manifold

We explain the algorithm for computing 1D unstable manifold of maps first.

86.2.1 Initialization

Take the first point x_1 at a distance of δ away from x_0 along E^u . The image of x_1 is $x_2 = F(x_1)$. The initial mesh point's sequence of the manifold is $M = \{x_0, x_1, x_2\}$.

86.2.2 Grow the Manifold

Suppose the mesh points sequence is $M = \{x_0, \dots, x_n\}$ and x'_n is the preimage of $x_n = F(x'_n)$. As shown in Fig. 86.1, a new point x_{n+1} is to be added to M at a distance of Δ_n away from x_n . The position of the new point is found in following two steps:

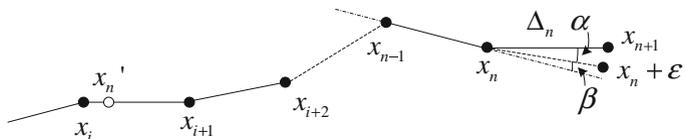


Fig. 86.1 Grow the manifold

- Step 1: Prediction: $\varepsilon = x_{i+1} - x'_n$ is taken as a prediction of preimage of the new point. The Jacobian matrix of the map F at point x'_n is A . Then $\varepsilon' = A\varepsilon$. Because the computed segment of the manifold is piece-wise linear and only first time differentiable, there is a minimum deflection angle β (see Fig. 86.1) between consecutive points. By keeping β small, sharp fold of the manifold can be pre-determined. If $\beta > \beta_{max}$, the step-size Δ_n is set to the minimum step-size Δ_{min} .
- Step 2: Correction: ε is adjusted by $\varepsilon = \varepsilon * \Delta_n / \Delta'_n$. The modulus of ε' is Δ_k after the adaptation. The new point is $x_{n+1} = F(x'_n + \varepsilon)$

The length of segment $x_n x_{n+1}$ is not exactly Δ_k , but the difference is negligible. Then we check if the angle α (see Fig. 86.1) satisfies the following condition

$$\alpha_{min} < \alpha < \alpha_{max} \tag{86.1}$$

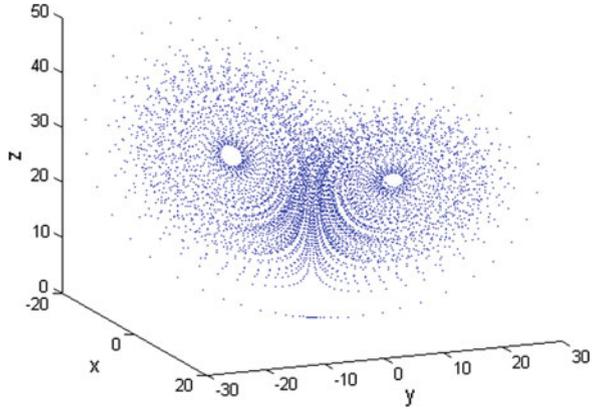
When α is small enough. If condition (86.1) is satisfied, Δ_n is acceptable and we will use. $\Delta_{n+1} = \Delta_n$. Δ_n is too small if $\alpha < \alpha_{min}$, but we accept x_{n+1} all the same and set $\Delta_{n+1} = S * \Delta_n$. If $\alpha > \alpha_{max}$, Δ_n is too big, we set $\Delta_n = \Delta_n / S$ and re-compute Δ_n . And S is the step-size increment factor. For the smooth change of density of the mesh, we suggest that *ratio* to be chosen within the range $1.2 < S < 1.6$, so that. At the same time, when $\Delta_n < \Delta_{min}$, we prevent Δ_n from getting too small and x_{n+1} will be accepted. On the other hand, when $\Delta_n > \Delta_{max}$, points will be inserted by linear interpolation to keep the quality of resolution. The algorithm stops when the arc-length of the manifold is computed up to *ARC*.

86.3 Stable Manifold of Discrete Lorenz System

Lorenz system is a model describing the dynamics of atmospheric convection, and it is well known for its butterfly shaped chaotic attractor. The model is written as

$$\begin{cases} \dot{x} = \sigma(y - x) \\ \dot{y} = \rho x - y - xz \\ \dot{z} = xy - \beta z \end{cases} \tag{86.2}$$

Fig. 86.2 Chaotic attractor of the continuous Lorenz system



When $\sigma = 10$, $\rho = 28$ and $\beta = 8/3$, the attractor is chaotic, as shown in Fig. 86.2. The model is continuous and in the form of an ordinary differential equation. By using difference, the system is discretized

$$\begin{cases} \frac{x_{n+1} - x_n}{T} = \sigma(y_n - x_n) \\ \frac{y_{n+1} - y_n}{T} = x_n(\rho - z_n) - y_n \\ \frac{z_{n+1} - z_n}{T} = x_n y_n - \beta z_n \end{cases} \quad (86.3)$$

The previous is simplified as

$$\begin{cases} x_{n+1} = T\sigma(y_n - x_n) + x_n \\ y_{n+1} = Tx_n(\rho - z_n) - Ty_n + y_n \\ z_{n+1} = T(x_n y_n - \beta z_n) + z_n \end{cases} \quad (86.4)$$

In order to maintain the property of the continuous Lorenz system, the value of T need to be appropriate. If T is too great, the approximation is to coarse and the discrete system is not chaotic anymore; on the other hand, if T is too small, the evolution speed of the system is too slow. We find that when $T = 0.01$, the discrete Lorenz system has a chaotic attractor (shown in Fig. 86.3) similar to that of the continuous Lorenz system, at the same time, the system evolves at a moderate speed.

The origin is a hyperbolic fixed point of the discrete Lorenz system, and the Jacobian matrix at it is

$$A = \begin{bmatrix} 0.9 & 0.1 & 0 \\ 0.28 & 0.99 & 0 \\ 0 & 0 & 0.9733 \end{bmatrix} \quad (86.5)$$

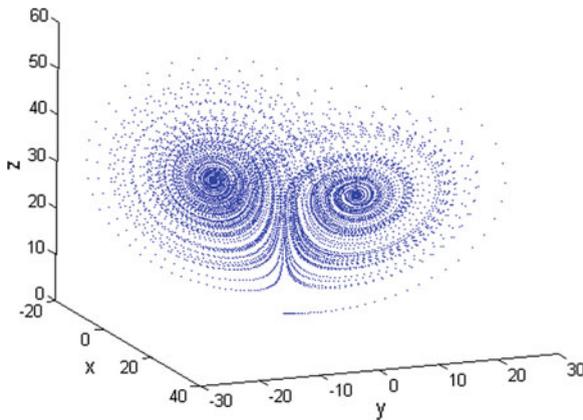


Fig. 86.3 Chaotic attractor of the discrete Lorenz system

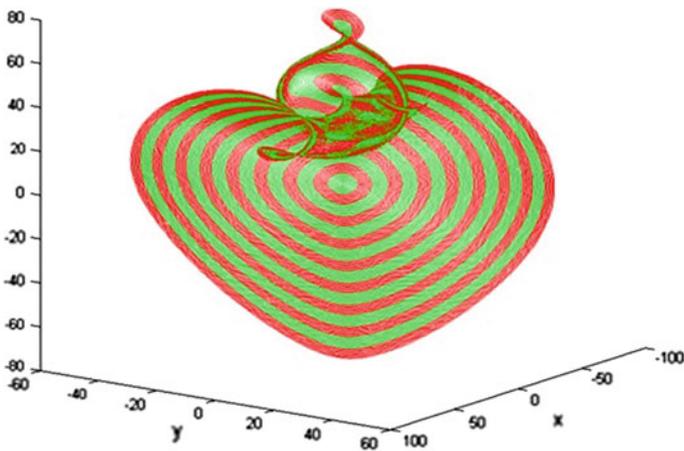


Fig. 86.4 The 2D stable manifold of discrete Lorenz system, covered by circles

Jacobian matrix A has three real eigenvalues: $\lambda_1 = 0.7717$, $\lambda_2 = 1.1183$ and $\lambda_3 = 0.9733$. It is interesting to notice that the discrete Lorenz has 2D stable manifold, which is also similar to that of the continuous Lorenz system.

The following parameters are used during the computation: $ARC = 80$, $\delta = 0.1$, $\beta_{\max} = 0.15$, $\alpha_{\max} = 0.1$, $\alpha_{\min} = 0.05$, $\Delta_{\max} = 0.1$, $\Delta_{\min} = 0.001$, $S = 1.4$, $SIZE_{\max} = 1$, $SIZE_{\min} = 0.5$ and $step = 0.8$ (Fig. 86.4).

86.4 Conclusion

This paper mainly studies the computation of 2D manifolds of maps. An algorithm for computing 1D manifold, which uses a prediction and correction scheme to add new mesh points, is proposed at first. The accuracy condition used in the algorithm is simpler than that of reference, and it resolves sharp folds of the manifold appropriately. What's more important is the algorithm is capable of computing both 1D stable and unstable manifold.

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References

1. Guckenheimer J, Vladimirsky A (2004) A fast method for approximating invariant manifolds. *SIAM J Appl Dyn Syst* 23(3):232–260
2. Krauskopf B, Osinga HM, Doedel EJ et al (2005) A survey of methods for computing (un)stable manifolds of vector fields. *Bifur Chaos Appl Sci Eng* 55(15):763–791
3. Li QD, Yang XS (2010) A new algorithm for computation of two-dimensional unstable manifolds and its applications. *Acta Phys Sin* 122(59):1416–1422
4. Li QD, Yang XS (2005) Computation of two dimensional unstable manifold. *Chin J Comput Phys* 26(22):549–554
5. You Z, Kostelich EJ, Yorke JA (1991) Calculating stable and unstable manifolds. *Int J Bifur Chaos Appl Sci Eng* 11(21):605–623
6. Parker TS, Chua LO (1989) *Practical numerical algorithms for chaotic systems*, vol 35 (34). Springer, Berlin, pp 35–38
7. Hobson D (1991) An efficient method for computing invariant manifolds. *J Comput Phys* 223(104):14–22
8. Krauskopf B, Osinga HM (1997). Growing unstable manifolds of planar maps. <http://www.ima.umn.edu/preprints/OCT97/1517.ps.gz>
9. England JP, Krauskopf B, Osinga HM (2004) Computing one-dimensional stable manifolds and stable sets of planar maps without the inverse. *SIAM J Appl Dyn Syst* 23(3):161–190

Chapter 87

New Lower Bounds of Solution of Generalized Lyapunov Equations

Chien-Hua Lee and Ping-Sung Liao

Abstract This paper discusses further results for the solution bounds of the algebraic generalized Lyapunov equations (the GLE). Some new lower matrix bounds for the solutions of the GLE are derived by making use of linear algebraic techniques. It is shown that, from the obtained results, new lower solution bounds of the continuous and discrete Lyapunov equations can also be obtained directly.

Keywords Generalized lyapunov equations · Matrix bound · Linear algebraic technique

87.1 Introduction

Among existing approaches that have been proposed to solve the stability analysis problem for linear system during the past several decades, the Lyapunov stability theory possibly is the most used one. Continuous and discrete Lyapunov type equations are used to deal with the mentioned problem. Furthermore, the bounds of the solutions for the Lyapunov equations can also be utilized to treat many system problems such as robust stability analysis; perturbation bound estimation, and so on. Therefore, a number of works have also been presented to estimate the solution bounds of the continuous and discrete Lyapunov equations [1, 2]. However, it is

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known that all the continuous and discrete Lyapunov equations are particular cases of the GLE [3, 4]. In literature, the GLE can be applied to solve the root clustering problem for linear system with/without parametric perturbations [5, 6]. However, it might be troublesome to solve the GLE. Recently, by making use of linear algebraic techniques, the estimation problem of the solution bounds of the GLE was first treated in [7]. Some matrix bounds and several eigenvalue bounds for the solutions of the GLE were developed. It is shown that the majority of existing solution bounds of the continuous and discrete Lyapunov equations are only the special cases of those of [8]. Furthermore, the tolerance perturbation bounds in terms of the mentioned solution bounds were estimated. It is also shown that the tighter those solution bounds are, the better the tolerance perturbation bounds are. Therefore, the research objective of the estimation problem for the solutions of the GLE is to obtain sharper solution bounds. This paper hence develops further results for the measurement of solution bounds of the GLE. Some new matrix bounds for the solutions of the GLE are derived. These new bounds can supplement those given in [9]. It is also shown that new lower solution bounds of the continuous and discrete Lyapunov equations can be obtained from proposed results of the GLE. At last, we also give a numerical example to show that the present results can be better for some case(s).

In this paper, A^T is the complex conjugate transpose of A and $A > (\geq) B$ means the matrix $A - B$ is a positive (semi) definite Hermitian matrix.

87.2 Main Results

Define regions Ω_1 and Ω_2 of the complex plane, respectively, as

$$\Omega_1 = \{(x, y) | \beta_0 + \beta_1x + \beta_2y < 0\} \tag{87.1}$$

$$\Omega_2 = \{(x, y) | \varphi_0 + \varphi_1y^2 + \varphi_2x + \varphi_3x^2 < 0\} \tag{87.2}$$

where $\beta_0, \beta_1, \beta_2, \varphi_0, \varphi_1, \varphi_2, \varphi_3 \in R, \beta_1^2 + \beta_2^2 \neq 0$ and $\varphi_1 \geq 0$.

For these regions, some root clustering results are presented as follows, respectively.

Theorem 1 [5] *If and only if for any given positive definite Hermitian matrix Q there exists a unique matrix $P > 0$ such that*

$$c_0P + c_1A^T P + c_2PA = -0.5Q \tag{87.3}$$

where $c_0 = \beta_0, c_1 = 0.5(\beta_1 + i\beta_2),$ and $c_2 = 0.5(\beta_1 - i\beta_2),$ then all eigenvalues of $A \in R^{n \times n}$ are located inside region $\Omega_1.$

Theorem 2 [5] *All eigenvalues of $A \in R^{n \times n}$ are located inside region Ω_2 if and only if for any given positive definite Hermitian matrix Q there exists a unique matrix $P > 0$ satisfies*

$$d_0P + d_1(A^T P + PA) + d_2A^T PA + d_3[(A^2)^T P + PA^2] = -Q \tag{87.4}$$

where $d_0 = \varphi_0, d_1 = 0.5\varphi_2, d_2 = 0.5(\varphi_1 + \varphi_3),$ and $d_3 = 0.25(\varphi_3 - \varphi_1).$

According to Theorems 1 and 2, some useful regions and the corresponding parameters c_i are summarized in [6, 7].

Without loss of generality, we assume $d_2 \geq 0$ in this paper. By setting $c_0 = 0$ and $c_1 = c_2 = 0.5$ in (87.3) or $d_0 = d_1 = 1, d_2 = d_3 = 0$ in (87.4), Eqs. (87.3) and (87.4) become the standard continuous Lyapunov equation

$$A^T P + PA = -Q \tag{87.5}$$

where A is now assumed to be a stable matrix.

Let $d_0 = d_2 = 1, d_1 = d_3 = 0$ in (87.4). Then (87.4) becomes the discrete Lyapunov equation

$$P + A^T PA = -Q \tag{87.6}$$

Here all eigenvalues of A are located inside the unit circle centered at the original point.

Equations (87.3) and (87.4) are the so-called “generalized Lyapunov equations”.

Besides the GLE, some previous results are given below.

Theorem 3 [9] Define a matrix U as

$$U \equiv 2c_2A + c_0I. \tag{87.7}$$

Then the solution P of the GLE (87.3) can be measured as

$$P \geq P_1 \equiv \alpha[Q - \alpha^2 U^T U]^{1/2} \tag{87.8}$$

where the positive constant α is chosen such that

$$Q > \alpha^2 U^T U. \tag{87.9}$$

Theorem 4 [9] If a positive constant α is selected so that

$$Q > \alpha^2 I, \tag{87.10}$$

Then the GLE (87.3) satisfies

$$P \geq P_2 \equiv \frac{\alpha}{\sigma_1(U)} (Q - \alpha^2 I)^{1/2}. \tag{87.11}$$

Define a matrix V as

$$V \equiv d_3A^2 + d_1A + 0.5d_0I. \tag{87.12}$$

Two lower solution bounds of the GLE (87.4) were also given in [10].

Theorem 5 [9] *If a positive constant α is selected such that*

$$Q > \alpha^2 V^T V, \tag{87.13}$$

Then the GLE (87.4) has the lower bounds

$$P \geq P_3 \equiv \alpha \{ Q + \alpha d_2 A^T [Q - \alpha^2 V^T V]^{1/2} A - \alpha^2 V^T V \}^{1/2}. \tag{87.14}$$

$$P \geq P_4 \equiv \frac{\alpha}{\sigma_1(V)} \left[Q + \frac{\alpha}{\sigma_1(V)} d_2 A^T (Q - \alpha^2 I)^{1/2} A - \alpha^2 I \right]^{1/2} \tag{87.15}$$

We derive a new lower solution bound of the GLE (87.2) as follows.

Theorem 6 *Define*

$$D \equiv (UQU^T)^{1/2}. \tag{87.16}$$

Then the solution P of the GLE (87.3) has the lower bound

$$P \geq P_5 \equiv \frac{1}{\alpha} D^{-1} [D(\alpha Q - Q^{-1}) D]^{1/2} D^{-1} \tag{87.17}$$

where $\alpha > 0$ is determined by

$$\alpha Q^2 > I. \tag{87.18}$$

Proof In light of the definition of U , the GLE (87.3) can be rewritten as

$$(c_0 P + c_1 A^T P + c_2 P A) = P U + U^T P = -Q \tag{87.19}$$

This means that all eigenvalues of the matrix U lie in the left side of the complex plane and hence the inverse of U exists. Therefore, one can conclude

$$\begin{aligned} & (UQU^T)^{1/2} (\alpha P + Q^{-1} U^{-1}) UQU^T (\alpha P + U^{-T} Q^{-1}) (UQU^T)^{1/2} \\ &= D(\alpha^2 P D^2 P + \alpha P U Q U^T U^{-T} Q^{-1} + \alpha Q^{-1} U^{-1} U Q U^T P \\ &+ Q^{-1} U^{-1} U Q U^T U^{-T} Q^{-1}) D \\ &= D[\alpha^2 P D^2 P + \alpha(P U + U^T P) + Q^{-1}] D \\ &= \alpha^2 D P D^2 P D - D(\alpha Q - Q^{-1}) D \geq 0 \end{aligned} \tag{87.20}$$

where the definition (87.19) is used Eq. (87.20) implies

$$(D P D)^2 \geq \frac{1}{\alpha^2} D(\alpha Q - Q^{-1}) D. \tag{87.21}$$

Selecting $\alpha > 0$ such that condition (87.18) holds, then Eq. (87.21) leads to the bound (87.17).

Theorem 7 Define

$$E \equiv (VQV^T)^{1/2}. \tag{87.22}$$

Then the solution P of the GLE (87.4) has the lower bound

$$P \geq P_6 \equiv \frac{1}{\alpha} E^{-1} [E[\alpha(Q + d_2A^T P_0A) - Q^{-1}]E]^{1/2} E^{-1} \tag{87.23}$$

where $\alpha > 0$ is determined by (87.18) and P_0 is defined by

$$P_0 \equiv \frac{1}{\alpha} E^{-1} [E(\alpha Q - Q^{-1})E]^{1/2} E^{-1}. \tag{87.24}$$

Proof By the definition of (87.14), the GLE (87.4) can be rewritten as

$$PV + V^T P = -Q - d_2A^T PA \tag{87.25}$$

Then proceeding the similar ways proposed in Theorem 6, we have

$$\begin{aligned} & (VQV^T)^{1/2} (\alpha P + Q^{-1}V^{-1}) VQV^T (\alpha P + V^{-T}Q^{-1}) (VQV^T)^{1/2} \\ &= E(\alpha^2 PE^2 P + \alpha PVQV^T V^{-T}Q^{-1} + \alpha Q^{-1}V^{-1}VQV^T P \\ &+ Q^{-1}V^{-1}VQV^T V^{-T}Q^{-1})E \\ &= E[\alpha^2 PE^2 P + \alpha(PV + V^T P) + Q^{-1}]E \\ &\alpha^2 EPE^2 PE - E[\alpha(Q + d_2A^T PA) - Q^{-1}]E \geq 0 \end{aligned} \tag{87.26}$$

where the relation (87.19) is used Eq. (87.26) implies

$$(\alpha EPE)^2 \geq E[\alpha(Q + d_2A^T PA) - Q^{-1}]E \tag{87.27}$$

$$\geq E(\alpha Q - Q^{-1})E. \tag{87.28}$$

Selecting $\alpha > 0$ such that condition (87.18) holds, Eq. (87.28) leads to bound (87.24) by solving this inequality. Then, substituting (87.24) into the right hand side of (87.27) results in bound (87.23).

Remark Remark 1 as mentioned in [10], it is hard or even impossible to compare the tightness between parallel bounds. We also found that the sharpness of obtained results (87.17) and (87.23) cannot be compared to those proposed in Theorems 3–5 by mathematical methods. However, they may give a supplement to each other.

Remark Remark 2 Setting $c_0 = 0$ and $c_1 = c_2 = 0.5$ in (87.3) and $d_0 = d_1 = 1, d_2 = d_3 = 0$ in (87.4), then bounds (87.17) and (87.23) become the following solution bound for the continuous Lyapunov equation (87.5)

$$P \geq \frac{1}{\alpha} (AQA^T)^{-1/2} \left[(AQA^T)^{1/2} (\alpha Q - Q^{-1}) (AQA^T)^{1/2} \right]^{1/2} (AQA^T)^{-1/2} \equiv P_{c3}. \tag{87.29}$$

Let $d_0 = d_2 = 1, d_1 = d_3 = 0$ in (87.4). Bound (87.23) becomes

$$P \geq \frac{2}{\alpha} Q^{-1/2} \left[Q^{1/2} [\alpha(Q + A^T P_{d0} A) - Q^{-1}] Q^{1/2} \right]^{1/2} Q^{-1/2} \equiv P_{d2} \tag{87.30}$$

where P_{d0} is defined as

$$P_{d0} \equiv \frac{2}{\alpha} Q^{-1/2} \left[Q^{1/2} (\alpha Q - Q^{-1}) Q^{1/2} \right]^{1/2} Q^{-1/2} \tag{87.31}$$

Note that (87.30) is a lower solution bound for the discrete Lyapunov equation (87.6).

87.3 A Numerical Example

Consider the matrix

$$A = \begin{bmatrix} -2 & -0.6 & 0 \\ 0.5 & -2.4 & 0 \\ 0 & 0 & -3.5 \end{bmatrix}.$$

It is seen that all eigenvalues of A are located within the region

$$\Omega_2 \{ (x, y) | 8 + y^2 + 6x + x^2 < 0 \} \quad (\text{Sector})$$

$$\Omega_2 \{ (x, y) | 8 + y^2 + 6x + x^2 < 0 \} \quad (\text{Circle})$$

In light of Theorems 1 and 2, the corresponding GLE, respectively, are

$$0.5P + (0.4 - i)A^T P + (0.4 + i)PA = -Q \text{ for } \Omega_1 \tag{87.32}$$

$$8P + 3(A^T P + PA) + A^T P A = -Q \text{ for } \Omega_2 \tag{87.33}$$

Select $Q = \begin{bmatrix} 4 & 0 & 0 \\ 0 & 4 & 1 \\ 0 & 1 & 3 \end{bmatrix}$ for the above Lyapunov equations. Then, from

Theorems 3–7, one can obtain the following bounds of P for the Lyapunov equations (87.32) and (87.33).

For Lyapunov equation (87.32):

$$P_1 = \begin{bmatrix} 0.1961 & -0.0019 - 0.0004j & 0.002 \\ -0.0019 - 0.0004j & 0.1911 & 0.029 \\ 0.002 & 0.029 & 0.1541 \end{bmatrix} \text{ for } \alpha = 0.1,$$

$$P_2 = \begin{bmatrix} 0.2351 & 0 & 0 \\ 0 & 0.2309 & 0.0441 \\ 0 & 0.0441 & 0.1868 \end{bmatrix} \text{ for } \alpha = 1,$$

$$P_5 = \begin{bmatrix} 0.4389 & -0.0658 - 0.0138j & -0.0189 - 0.0009j \\ -0.0658 - 0.0138j & 0.3105 & 0.0416 - 0.0003j \\ -0.0189 - 0.0009j & 0.0416 - 0.0003j & 0.1813 \end{bmatrix} \text{ for } \alpha = 0.3.$$

For Lyapunov equation (87.33)

$$P_3 = \begin{bmatrix} 0.2128 & 0.0027 & 0.0014 \\ 0.0027 & 0.2245 & 0.0285 \\ 0.0014 & 0.0285 & 0.2105 \end{bmatrix} \text{ for } \alpha = 0.1,$$

$$P_4 = \begin{bmatrix} 0.0311 & 0.0001 & 0 \\ 0.0001 & 0.0312 & 0.0042 \\ 0 & 0.0042 & 0.0277 \end{bmatrix} \text{ for } \alpha = 0.1,$$

$$P_6 = \begin{bmatrix} 1.2228 & -0.4998 & -0.1380 \\ -0.4998 & 0.9336 & 0.1339 \\ -0.1380 & 0.1339 & 0.3693 \end{bmatrix} \text{ for } \alpha = 0.2.$$

For this case, it is seen that $P_5 \geq P_1$, $\lambda_i(P_5) > \lambda_i(P_2)$ for all i , and $P_6 > P_3 > P_4$. This shows that all proposed bounds are the best for this case.

87.4 Conclusions

The estimation problem of the solutions of the GLE has been studied. Several lower matrix bounds of the solutions for the GLE are presented. It is seen that all results are new. Furthermore, according to these obtained results, new lower solution bounds for the continuous and discrete Lyapunov equations are also derived. From the given numerical example, it is also shown that these obtained bounds are better than existing ones for some case(s).

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References

1. Choi HH, Kuc TY (2002) Lower matrix bounds for the continuous algebraic Riccati and Lyapunov matrix equations. *Automatica* 38:1147–1152
2. Komaroff N (1988) Simultaneous eigenvalue lower bounds for the Lyapunov matrix equation. *IEEE Trans Automat* 33:126–132
3. Lee CH (1997) New results for the bounds of the solution for the continuous Riccati and Lyapunov equations. *IEEE Trans Automat* 42:118–123
4. Lee CH (1996) Upper and lower matrix bounds of the solution for the discrete Lyapunov equation. *IEEE Trans Automat* 41:1338–1344
5. Gutman S, Jury EI (1981) A general theory for matrix root-clustering in subregions of the complex plane. *IEEE Trans Automat* 26:853–858
6. Abdul-Wahab A-A (1990) Lyapunov-type equations for matrix root-clustering in subregions of the complex plane. *Int J Syst Sci* 21:1819–1825
7. Horng HY, Chou JH, Horng IR (1993) Robustness of eigenvalue clustering in various regions of the complex plane for perturbed systems. *Int J Control* 57:1469–1476
8. Yadavalli RK (1993) Robust root clustering for linear uncertain systems using generalized Lyapunov theory. *Automatica* 29:237–243
9. Lee CH, Lee ST (2001) On the estimation of solution bounds of the generalized Lyapunov equations and the robust root clustering for the linear perturbed systems. *Int J Control* 74:996–1003
10. Mori T, Derese IA (1984) A brief summary of the bounds on the solution of the algebraic matrix equation in control theory. *Int J Control* 39:247–253

Chapter 88

Existence of Solution for Singular Elliptic Systems Involving Critical Sobolev-Hardy Exponents

Xiaoli Pan

Abstract The aim of the contemporary variational theory is to transform the problem of searching the solution of equation or equation system into the problem of investigating the critical point of the corresponding energy function in a suitable space. This paper concerns the existence of solution for a singular quasilinear elliptic system involving two critical Sobolev Hardy exponents. Using Sobolev Hardy inequality, Ekeland's variation principle and the critical point theorem, the existence of solution was proved under the certain conditions that the coefficients and nonlinear term of the equations meet.

Keywords Nonlinear term • Critical Sobolev-Hardy exponent • Elliptic equation systems • Ekeland's variational principle

88.1 Introduction

In this paper, we consider the following quasilinear elliptic equation systems with the nonlinear terms.

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$$\begin{cases} -\Delta_p u = \frac{\mu_1 |u|^{p-2} u}{|x|^p} + \frac{|u|^{p^*(s)-2} u}{|x|^s} + \eta(\alpha + 1) |u|^{\alpha-1} |v|^{\beta+1} u + \lambda F_u(x, u, v) & x \in \Omega \\ -\Delta_q v = \frac{\mu_2 |v|^{q-2} v}{|x|^q} + \frac{|v|^{q^*(s)-2} v}{|x|^s} + \eta(\beta + 1) |u|^{\alpha+1} |v|^{\beta-1} v + \lambda F_v(x, u, v) & x \in \Omega \\ u = v = 0 & x \in \partial\Omega \end{cases} \tag{88.1}$$

where $\Delta_p u = \operatorname{div}(|\nabla u|^{p-2} \nabla u)$ is the p -Laplacian operator, $\lambda \geq 0$ is a real parameter, $0 \leq \mu_1 < \bar{\mu}_p = \left(\frac{N-p}{p}\right)^p$, $0 \leq \mu_2 < \bar{\mu}_q = \left(\frac{N-q}{q}\right)^q$, $0 \leq s \leq \min(p, q)$, $p^*(s) = \frac{p(N-s)}{N-p}$ and $q^*(s) = \frac{q(N-s)}{N-q}$ are the Sobolev- Hardy critical exponents, $F_u(x, u, v)$ and $F_v(x, u, v)$ are the partial derivatives of $F(x, u, v)$, Ω is an open bounded domain in R^N ($N \geq 3$) with Origin [1, 2].

In recent years, people have paid much attention to the existence of solutions for singular problems, in the present paper, we obtain the existence of solution by using Ekeland’s variational principle and the critical point theorem [3].

Assume α, β with

$$\frac{\alpha+1}{p^*(s)} + \frac{\beta+1}{q^*(s)} = 1$$

Use the Sobolev-Hardy inequality with $0 \leq \mu_1 < \bar{\mu}_p$, define the equivalent norm in $W_0^{1,p(x)}(\Omega)$:

$$\|u\|_{1,p} = \left(\int_{\Omega} \left(|\nabla u|^p - \frac{\mu_1 u^p}{|x|^p} \right) dx \right)^{1/p}$$

And the best Sobolev constant

$$A_{s, \mu_1} = \inf_{u \in W_0^{1,p}(\Omega) \setminus \{0\}} \frac{\int_{\Omega} \left(|\nabla u|^p - \frac{\mu_1 u^p}{|x|^p} \right) dx}{\left(\int_{\Omega} \frac{|u|^{p^*(s)}}{|x|^s} dx \right)^{p/p^*(s)}}$$

the similar definition of $\|u\|_{1,p}$ and A_{s, μ_1} .

Assume $X = W_0^{1,p(x)}(\Omega) \times W_0^{1,q(x)}(\Omega)$ and $\|(u, v)\|_X = \max\{\|u\|_{1,p}, \|v\|_{1,q}\}$ we define the energy functional corresponding to problem (88.1)

$$\begin{aligned}
 I(u, v) = & \frac{1}{p} \int_{\Omega} |\nabla u|^p dx + \frac{1}{q} \int_{\Omega} |\nabla v|^q dx - \frac{\mu_1}{p} \int_{\Omega} \frac{|u|^p}{|x|^p} dx - \frac{\mu_2}{q} \int_{\Omega} \frac{|v|^q}{|x|^q} dx \\
 & - \frac{1}{p^*(s)} \int_{\Omega} \frac{|u|^{p^*(s)}}{|x|^s} dx - \frac{1}{q^*(s)} \int_{\Omega} \frac{|v|^{q^*(s)}}{|x|^s} dx - \eta \int_{\Omega} |u|^{\alpha+1} |v|^{\beta+1} dx \quad (88.2) \\
 & - \lambda \int_{\Omega} F(x, u, v) dx
 \end{aligned}$$

and $I \in C^1(X, R)$, by the Hardy inequality, We say that the critical point of $I(u, v)$ is a weak solution of (88.1), if for any $(\varphi, \xi) \in X$, there holds $\langle I'(u, v), (\varphi, \xi) \rangle$

$$\begin{aligned}
 = & \int_{\Omega} |\nabla u|^{p-2} \nabla u \nabla \varphi dx + \int_{\Omega} |\nabla v|^{q-2} \nabla v \nabla \xi dx - \int_{\Omega} \frac{\mu_1 |u|^{p-2} u \varphi}{|x|^p} dx - \int_{\Omega} \frac{\mu_2 |v|^{q-2} v \xi}{|x|^q} dx \\
 & - \int_{\Omega} \frac{|u|^{p^*(s)-2} u \varphi}{|x|^s} dx - \int_{\Omega} \frac{|v|^{q^*(s)-2} v \xi}{|x|^s} dx - \eta \int_{\Omega} (\alpha + 1) |u|^{\alpha-1} |v|^{\beta+1} u \varphi dx \\
 & - \eta \int_{\Omega} (\beta + 1) |u|^{\alpha+1} |v|^{\beta-1} v \xi dx - \lambda \int_{\Omega} F_u \varphi + F_v \xi dx = 0
 \end{aligned}$$

In the paper, assume $F(x, u, v)$ satisfies:

(f₁) $F \in C^1(R^n \times R^n \times R, R)$, and $F(x, 0, 0) = 0$.

(f₂) $\lim_{|t_1| \rightarrow \infty} \frac{f(x, t_1, t_2)}{|t_1|^{p^*-2} t_1} = 0$ uniformly for t_2 and $x \in \Omega$;

$\lim_{|t_2| \rightarrow \infty} \frac{f(x, t_1, t_2)}{|t_2|^{q^*-2} t_2} = 0$ Uniformly for t_1 and $x \in \Omega$.

(f₃) There exists constants a, b, c such that

$F_u(x, U) \leq a \|U\|^p, F_v(x, U) \leq a \|U\|^q, F(x, u_n, v_n) \leq c \left(\|u\|_{1,p}^p + \|v\|_{1,q}^q \right)$ for any $U = (u, v)$.

Theorem 1 Suppose that $0 \leq \mu_1 < \bar{\mu}_p, 0 \leq \mu_2 < \bar{\mu}_q$, and $F(x, u, v)$ satisfies (f₁) – (f₃). Then there exists $\lambda^* > 0$ such that problem (88.1) possesses at least one solution for every $\lambda \in (0, \lambda^*)$.

Lemma 1 (Sobolev-Hardy inequality)

Assume $1 < p < N, p \leq r < p^*(s) = \frac{p(N-s)}{N-p}, 0 \leq s \leq p$, then

(1) For any $u \in W_0^{1,p(x)}(\Omega)$, there exists constant $C > 0$ such that

$$C \left(\int_{\Omega} \frac{|u|^r}{|x|^s} dx \right)^{p/r} \leq \int_{\Omega} |\nabla u|^p dx$$

(2) Mapping $u \rightarrow \frac{u}{x^{s/r}}$ is tight from $W_0^{1,p(x)}(\Omega)$ to $L^r(\Omega)$ when $r < p^*(s)$.

Lemma 2 Suppose $F(x, u, v)$ satisfies $(f_1) - (f_2)$, then there exist constants $\rho, \alpha, \lambda_1^*$ such that $I(u, v)|_{\|(u,v)=\rho\|} \geq \alpha > 0$ when $\lambda \in (0, \lambda_1^*)$, and exists $e_0 \in X$ satisfies $\|e_0\| > \rho, I(e_0) < 0$.

Proof According to the Young inequality, we get that

$$\int_{\Omega} |u|^{\alpha+1} |v|^{\beta+1} dx \leq \int_{\Omega} \frac{\alpha+1}{p^*(s)} |u|^{p^*(s)} dx + \int_{\Omega} \frac{\beta+1}{q^*(s)} |v|^{q^*(s)} dx$$

By Sobolev-Hardy inequality, we obtain

$$\int_{\Omega} |u|^{p^*(s)} dx \leq C_1 A_{s, \mu_1}^{-p^*(s)/p} \|u\|^{p^*(s)}; \int_{\Omega} |v|^{q^*(s)} dx \leq C_2 A_{s, \mu_2}^{-q^*(s)/q} \|v\|^{q^*(s)}$$

where $C_1, C_2 > 0$, when $\lambda \in (0, \frac{C_3}{2})$, we get

$$\begin{aligned} I(u, v) &\geq \frac{1}{p} \int_{\Omega} |\nabla u|^p - \frac{\mu_1 |u|^p}{|x|^p} dx + \frac{1}{q} \int_{\Omega} |\nabla v|^q - \frac{\mu_2 |v|^q}{|x|^q} dx \\ &\quad - \left(\frac{1}{p^*(s)} + \frac{\lambda C_3}{2}\right) \int_{\Omega} \frac{|u|^{p^*(s)}}{|x|^p} dx - \left(\frac{1}{q^*(s)} + \frac{\lambda C_3}{2}\right) \int_{\Omega} \frac{|v|^{q^*(s)}}{|x|^q} dx \\ &\quad - \eta \int_{\Omega} |u|^{\alpha+1} |v|^{\beta+1} dx - \lambda C_4 \geq \frac{1}{p} \int_{\Omega} |\nabla u|^p - \frac{\mu_1 |u|^p}{|x|^p} dx + \frac{1}{q} \int_{\Omega} |\nabla v|^q - \frac{\mu_2 |v|^q}{|x|^q} dx \\ &\quad - \frac{1+p^*(s)}{p^*(s)A_{s, \mu_1}^{-p^*(s)/p}} \left(\int_{\Omega} |\nabla u|^p - \frac{\mu_1 |u|^p}{|x|^p} dx\right)^{p^*/p} - \frac{1+q^*(s)}{q^*(s)A_{s, \mu_2}^{-q^*(s)/q}} \left(\int_{\Omega} |\nabla v|^q - \frac{\mu_2 |v|^q}{|x|^q} dx\right)^{q^*/q} \\ &\quad - C_1 A_{s, \mu_1}^{-p^*(s)/p} \frac{\alpha+1}{p^*} \|u\|^{p^*(s)} - C_2 A_{s, \mu_2}^{-q^*(s)/q} \frac{\beta+1}{q^*} \|v\|^{q^*(s)} - \lambda C_4 \\ &= A_1 \|u\|^p + A_2 \|v\|^q - [B_1 \|u\|^{p^*(s)} + B_2 \|v\|^{q^*(s)}] - \lambda C \end{aligned}$$

where positive constant $C = C_4$ do not depend on λ and $A_1 = \frac{1}{p}, A_2 = \frac{1}{q}, B_1 = \frac{1+p^*(s)}{p^*(s)A_{s, \mu_1}^{-p^*(s)/p}} + C_1 A_{s, \mu_1}^{-p^*(s)/p} \frac{\alpha+1}{p^*}, B_2 = \frac{1+q^*(s)}{q^*(s)A_{s, \mu_2}^{-q^*(s)/q}} + C_2 A_{s, \mu_2}^{-q^*(s)/q} \frac{\beta+1}{q^*}$

Let $f(t_1) = A_1 t_1^p - B_1 t_1^{p^*(s)} - \frac{\lambda C}{2}, g(t_2) = A_2 t_2^q - B_2 t_2^{q^*(s)} - \frac{\lambda C}{2}$, then $I(u, v) \geq f(\|u\|) + g(\|v\|)$, there exists constant $\lambda_1^* > 0$ when $0 < \lambda < \lambda_1^*$, there exist constant $\rho_1 = \left(\frac{A_{s, \mu_1}^{p^*(s)/p}}{1+p^*(s)}\right)^{1/(p^*(s)-p)} > 0$ satisfies $f(\rho_1) = \sup_{t_1 \geq 0} f(t_1) > 0$, Similarly,

there exist constant $\exists \rho_2 = \left(\frac{A_{s, \mu_2}^{q^*(s)/q}}{1+q^*(s)}\right)^{1/(q^*(s)-q)} > 0$ satisfies $g(\rho_2) = \sup_{t_2 \geq 0} g(t_2) > 0$.

Therefore, there exist constants $\rho = \min\{\rho_1, \rho_2\}$ and $\alpha > 0$ such that $I(u, v)|_{\|(u,v)=\rho\|} \geq \alpha > 0$, fixed $(u_0, v_0) \in X$ with u_0 and v_0 are not zero in the same

time, by $(f_1) - (f_2)$, we obtain $I(tu_0, tv_0) \rightarrow -\infty$ when $t \rightarrow +\infty$, let $e_0 = (t_0u_0, t_0v_0)$ with t_0 sufficiently large, then we get $I(e_0) < 0$ [4, 5].

Lemma 3 Suppose $F(x, u, v)$ satisfies $(f_2) - (f_3)$, then there exists constant $\lambda_2^* > 0$, $I(u, v)$ satisfies $(PS)_c$ condition when $\lambda \in (0, \lambda_2^*)$. That is, $\{(u_n, v_n)\} \subset X$ has a convergent subsequence satisfies $I(u_n, v_n) \rightarrow c$ and $I'(u_n, v_n) \rightarrow 0$ for any (u_n, v_n) , where $c = \inf_{\gamma \in \Gamma} \max_{0 \leq t \leq 1} I(\gamma(t); c \geq \alpha > 0)$, $\Gamma = \{\gamma \in (C^1[0, 1], X) : \gamma(0) = 0, \gamma(1) = e\}$

Proof By $I'(u_n, v_n) \rightarrow 0$, we get

$$\begin{aligned} \int_{\Omega} |\nabla u_n|^p dx - \int_{\Omega} \frac{\mu_1 |u_n|^p}{|x|^p} dx - \int_{\Omega} \frac{|u_n|^{p^*(s)}}{|x|^s} dx \\ - \eta \int_{\Omega} (\alpha + 1) |u_n|^{\alpha+1} |v_n|^{\beta+1} dx - \lambda \int_{\Omega} F_u u_n dx = o(1) \|u_n\|_{1,p} \end{aligned} \tag{88.3}$$

$$\begin{aligned} \int_{\Omega} |\nabla v_n|^q dx - \int_{\Omega} \frac{\mu_2 |v_n|^q}{|x|^q} dx - \int_{\Omega} \frac{|v_n|^{q^*(s)}}{|x|^s} dx - \eta \int_{\Omega} (\beta + 1) |u_n|^{\alpha+1} |v_n|^{\beta+1} dx \\ - \lambda \int_{\Omega} F_v v_n dx = o(1) \|v_n\|_{1,q} \end{aligned} \tag{88.4}$$

By $I(u_n, v_n) \rightarrow c$, we obtain

$$\begin{aligned} I(u_n, v_n) &= \frac{1}{p} \int_{\Omega} |\nabla u_n|^p dx - \frac{\mu_1}{p} \int_{\Omega} \frac{|u_n|^p}{|x|^p} dx - \frac{1}{p^*(s)} \int_{\Omega} \frac{|u_n|^{p^*(s)}}{|x|^s} dx \\ &+ \frac{1}{q} \int_{\Omega} |\nabla v_n|^q dx - \frac{\mu_2}{q} \int_{\Omega} \frac{|v_n|^q}{|x|^q} dx - \frac{1}{q^*(s)} \int_{\Omega} \frac{|v_n|^{q^*(s)}}{|x|^s} dx \\ &- \eta \int_{\Omega} |u_n|^{\alpha+1} |v_n|^{\beta+1} dx \\ &- \lambda \int_{\Omega} F(x, u_n, v_n) dx = c + o(1) \end{aligned} \tag{88.5}$$

Let $(5) - (3) \times \frac{1}{p^*(s)} - (4) \times \frac{1}{q^*(s)}$, we get

$$\begin{aligned}
 c + o(1) &\geq \left(\frac{1}{p} - \frac{1}{p^*(s)}\right) \int_{\Omega} \left(|\nabla u_n|^p - \mu_1 \int_{\Omega} \frac{|u_n|^p}{|x|^p} \right) dx \\
 &+ \left(\frac{1}{q} - \frac{1}{q^*(s)}\right) \int_{\Omega} \left(|\nabla v_n|^q - \mu_2 \int_{\Omega} \frac{|v_n|^q}{|x|^q} \right) \\
 &- \eta \left(1 - \frac{1}{p^*(s)} - \frac{1}{q^*(s)}\right) \int_{\Omega} |u_n|^{\alpha+1} |v_n|^{\beta+1} dx \\
 &- \lambda \left(\int_{\Omega} F(x, u_n, v_n) dx - \frac{1}{p^*(s)} \int_{\Omega} F_u u_n dx - \frac{1}{q^*(s)} \int_{\Omega} F_v v_n dx \right) \\
 &\geq \frac{p-s}{p(N-s)} \|u_n\|_{1,p}^p + \frac{q-s}{q(N-s)} \|v_n\|_{1,q}^q \\
 &- \eta \left(\frac{p^*(s)q^*(s) - p^*(s) - q^*(s)}{p^*(s)q^*(s)} \right) \\
 &\left[\frac{\alpha+1}{p^*(s)} C_1 A_{s,\mu_1}^{-p^*(s)/p} \|u_n\|_{1,p}^{p^*(s)} + \frac{\beta+1}{q^*(s)} C_2 A_{s,\mu_2}^{-q^*(s)/q} \|v_n\|_{1,q}^{q^*(s)} \right] \\
 &- \lambda \left(\int_{\Omega} F(x, u_n, v_n) dx - \frac{1}{p^*(s)} \int_{\Omega} F_u u_n dx - \frac{1}{q^*(s)} \int_{\Omega} F_v v_n dx \right)
 \end{aligned}$$

by (f_3) , $\{(u_n, v_n)\}$ is an bounded $(PS)_c$ sequence in X , Together with Lemma 1, we can choose a subsequence of $\{(u_n, v_n)\}$ (still denoted by $\{(u_n, v_n)\}$), and there exists $(u, v) \in X$ such that $\{(u_n, v_n)\}$ weakly converges to (u, v) in X [6, 7].

Lemma 4 (Elkland’s variation principle) *Set M is a complete metric space with distance d , $I(u) : M \rightarrow \mathbb{R}, I(u) \neq +\infty$ is a proper lower semi-continuous function on M which is bounded blow. Suppose that $\varepsilon > 0$ and $u_0 \in M$, then for any $\omega \in M$ there exists $u \in M$ such that*

$$I(\omega) - I(v) + \varepsilon d(\omega, v) \geq 0; I(v) \leq I(u_0) - \varepsilon d(u_0, v).$$

Proof of Theorem 1 By (f_2) , we get $I(su_1, sv_1) < 0$ when u_1 and v_1 are not zero in the same time and $s \rightarrow 0$. By the conclusion of Lemma 2, there exists constant $\rho_1 > \rho$ such that $\inf_{\|(u,v)\| \leq \rho} I(u, v) < 0$.

Let $\{(u_n, v_n)\} \subset X$ is a minimizing sequence of $\inf_{\|(u,v)\| \leq \rho} I(u, v) < 0$ suppose $\{(u_n, v_n)\} \subset \{(u, v) \in X : \|(u, v)\| \leq \rho_1\}$ then there exists a subsequence, still denoted by $\{(u_n, v_n)\}$, satisfies $\|(u, v)\| \leq \rho_1$. By Lemma 4, suppose every (u_n, v_n) is a minimum point of the minimax problem $\inf\{I(u, v) + \delta_n \|(u_n, v_n) - (u, v)\| :$

$\|(u, v)\| \leq \rho_1\}$ when $\delta_n \rightarrow 0^+$, then $I(u, v) + \delta_n\|(u_n, v_n) - (u, v)\| \geq I(u_n, v_n)$ when $\|(u, v)\| \leq \rho_1$. Let

$$\{(u, v) \in X : u = u_n + \varepsilon\varphi, v = v_n + \varepsilon\xi, \|(u, v)\| \leq \rho_1\}$$

Then

$$\langle I'(u, v), (\varphi, \xi) \rangle \geq -\delta_n\|(\varphi, \xi)\|, \langle I'(u, v), (\varphi, \xi) \rangle \leq \delta_n\|(\varphi, \xi)\|$$

Hence $I'(u_n, v_n) \rightarrow 0$ Let $\lambda^* = \min\{\lambda_1^*, \lambda_2^*\}$, By Lemma 4, sequence $\{(u_n, v_n)\} \subset X$ exists a subsequence that converges to (u_0, v_0) in X for any $\lambda \in (0, \lambda^*)$ such that $I(u_0, v_0) < 0$ and $I'(u_0, v_0) = 0$. The proof is complete.

References

1. Kang D (2007) Solutions for semi linear elliptic problems with critical Sobolev-Hardy exponents in \mathbb{R}^N . *Nonlinear Anal* 66(1):241–252
2. Velin J (2003) Existence results for some nonlinear elliptic system with lack of compactness. *Nonlinear Anal* 52(3):1017–1034
3. Keiland I (1974) On the variation principle. *J Math Anal Appl* 47:324–353
4. Chen J (2005) Some further results on a semi linear equation with concave convex nonlinearity. *Nonlinear Anal* 62(1):71–87
5. Djellit A, Saadia T (2003) Existence of solutions for a class of elliptic systems in \mathbb{R}^N involving the palladian. *Electron J Diff Eons* 6:1–8
6. Boccardo L, De Figueiredo DG (2002) Some remarks on a system of quasilinear elliptic equations. *NoDEA* 9:309–323
7. Silva E, Soarea S (2001) Quasilinear dirichlet problems in \mathbb{R}^N with critical growth. *Nonlinear Anal* 43(1):1–20

Chapter 89

Analysis of Dynamic Time-Slot Control Random Multi-Access Protocol with Two-Dimensional Probability for Ad Hoc Network

Chun-fen Li, Dong-feng Zhao and Yi-fan Zaho

Abstract This paper presents a dynamic time-slot control random multi-access (DTCRM) protocol with two-dimensional probability for ad hoc network. For this protocol, the system time is slotted dynamically realized by the location of packets arriving time and the choice of two parameters p_1 and p_2 . A mathematical model is given for the DTCRM protocol using the average cycle method. Simulation results verify the high accuracy of the analysis. The results show that the DTCRM protocol is better than the typical protocols.

Keywords Dynamic time-slot control · Two-dimensional probability CSMA · Qos · Throughputs · Ad hoc network

89.1 Introduction

With the fast development of wireless communication network, ad hoc network which considered to be the representative of typical network, has greatly progress in many aspects such as mobility, Self-organization, multi-service and high reliability. Communication terminal corresponding with data processing technology, and widely application of low cost and low power loss terminal devices, promotes the research on ad hoc network [1, 2]. Moreover, the requirements of multi-service and high QoS also boost the study of control strategies and protocols on MAC layer. The typical CSMA/CA series protocols establish a solid foundation for the development of multi-channel random multi-access protocol research [3, 4].

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Aiming the characteristics of ad hoc network, the DTCRM protocol ensures higher Qos for ad hoc networks. By means of locating the arriving time of user terminals to determine the transmitting time, and assigning different priorities for different services to improve the Qos. We use the average cycle method [8, 9] to investigate the DTCRM protocol. In addition, it provides the system analysis process and throughputs [5, 6].

89.2 The Description of DTCRM Protocol

In ad hoc networks with the DTCRM protocol, the system time is divided into time slots. Consider an ad hoc network having N channels ($i = 1, 2, \dots, N$). In order to facilitate the calculation, the user terminals have also set N kinds services ($m = 1, 2, \dots, N$); consider the service which has bigger sequence number having higher priority. The arriving processes of each type of service obey the Poisson distribution, the packet arrival rate of each channel i ($i = 1, 2, \dots, N$) is denoted by G_i . The system's control clock takes the largest system propagation delay of the packets transmission as unit length, denoted by a . Assume that all packets are of unit length and the length is an integer multiple of a . When user terminal will transmit packets of the type m service, it detects the channels i ($i = 1, 2, \dots, m$) according to the channel order. Packets arriving during the idle time slot will be transmitted in the following time slot with probability $p1$, given up transmitting with probability $1-p1$ and user terminal retreats randomly with a period of time to detect channel again. While packets arriving detect the channel is busy, will keep detecting until the channel is available for transmission with probability $p2$, quit detecting with probability $1-p2$ and user terminal retreats randomly with a period of time to detect channel again. If the arriving time of user terminal is in the interval of $[na, na + \frac{a}{2})$, the transmitting time of packets must be in $na + \frac{a}{2}$, while the arriving time is in the interval of $[na + \frac{a}{2}, na + a)$, the transmitting time must be in $na + a$. Moreover, the user terminals access the channels with probability, so it is likely to collide with each other. If conflict happens, it indicates user terminal transmits packets unsuccessfully. Then user terminal retreats randomly with a period of time to detect channel again until the packets transmitting successfully [7].

The channels with the DTCRM protocol can experience three random events: packet transmission successfully, U ; packet conflict, B ; and channel idle, I . Using the analytical means described by article, these three random events can be divided into an idle random event, I , and a composite random event, BU [8, 9]. I denote channels that are in an idle period and BU denotes channels that are in a busy period. These two types of random events are interlaced on the time axis. A busy period, BU , plus the following idle period, I , constitute a average cycle, Tn . Consider the following diagram in Fig. 89.1 denoting the random process of packets transmitted in channel i ($i = 1, 2, \dots, N$)

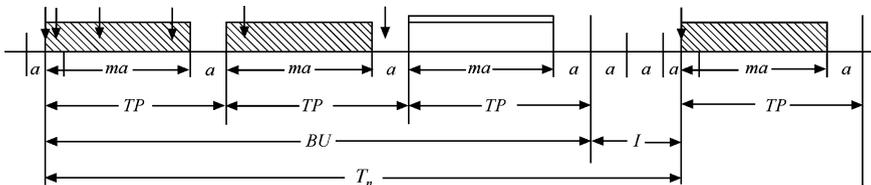


Fig. 89.1 Packet transmission for channel i in the system of DTCRM protocol

According to the DTCRM protocol, build a Joint probability distribution of random variables N_{BU} and N_I in an average cycle:

$$\begin{aligned}
 P(N_{BU} = j, N_I = k) &= (1 - e^{-p_1 G_i a}) \\
 &(1 - e^{-p_1 p_2 G_i (1+a)})^{j-1} e^{-p_1 p_2 G_i (1+a)} (e^{-p_1 G_i a})^{k-1} \\
 i &= 1, 2, \dots, N; j = 1, 2, \dots, N; k = 1, 2, \dots, N
 \end{aligned}
 \tag{89.1}$$

89.3 The Throughputs Analysis of DTCRM Protocol

Theorem For the DTCRM protocol, the systemic throughput is given by

$$\begin{aligned}
 S &= \sum_{i=1}^N \frac{E[U_i]}{E[I_i] + E[BU_i]} \\
 &= \frac{N p_1 G e^{-p_1 p_2 G (1+a)} [a e^{-p_1 G a} + p_2 (1+a) (1 - e^{-p_1 G a})]}{(1+a)(1 - e^{-p_1 G a}) + a e^{-p_1 p_2 G (1+a)} [1 - \frac{1}{4} (1 - e^{-p_1 G a})]}
 \end{aligned}
 \tag{89.2}$$

Proof Calculate $E(U_i)$ firstly, due to formula (89.1) can get:

$$\begin{aligned}
 P(j) &= \sum_{k=1}^{\infty} P(j, k) = (1 - e^{-p_1 p_2 G_i (1+a)})^{j-1} e^{-p_1 p_2 G_i (1+a)} \\
 &= e^{-p_1 p_2 G_i (1+a)} \sum_{x=0}^{j-1} \binom{j-1}{x} [1 - e^{-p_1 p_2 G_i (1+a)} - \\
 &\quad p_1 p_2 G_i (1+a) e^{-p_1 p_2 G_i (1+a)}]^{j-1-x} \\
 &\quad [p_1 p_2 G_i (1+a) e^{-p_1 p_2 G_i (1+a)}]^x
 \end{aligned}
 \tag{89.3}$$

According to $E(N_{BU}) = E(N_B) + E(N_U)$, can obtain

$$\begin{aligned}
 E(N_U) &= \sum_{j=1}^{\infty} e^{-p_1 p_2 G_i(1+a)} \sum_{x=0}^{j-1} x \binom{j-1}{x} [1 - e^{-p_1 p_2 G_i(1+a)} - \\
 &\quad p_1 p_2 G_i(1+a) e^{-p_1 p_2 G_i(1+a)}]^{j-1-x} \cdot \\
 &\quad \left[p_1 p_2 G_i(1+a) e^{-p_1 p_2 G_i(1+a)} \right]^x \\
 &= p_1 p_2 G_i(1+a)
 \end{aligned} \tag{89.4}$$

$$E(U_{i1}) = E(N_U) \times 1 = p_1 p_2 G_i(1+a) \tag{89.5}$$

Using formula (89.1) again can deduce the next formula:

$$\begin{aligned}
 P(k) &= \sum_{j=1}^{\infty} P(j, k) = (e^{-p_1 G_i a})^{k-1} (1 - e^{-p_1 G_i a}) \\
 &= (e^{-p_1 G_i a})^{k-1} [(1 - e^{-p_1 G_i a} - p_1 G_i a e^{-p_1 G_i a}) + p_1 G_i a e^{-p_1 G_i a}]
 \end{aligned} \tag{89.6}$$

The successful probability is $\frac{p_1 G_i a e^{-p_1 G_i a}}{1 - e^{-p_1 G_i a}}$, so can get:

$$E(U_{i2}) = \frac{p_1 G_i a e^{-p_1 G_i a}}{1 - e^{-p_1 G_i a}} \times 1 \tag{89.7}$$

$$E(U_i) = E(U_{i1}) + E(U_{i2}) = p_1 p_2 G_i(1+a) + \frac{p_1 G_i a e^{-p_1 G_i a}}{1 - e^{-p_1 G_i a}} \tag{89.8}$$

$$\begin{aligned}
 E(N_{BU}) &= e^{-p_1 p_2 G_i(1+a)} \sum_{j=1}^{\infty} j (1 - e^{-p_1 p_2 G_i(1+a)})^{j-1} \\
 &= e^{p_1 p_2 G_i(1+a)}
 \end{aligned} \tag{89.9}$$

$$E(BU_i) = E(N_{BU}) \times (1+a) = (1+a) e^{p_1 p_2 G_i(1+a)} \tag{89.10}$$

So we can obtain $E(I_i)$,

$$E(I_i) = (1 - e^{-p_1 G_i a}) \sum_{k=1}^{\infty} k (e^{-p_1 G_i a})^{k-1} = \frac{1}{1 - e^{-p_1 G_i a}} \tag{89.11}$$

Because of the dynamic control of time slots, the probabilities are equal to 1/2 whether adjust time slots or not in the final slot of an average cycle. So the average time is

$$E(I_a) = \frac{1}{2} \times \frac{a}{2} + \frac{1}{2} \times a = \frac{3a}{4} \tag{89.12}$$

$$E(I_i) = [E(N_I) - 1]a + E(I_a) = \left(\frac{1}{1 - e^{-p_1 G_i a}} - \frac{1}{4} \right) a \tag{89.13}$$

Fig. 89.2 Throughput of DTCRM and slotted two-dimensional CSMA and continuous time two-dimensional CSMA ($p_1 = 0.0958, p_2 = 0.0860$)

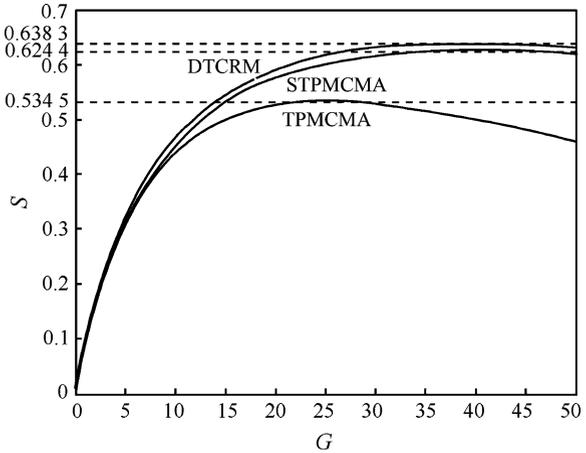
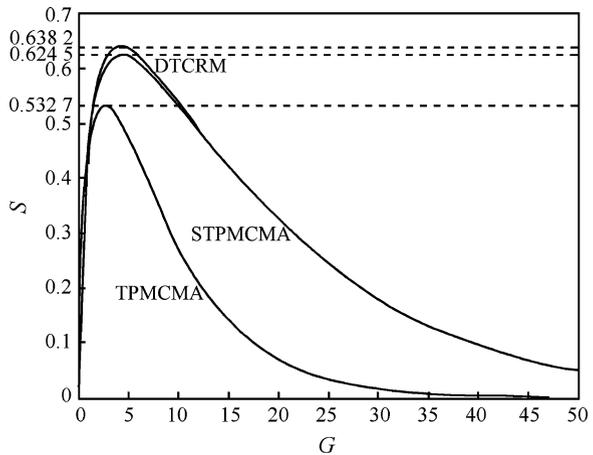


Fig. 89.3 Throughput of DTCRM and slotted two-dimensional CSMA and continuous time two-dimensional CSMA ($p_1 = 0.09, p_2 = 0.0893$)



Because all N channels of the system are balanced, $G_1 = G_2 = \dots = G_i = \dots = G_N = G$, from above analysis, Theorem 1 can be proved.

89.4 Simulation Results and Analysis

The simulation of the DTCRM protocol is based on the analytical results in the previous section. The simulation experiment uses the MATLAB7.0. In simulations, let system propagation delay a equals to 0.1, the number of channel N equals to 4, the length of packets arriving equals to unite length, the priorities of services are 4.

Fig. 89.4 Throughput for parameters $p_1 = 0.0958$ and $p_2 = 0$

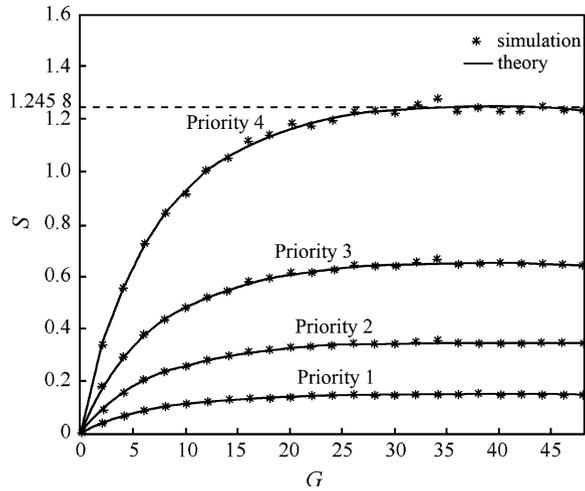


Fig. 89.5 Throughput for parameters $p_1 = 0.0958$ and $p_2 = 0.0860$

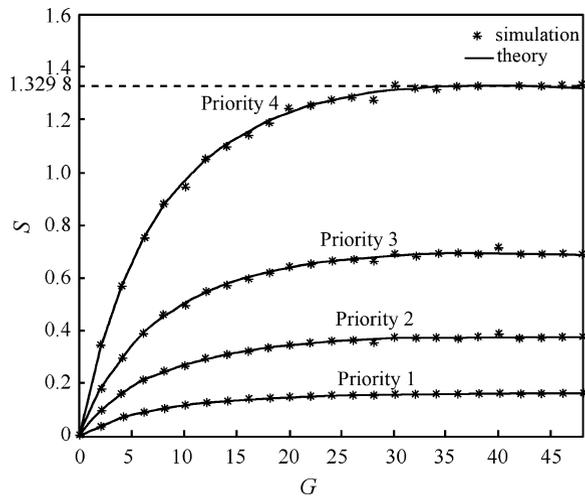


Figure. 89.2 and 89.3 compares the DTCRM with slotted two-dimensional CSMA and continuous time two-dimensional CSMA. Figures. 89.4, 89.5, 89.6, 89.7, 89.8, and 89.9 provide the simulation results of DTCRM protocol in selecting different combination of p_1 and p_2 , and give the changing curves of S - G for each priority [10].

From the simulation the conclusions are: as shown in Figs. 89.2 and 89.3, the throughputs of DTCRM is approximately equal to TPMCMA and STPMCMA when the system of light loads, but superior to TPMCMA and STPMCMA significantly when the system of heavy load. This is due to the using of dynamic slot control; reduce the waiting time of transmitting packets, thus improving the

Fig. 89.6 Throughput for parameters $p_1 = 0.4671$ and $p_2 = 0$

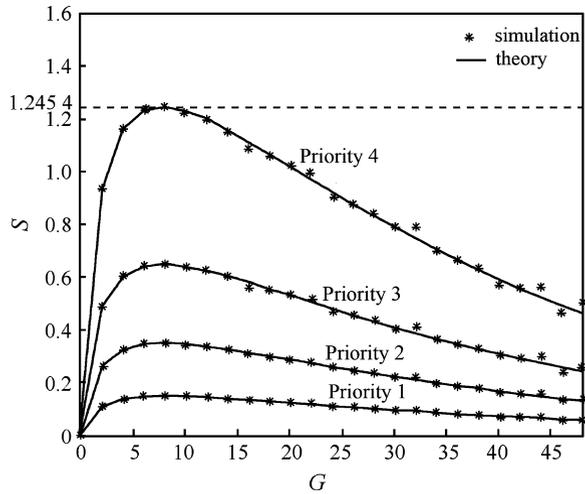
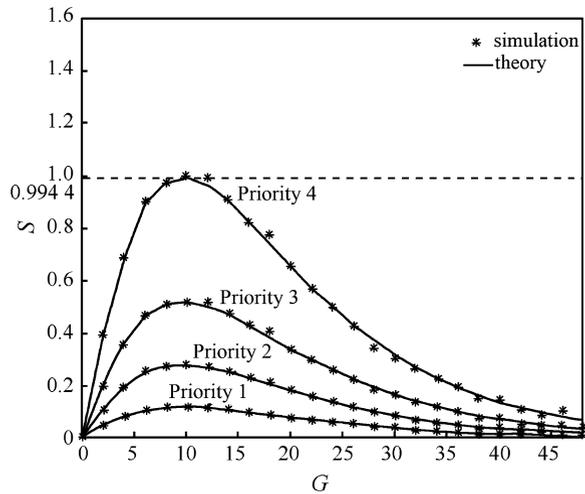


Fig. 89.7 Throughput for parameters $p_1 = 0.0958$ and $p_2 = 1$



utilization rate of channels. As shown in Fig. 89.4, 89.5, 89.6, 89.7, 89.8, 89.9 while probability variables in the value region of $p_1 \in [0.0958, 0.9432]$ and $p_2 \in [0.0860, 0.0893]$, the system will obtain better throughputs performance. While the system load is lighter, select larger probability variables will reduce the access time thus improve the system throughputs performance. When the system of heavy load select minor probability variables can decrease the conflicts thus increase the success rates of packets transmitting. Besides, increase the value of parameters p_1 and p_2 of light system load will elevate the changing curves of S-G significantly. Moreover, decrease the value of parameters p_1 and p_2 of heavy system load can slow down the fall of the changing curves of S-G to keep the better throughputs performance and improving system's stability consequently.

Fig. 89.8 Throughput for parameters $p1 = 0.3737$ and $p2 = 0.0860$

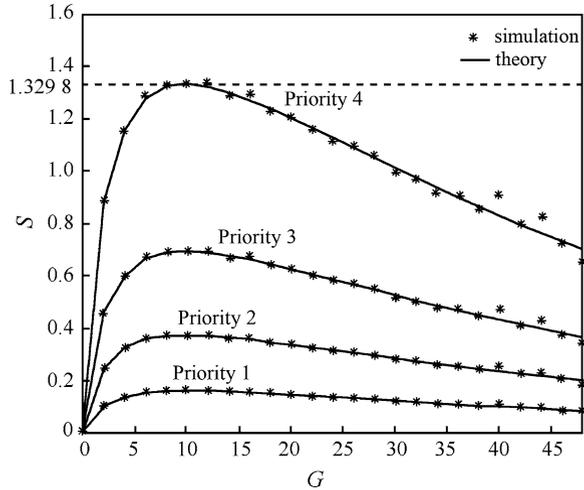
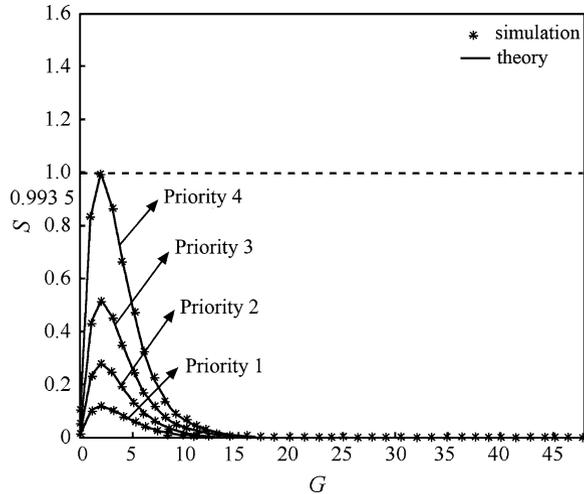


Fig. 89.9 Throughput for parameters $p1 = 0.4671$ and $p2 = 1$



89.5 Conclusions

According to ad hoc network, this paper presents a DTCRM protocol with two-dimensional probability, using random multi-access of double probabilities control strategy. The value selection of parameters $p1$ and $p2$ in accordance with system load situation, enables the system has a better QoS performance in the different load situation. The theoretical analysis result is consistent with the simulation result. It suggests that the analysis method is effective and the control strategy presented is meaningful.

References

1. Tang Z, Garcia-Luna-Aceves JJ (1999) Hop-reservation multiple access (HRMA) for ad-hoc network. *IEEE INFOCOM'99 New York* 22:194–201
2. Garces R, Garcia-Luna-Aceves JJ (1999) Collision avoidance and resolution multiple access for multichannel wireless network. *IEEE Infocom'2000 Tel Aviv Israel* 22:776–783
3. Jain N, Das SR, Nasipuri A (2001) A multi-channel CSMA MAC protocol with receiver-based channel selection for multihop wireless networks. *IEEE Int Conf Comput Commun Netw* 2:390–398
4. Sucec J, Marsic I (2002) Clustering overhead for hierarchical routing in mobile ad hoc networks. *Proc IEEE Infocom NewYork* 12:1698–1706
5. Chatzimisios P, Boucouvalas AC (2005) Packet delay analysis of the advanced infrared (AIR) CSMA/CA MAC protocol in optical wireless LANs. *Int J Commun Syst* 18:307–331
6. Nicopolitidis P, Papadimitriou GI, Obaidat MS (2005) Carrier-sense-assisted adaptive learning MAC protocols for distributed wireless LANs. *Int J Commun Syst* 18:657–669
7. Sabharwal A (2007) Opportunistic spectral usage: bounds and a multi-Bandcsma/CA Protocol. *IEEE/ACM Trans Netw* 15(3):533–544
8. Zhao DF (1999) Study on the average cycle method for slotted multiple-access communications. *J China Inst Commun* 20(8):80–85
9. Zhao DF (1999) Study on a new method for the continuous-time systems of random access channel. *J Electron* 20(1):27–41
10. Zhao DF (1999) Study on a new method for continuous-time systems of random access channel. *J Electron* 21(1):37–41

Chapter 90

Analysis of Double Clocks Random Multi-Access Protocol with Multi-Channel and Two-Dimensional Probability

Chun-fen Li, Dong-feng Zhao and Yi-fan Zhao

Abstract In order to improve the quality of service (Qos) and channel utility of wireless communication networks, to present the double clocks random multi-access protocol with multi-channel and two-dimensional probability (DCRM) protocol. By means of double clocks control mechanism realized by combination of continuous and slotted clocks to promise higher channel utility. The average period method was used to get throughputs of system and each priority. Analysis shows that the DCRM protocol can ensure higher throughput and Qos demands which support multi-services and higher priority service. What is more, provide a feasible method to realize the system with the DCRM protocol in theory.

Keywords Double clocks · Two-dimensional probability · CSMA · Multi-channel · Qos

90.1 Introduction

Along with the rapid growth of multi-services of wireless communication network, the original strategies of service QoS control cannot meet the quality of multi-services. However, multi-channel random multi-access protocols can provide many merits such as reducing time delay, improving throughput, taking full advantage of channel and supporting Qos easily [1].

According to communication system with multi-channels, unreasonable methods of resource assigning can lead to serious blocking of some channels but others unoccupied. Thus, this paper built the model of the DCRM protocol. With this

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protocol, the system selects slotted clock control while channel is busy, and continuous clock control under the idle state of channel [2]. The average cycle method was used to build the system model. Meanwhile, system used the controlling of arriving rate of priorities to realize load equilibrium [3, 4].

90.2 DCRM Protocol

Consider wireless communication networks with the DCRM protocol having N channels and N priorities. The service with priority i occupies channel 1 to channel i ($i = 1, 2, \dots, N$), i.e., priority 1 occupies channel 1, the service with priority 2 occupies channel 1 and channel 2, and the service with priority N occupies channels 1 to N . The service with bigger sequence number has higher priority. The packet arrival rate for service with priority i on channel j is $\lambda_j^{(Pi)} = G_j / (N - j + 1) (j \leq i)$, so the system model is a load equilibrium mode because of the packet arrival rate of each channel is G [5].

The system uses the double clocks control mechanism:

1. In the idle state of channel, the system was controlled by the continuous clock. User terminal transmitted packets with probability $p1$, and gave up transmission with probability $1 - p1$.
2. While the channel is busy, the slotted clock started work. User terminal kept sensing channel with probability $p2$, and quitted sensing channel with probability $1 - p2$ until channel idle to experience the first process again.

Before the analysis of system performance, assume that:

1. The access pattern of channel j ($j = 1, 2, \dots, N$) was double clocks random multi-access with multi-channel and two-dimensional probability, and the arriving process of channel j was independent *Poisson* process with parameter of G_j ;
2. The system time is divided into time slots. Let a denote the system propagation delay of the packet transmission time. All packets are of unit length and the length is an integer multiple of a .
3. Assume the channel does not has noises and interference, that is channel is in ideal state.
4. The conflict of packets may be happen during the transmission process, the DCRM protocol would schedule user terminal transmitting again, the packets transmitted once again had no influence on arriving process.

According to the analytical means described by article [5–7], the channel can experience two random events:

1. channels that are in an idle period, I .
2. a composite random event that channels are in a busy period, BU .

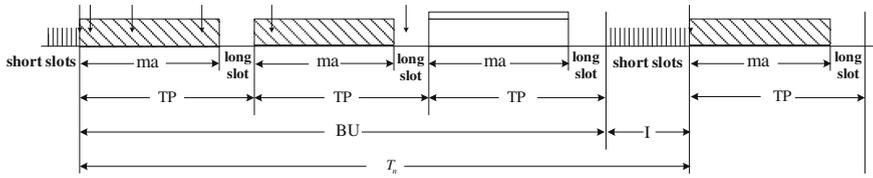


Fig. 90.1 The packets sending process in j th channel of double clocks multi-channel random multi-access protocol with two dimensional probabilities

These two types of random events are interlaced on the time axis. A busy period, BU , plus the following idle period, I , constitute a average cycle, T_n . Consider the following diagram in Fig. 90.1 denoting the random process of packets transmitted in channel $i (i = 1, 2, \dots, N)$.

Packets arriving during the idle time slot controlled by continuous clock will be transmitted immediately with probability p_1 , while those arriving during the transmission period controlled by slotted clock will sense that the channel is busy and will detect that the channel is available for transmissions with probability p_2 until the channel is sensed idle. Then the packets that were not sent will be transmitted with probability p_1 immediately. If the total number of packets to be transmitted is equal to or exceeds two, a conflict occurs in the next TP with probability 1. If it equals one, then the packet will be transmitted successfully. If it equals zero, the busy period ends. Moreover, the length of each TP is $1 + a$ in each busy period, BU . The arrived sequence is a random Poisson process with an independent stationary increment [6].

90.3 System Analysis of DCRM

Theorem 1 For the DCRM protocol, the systemic throughput is given by

$$s = \frac{NGp_1 e^{-Gp_1 p_2 (1+a)} [p_2 (1+a) + (a - p_2 - p_2 a) e^{-Gp_1 a}]}{(a - \frac{1}{2} Gp_1 a^2 e^{-Gp_1 a}) e^{-Gp_1 p_2 (1+a)} + (1+a)(1 - e^{-Gp_1 a})}$$

Proof Above all, define the following variables.

$z(t)$: the event of n packets arriving during the interval of t .

$x(t)$: the event of $m (0 \leq m \leq n)$ packets deciding to transmit with probability p_1 during the interval of t .

A_k : the event of k packets keeping sensing channel with probability p_2 during those arriving in a TP .

B_j : after A_k , the event of j packets determining transmitting with probability p_1 in an idle period.

q0: the probability of no packets arriving in a TP and arriving packets giving up sensing channel and packets keeping sensing channel quitting transmission in an idle period.

q1: the probability of the number of packets transmission in following TP equaling 1.

N: the number of I in a TP.

M: the number of TP which event experience Ak with probability q1.

W: the number of TP in a busy period.

P_{I1}: the probability of the number of packets arriving in a idle slot equaling 1.

P_{I2}: the probability of the number of packets arriving in a idle slot exceeding 1.

For channel j of an system with the DCRM protocol, $P(Z(t) = n) = \frac{(G_j^t)^n}{n!} e^{-G_j^t}$ indicates that:

$$P(X(t) = m) = \sum_{n=m}^{\infty} P(Z(t) = n) C_n^m p_1^m (1 - p_1)^{n-m} \tag{90.1}$$

$$= \sum_{n=m}^{\infty} \frac{(G_j^t)^n}{n!} e^{-G_j^t} C_n^m p_1^m (1 - p_1)^{n-m} = \frac{(G_j p_1 t)^m}{m!} e^{-G_j p_1 t}$$

$$P(X(a) = 0) = e^{-G_j p_1 a} \tag{90.2}$$

$$P(X(a) = 1) = G_j p_1 a e^{-G_j p_1 a} \tag{90.3}$$

First, caculate the average length of event U_j which packets transmitting successfully for j channel

$$E(U_{j1}) = \frac{P(X(a) = 1)}{1 - P(X(a) = 0)} \times 1 = \frac{G_j p_1 a e^{-G_j p_1 a}}{1 - e^{-G_j p_1 a}} \tag{90.4}$$

$$E(U_{j2}) = E[M] \times 1 \tag{90.5}$$

As an result of $Z((1 + a) = n) = \frac{G_j^n (1+a)^n}{n!} e^{-G_j(1+a)}$, can get

$$P(A_k) = \sum_{n=k}^{\infty} p(Z(1 + a) = n) C_n^k p_2 (1 - p_2)^{n-k} = \frac{[G_j p_2 (1 + a)]^k}{k!} e^{-G_j p_2 (1+a)} \tag{90.6}$$

$$p(B_j) = \sum_{k=j}^{\infty} p(A_k) C_k^j p_1^j (1 - p_1)^{k-j} = \frac{[G_j p_1 p_2 (1 + a)]^j}{j!} e^{-G_j p_1 p_2 (1+a)} \tag{90.7}$$

$$q_0 = P(B_0) = e^{-G_j p_1 p_2 (1+a)} \tag{90.8}$$

$$q_1 = P(B_1) = G_j p_1 p_2 (1 + a) e^{-G_j p_1 p_2 (1+a)} \tag{90.9}$$

$$E[U_j] = E[U_{j1}] + E[U_{j2}] = \frac{G_j p_1 a e^{-G_j p_1 a}}{1 - e^{-G_j p_1 a}} + G_j p_1 p_2 (1 + a) \quad (90.10)$$

Secondly, solve the average length of event BU_j for j channel.

$$E[BU_j] = E\{E[BU_j/W]\} = (1 + a)E[W] = \frac{1}{q_0}(1 + a) = \frac{1 + a}{e^{-G p_1 p_2 (1+a)}} \quad (90.11)$$

Then obtain the average length of event I_j for j channel. The normalized probability of the event which the number of packets arriving in a slot equaling 1 is $p_{I1} = \frac{G_j p_1 a e^{-G_j p_1 a}}{1 - e^{-G_j p_1 a}}$, and the normalized probability of the event which the number of packets arriving in a slot exceeding 1 gave by $p_{I2} = \frac{1 - G_j p_1 a e^{-G_j p_1 a} - e^{-G_j p_1 a}}{1 - e^{-G_j p_1 a}}$, so

$$E[I_j] = \frac{1}{1 - e^{-G_j p_1 a}} a + \frac{G_j p_1 a^2 e^{-G_j p_1 a}}{2(1 - e^{-G_j p_1 a})} + \frac{(1 - G_j p_1 a e^{-G_j p_1 a} - e^{-G_j p_1 a})a}{1 - e^{-G_j p_1 a}} \quad (90.12)$$

Because all N channels of the system are balanced, from $G_1 = G_2 = \dots = G_j = \dots = G_N = G$, Theorem 1 can be proved.

Theorem 2 For the DCRM protocol with load equilibrium, the throughput based on priority i in the system is given by

$$s_{pi} = \left(\sum_{j=1}^i \frac{1}{N - j + 1} \right) \left\{ \frac{NG p_1 e^{-G p_1 p_2 (1+a)} [p_2 (1 + a) + (a - p_2 - p_2 a) e^{-G p_1 a}]}{(a - \frac{1}{2} G p_1 a^2 e^{-G p_1 p_2 (1+a)} + (1 + a)(1 - e^{-G p_1 a}))} \right\}$$

Proof Using $E(U_j^{(Pi)})$ express the length of packets transmitting successfully with priority i in an average cycle for channel j ($i \geq j$). The system channel is load equilibrium, and the packet arrival rate for service with priority i on channel j is $\lambda_j^{(Pi)} = G/(N - j + 1)$. Therefore, from Eqs. (90.10), (90.11), (90.12) and $G_1 = G_2 = \dots = G_j = \dots = G_N = G$,

$$E(U_j^{(Pi)}) = \frac{\lambda_j^{(Pi)}}{G_j} E(U_j) = \frac{1}{(N-j+1)} \left[\frac{G_j p_1 a e^{-G_j p_1 a}}{1 - e^{-G_j p_1 a}} + G_j p_1 p_2 (1 + a) \right]$$

Theorem 2 is proved.

90.4 Discussion

The system with the DCRM protocol uses double clocks control strategy. Employ slotted clock in busy state of channel and continuous clock in idle state. So the system can use two types slot which consists of tiny slot and large slot. When system has signaled that is channel in the state of busy to use the tiny slot, and there is no signal in the channel to use large slot [7].

According to paper, the average length of I with the slotted random multi-access protocol with two-dimensional probability is [8]:

$$E[I_j]_s = \frac{a}{1 - e^{-G_j p_1 a}} \tag{90.13}$$

In this paper, the average length of I with the DCRM protocol is given by

$$E[I_j]_M = \left(\frac{1}{1 - e^{-G_j p_1 a}} - 1 \right) a + \frac{G_j p_1 a^2 e^{-G_j p_1 a}}{2(1 - e^{-G_j p_1 a})} + \frac{(1 - G_j p_1 a e^{-G_j p_1 a} - e^{-G_j p_1 a}) a}{1 - e^{-G_j p_1 a}} \tag{90.14}$$

And then subdivide the tiny slot constantly until the length of tiny slot approaching to zero, in that way the system controlled by tiny slots will transform to continuous system, so let the length of a from Eqs. (90.13), (90.14) approach to zero, and take limit towards Eqs. (90.13), (90.14)

$$\lim_{a \rightarrow 0} E[I_j]_s = \frac{a}{1 - e^{-G_j p_1 a}} = \frac{p_1}{G_j} \tag{90.15}$$

$$\begin{aligned} \lim_{a \rightarrow 0} E[I_j]_M &= \left(\frac{1}{1 - e^{-G_j p_1 a}} - 1 \right) a + \frac{G_j p_1 a^2 e^{-G_j p_1 a}}{2(1 - e^{-G_j p_1 a})} \\ &+ \frac{(1 - G_j p_1 a e^{-G_j p_1 a} - e^{-G_j p_1 a}) a}{1 - e^{-G_j p_1 a}} = \frac{p_1}{G_j} \end{aligned} \tag{90.16}$$

Form above analysis shows that Eqs. (90.15), (90.16) results are consistent. It confirms the realization of system with the DCRM protocol can by means of subdivision of tiny slot to approximate continuous time is feasible.

90.5 Conclusion

The performance analysis of the DCRM protocol is based on the analytical results in the previous section. With the DCRM protocol, packets arriving while channel in the state of idle was transmitted immediately thereby save the wasted time which wait to the following idle slot, improve the channel utility consequently.

Random multi-access protocols with multi-channel and two-dimensional probability transmit packets with probability $p1$ in the idle state of channel, keep sensing channel with probability $p2$ while channel busy. But system employed only a uniform control clock, the packets arriving during the idle time slot would wait for the starting point of the following slot to be transmitted [9]. The waiting process reduced the channel utility, and increases the delay of system and goes against the promotion of systematic throughputs. With the DCRM protocol, aim at different state of channel employing disparate clock control strategy to save the waiting time and enhance the channel utility. Therefore, the systematic

throughputs are superior to the Performance simulation and analysis Random multi-access protocols with multi-channel and two-dimensional probability. And the more important thing is that provide a feasible method to realize the system with the DCRM protocol theoretically.

References

1. Garces R, Garcia-Luna-Aceves JJ (1999) Collision avoidance and resolution multiple access for multichannel wireless network. *IEEE Infocom'2000 Tel Aviv Israel* 2(3):776–783
2. Garces R, Garcia-Luna-Aceves JJ (2000) Collision avoidance and resolution multiple access for multichannel wireless networks. *IEEE Infocom'2000 Tel Aviv Israel* 1(1):595–602
- Jain N, Das SR, Nasipuri A (2001) A multi-channel CSMA MAC protocol with receiver-based channel selection for multihop wireless networks. In: *IEEE international conference on computer communications and networks* 122(2), pp 980–987
4. Chatzimisios P, Boucouvalas AC (2005) Packet delay analysis of the advanced infrared (AIR) CSMA/CA MAC protocol in optical wireless LANs. *Int J Commun Syst* 18:307–331
5. Dongfeng Z (1999) Study on the average cycle method for slotted multiple-access communications. *J China Inst Commun* 20(8):80–85
6. Dongfeng Z (1999) Study on a new method for the continuous-time systems of random access channel. *J Electron* 20(1):27–41
7. Zhao DF (1999) Study on a new method for continuous-time systems of random access channel. *J Electron* 21(1):37–41
8. Ding HW, Zhao DF, Huang MM (2010) Analysis of a new random multi-access MAC protocol and its energy efficiency for wireless sensor networks. *J China Inst Commun* 31(2):51–57
9. Long Y, Garcia-Luna-Aceves JJ (2004) Node activation with polling channel access. In: *IEEE ICC 2004*, vol 54. Paris, France, 4352–4356

Chapter 91

K-Mean Clustering Analysis and Its Applications to Classification of Tumor Gene

Lingbo Cong and Wanqing Ruan

Abstract Feature gene selection of tumor classification is an important means to find the expression of tumor-specific genes. To study the tumor gene expression pattern, k-means clustering analysis method is considered. It is used for selecting the best genetic center, extracting scalar features and determining the corresponding gene label. The experimental results show that the correct rate of the classification results by this method is 87 %.

Keywords Gene expression profile · Feature gene · K-mean clustering

91.1 Introduction

The tumor is highly heterogeneous disease. It is difficult to find the type of tumor based on the clinic pathologic analysis. Gene Chip technology is available to people with high-flux, precise, sensitive, and rapid molecular level detection for observation of the tumor. DNA microarray experiment can get tens of thousands of gene expression at one time. This technology provides a new research method for oncology research. Classification and Detection using gene expression profiles of tumor samples is gradually becoming an important research field of bioinformatics [1]. Since Golub et al. used leukemia gene expression data as classified samples to propose gene choice algorithm based on the weight voting, many new methods of

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informative gene selection or feature information extraction have been proposed [2]. Furlanello et al. proposed a fast feature ordering algorithm that eliminate a large number of redundant genes with weight distribution of entropy [3]. Chun et al. proposed the algorithm that getting phenotype and gene information from gene expression data for better scalability and performance. In this paper, the signal-to-noise ratio and Bhattacharyya distance method is combined to eliminate the gene irrelevant and the scalar feature extraction methods is used to select classification factors and determine the gene label.

91.2 Fundamental and Method

91.2.1 K-Means Clustering Analysis Method

Clustering does not require any priori domain knowledge; the basic idea is to define distance or similarity coefficient between multivariate distances or similarity coefficient to determine the multivariate relationship, which is the classification. Cluster number K and iteration time or convergence conditions must be designated before using the k-means clustering algorithm. K initial center are appointed, each gene is assigned to recent or “similar” center to form the class according to certain similarity measure standard then average vector of every kind is as center of mass redistribute and iterative convergence until class (such as center fixed) or to achieve maximum iteration times [4].

Steps of k-means clustering analysis method:

Step 1 Enter gene expression matrix $U_k = \left\{ \begin{matrix} 1; k \\ 0; others \end{matrix} \right\}$ and class number K ,

initialize center V , set maximum iterations T and center convergence error tolerance δ .

Step 2 Calculate distance d_{ik} between vector $X_i(i = 1, \dots, n)$ and every center $V_k(k = 1, \dots, K)$ (using Euclidean distance $d_{ik} = d(x_j, v_k)$ or Pearson related coefficient $d_{ik} = 1 - r(x_i, v_k)$), distribute X_i to the nearest center, that if

$$d_{ik} = \text{Min}\{d_{ik}\}, X_i \in S_k, U_{ki} = \left\{ \begin{matrix} 1; k = k^* \\ 0; others \end{matrix} \right\}.$$

Step 3 counter V using the newest U :

$$V_k = \frac{\sum_{i=1}^n (U_{ki})X_i}{\sum_{i=1}^n (U_{ki})}, k = 1, \dots, K \tag{91.1}$$

And calculate center error: $E_t = \|V_t - V_{t-1}\|_2 = \sqrt{(V_t - V_{t-1})^T (V_t - V_{t-1})}$, it is iteration time variable.

Step 4 Proceed repeatedly step 2 and step 3, until $E_t < \varepsilon$ or $t = T$, output final U and V .

91.2.2 Fundamental of SVM

Assume training set, $(x_1, y_1), (x_2, y_2), \dots, (x_l, y_l), x \in R^n, y \in \{+1, -1\}$ SVM solve the optimization problem as follows:

$$\begin{aligned} \min_{\omega, b, \xi} \quad & \frac{1}{2} (\omega \cdot \omega) + C \sum_{i=1}^l \xi_i \\ \text{s.t.} \quad & (\omega \cdot \phi(x_i)) + b \geq 1 - \xi_i, \quad \text{if } y_i = 1 \\ & (\omega \cdot \phi(x_j)) + b \leq -1 + \xi_j, \quad \text{if } y_j = -1 \\ & \xi_i \geq 0, i = 1, 2, \dots, l \end{aligned}$$

In the formula, Φ is some nonlinear, C are error costs, ξ is slack variable, then its dual problem is got:

$$W(\alpha) = \sum_{i=1}^l \alpha_i - \frac{1}{2} \sum_{i=1}^l \sum_{j=1}^l \alpha_i \alpha_j y_i y_j K(x_i, x_j) \tag{91.2}$$

Satisfying the under constraint conditions:

$$\begin{aligned} 0 \leq \alpha_i \leq C, i = 1, 2, \dots, l \\ \sum_{i=1}^l \alpha_i y_i = 0 \end{aligned} \tag{91.3}$$

By solving quadratic optimization problem of maximization type (91.2) under the condition of type (91.3), the optimal hyper plane is constructed getting a decision function that can be used to classify the new samples

$$f(x) = \text{sgn} \left(\sum_{i=1}^l y_i \alpha_i^0 K(x_i, x) - b^0 \right) \text{ [5].}$$

91.3 Feature Selection Algorithm

91.3.1 Fundamental of SVM

In the process of judging the cancer gene label, much of the “irrelevant gene” need to be removed to reduce searching scope of gene, owing to the large number of

genes. In fact, some gene expression level of all samples is very close in the gene expression profiling. Neither its mean value nor its variance are not obvious different between average person and cancerous person. It is thought that these genes are not related to the sample class, so the independent gene must be rejected.

91.3.1.1 Use Signal to Noise Ratio to Reject Independent Gene

In 1999, Golub et al. take the signal-to-noise ratio as the measurement weighting contribution of gene for the sample classification, d is signal to noise ratio of gene.

$$d = \frac{\mu_1 - \mu_2}{\sigma_1 - \sigma_2} \quad (91.4)$$

91.3.1.2 Use Bhattacharyya Distance Method to Reject Independent Gene

Bhattacharyya distance is used to measure the classification information of genes, B is Bhattacharyya distance of gene [6].

$$B = \frac{1}{4} \frac{(\mu_1 - \mu_2)}{(\sigma_1^2 + \sigma_2^2)} + \frac{1}{2} \ln \left(\frac{\sigma_1^2 + \sigma_2^2}{2\sigma_1\sigma_2} \right) \quad (91.5)$$

91.3.1.3 Combine Two Methods to Reject Independent Gene

Some important information may be lost by one standard, so two methods are combined in this paper. Choose appropriate threshold value to reject independent gene. According to the number of sample classification information, genes are classified to information gene and independent gene. Make S_I as genetic information collection, S_N is independent gene collection, then it is defined,

$$g \in \begin{cases} S_I, B(g) > \theta \\ S_N, B(g) \leq \theta \end{cases} \quad (91.6)$$

g is gene, $B(g)$ is Bhattacharyya distance or signal to noise ratio of g , θ is specified threshold.

91.3.2 Choose the Best Gene Center with K-Means Clustering Analysis Method

The gene scope is reduced, but direct correlation gene number of one kind of tumor is very few, therefore we need to carry on processing further to the gene that

carries on the K- average value cluster to the sample. Carry on the cluster to start value $K = K + 1$ in turn, starting value is elected as $K = 2$. In computation, if K was selected too small, many primitive gene expression data would be lost; if K was selected too big, many redundancies information would be retained. Two kinds of situations can reduce classified accuracy. In order to obtain the better effect of cluster, the cluster integer K are changeable, through many times tests, the best K value of classified effect will be found.

91.3.3 Establishment and Verify of Gene Label

Relative to the number of genes, the number of sample is very small, the direct application of sample for classification can cause learning problems of little sample. In fact, if features were small, the effect of categories would be better for genetic classification problem. Based on this consideration, k-means clustering analysis is used to ascertain. For classification, classification center can't get the corresponding gene tags. Therefore, it is needed to use the classification center to get the corresponding gene tags. Get the classification center, then extract feature and choose features genes.

91.3.3.1 Scalar Feature Extraction

Features choice is that some most representative characteristics are picked out from the original features as the classification feature of the samples; basic task is how to find out the most effective features. The most simple feature selection method is to choose those most influential characteristics to classification according to the knowledge of the expert, and the other possible is to choose with mathematics method to find out the most classification of information features. If the difference of one kind of samples is called as inside change and the difference of different kinds of samples is called as separate difference, separate difference of the ideal characteristics gene must be bigger. Remember separate difference as scatter and inside change as compact, use score (the ratio of them) to show the genes identified ability. Score (j) represents the identification ability of gene j. the points granted is less mean that the gene and category is more related and the ability to identify is higher, the characteristics of gene j expression data reparability is better. Calculate all genes score, sort up each gene according to the grades.

91.3.3.2 Ascertainning of Gene Label

Suppose sample $x_{ij}, j = 1, 2, \dots, n$, feature gene center is $\bar{x}_i, i = 1, 2, \dots, k$, steps of determining gene label are:

Step 1 Classify sample genes, discriminate categories set of each gene, $S_i, i = 1, 2, \dots, k$

Step 2 For every sample element $x_{ij} \in S_i, i = 1, 2, \dots, k$ of collection class, $S_i, i = 1, 2, \dots, k,$

Calculate Euclidean distance,
$$d_{rs}^2 = \sqrt{\sum_{i=1}^p (x_{ij} - \bar{x}_i)^2}$$

And related coefficient,
$$r_{ij} = \frac{\sum_{k=1}^n (x_{ij} - \bar{x}_i)(x_{kj} - \bar{x}_j)}{\left\{ \left[\sum_{k=1}^n (x_{ki} - \bar{x}_i)^2 \right] \cdot \left[\sum_{k=1}^n (x_{kj} - \bar{x}_j)^2 \right] \right\}^{1/2}}$$

Take the gene which distance is the least as gene label.

91.3.3.3 Confirm Characteristic Gene Accuracy Based on Support Vector Machines Method

With the support vector machines method, the classified result accuracy may be obtained by which the characteristic gene computed above is taken as the training regulations, the cancer patient sample is taken as the test collection and the sample is classified.

91.4 Experimental Results and Analysis

91.4.1 Rejecting of Independent Gene

Combine two methods to reject independent gene, when Bhattacharyya distance threshold value $\theta = 0.1$ and signal to noise ratio threshold value $\theta = 0.1$, 175 genes are information gene in 2000 genes, 1881 genes are independent gene. 134 genes after removing independent genes contain classification information in varying degrees, is the basis for further analysis.

91.4.2 Choose the Best Gene Center with K-Means Clustering Analysis Method

Using Bhattacharyya distance method, the gene scope is reduced to 134 genes. Take K-means clustering analysis method for these data. After experiment, it is achieved that the classification result is the best when $K = 2$, viewing Fig. 91.1.

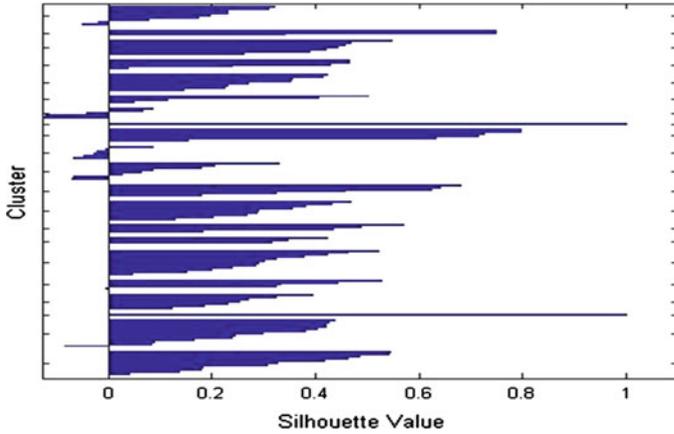


Fig. 91.1 K-clustering analysis classification figure

91.4.3 Establishment and Verify of Gene Label

With fundamental of feature selection, take feature selection to the 21 gene centers in Table 91.1, the result is shown in chart 1, $C = 90$.

Through calculating, the character genes and gene labels are shown in Table 91.2.

91.4.4 Confirm Characteristic Gene Accuracy Based on Support Vector Machines Method

Using support vector machines method, 11 characteristics genes calculated above are taken as training set and 40 samples of cancer patients are taken as test set to

Table 91.1 Scores of 21 classification centers

Serial number	Scores	Whether for features genes	Serial number	Scores	Whether for features genes
1	95.6	yes	12	93.1	yes
2	98.4	yes	13	94.2	yes
3	92.5	yes	14	85.3	not
4	94.4	yes	15	89.0	not
5	85.9	not	16	91.7	yes
6	83.7	not	17	88.7	not
7	93.6	yes	18	80.2	not
8	89.2	not	19	92.5	yes
9	84.2	not	20	87.5	not
10	92.7	yes	21	90.4	yes
11	79.8	not			

Table 91.2 Gene number of classification centers

Serial number	Gene number	ID
1	Z50753	ENSG00000044012
2	U30825	ENSG00000111786
3	R87126	
4	M22382	ENSG00000144381
7	U09564	
10	R84411	ENSG00000125835
12	X63629	ENSG00000062038
13	M36634	ENSG00000146469
16	M82919	ENSG00000166206
19	J05032	ENSG00000115866
21	H08393	ENSG00000116455

classify the samples, the accuracy of the classification results is at 87 %. This suggests that the 11 characteristics genes selected contain wealth information that can represent the feature of the cancer genes.

91.5 Summary

A key problem of gene expression data classification is feature selection. In this paper, a series of data pretreatment, scalar feature extraction and K-clustering analysis are conducted; the characteristics genes have good classification ability for sample set. Using support vector machines method, the accuracy of the classification results is at 85 %. According to certain genes tags the types of cancers can be effectively judged providing great contribution for physiology information.

References

1. Golub TR, Slonim DK, Tamayo P et al (1999) Molecular classification of cancer: class discovery and class prediction by gene expression monitoring. *Science* 286(5439):531–537
2. Furlanello C, Serafini M, Merler S et al (2003) An accelerated procedure for recursive feature ranking on microarray data. *Neural Netw* 16(5–6):641–648
3. Chun T, Aidong Z, Jian P (2003) Mining phenotypes and informative genes from gene expression data. *Proc 9th ACM SIGKDD Int Conf Knowl Discov Data Min* 4:655–660
4. Duda OR, Hart PE, Stork GD (2001) *Pattern classification*. second edition. Wiley, New York, 6(7):46–48
5. Theodoridis S, Koutroumbas K (2003) *Pattern classification*, vol 5 issue no 6, 2nd edn. Academic Press, New York pp 177–179
6. Wang SL, Wang J, Chen HW et al (2006) SVM-based tumor classification with gene expression data/international conference on advanced data mining and applications, vol 4093. Springer, Berlin, Heidelberg, pp 864–870

Chapter 92

Analysis on Stress Concentration Factor for Elliptical Hole Based on FEM Theory

Hong Lan, Huimin Wang, Liang Cao and Zhiliang Wang

Abstract A rectangle board with a elliptical hole was simulated with the help of FEM software, then the stress concentration factor on the edge of hole for different direction of uniformly distributed load were discussed and compared with the theoretical solution of elastic mechanics. The analysis results showed that when the load direction was along with the major axis of ellipse, the stress concentration factor increased linearly with the increase of the ellipse minor axis and major axis ratio, and the error between FEM calculation results and theoretical solution was much small. When the load direction was along with the minor axis of ellipse, there was a rapid decline for the stress concentration factor with the increase of the ellipse minor axis and major axis ratio. The model boundary between elliptical hole and crack in FEM calculation was proposed in this paper, and the principle of the openings of components was pointed out, guidance for engineering practice was provided.

Keywords Elliptical hole · FEM · Stress concentration

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92.1 Preface

Due to the need for the use in engineering fields, the openings on the board and other components is a common engineering measures. Because of the openings, the stress would increase significantly within the local range of component, that is the stress concentration phenomenon [1, 2]. The extent of stress increase is indicated by stress concentration factor in engineering. The analysis on stress concentration problem could be carried out by experimental methods such as electrical measuring method, photoelastic method, speckle interferometry method and moiré method, by the solution of complex variable function and by the numerical solution based on FEM method and boundary element method. Within so many methods, FEM method has the characteristics of a variety of conditions could be simulated, high computational efficiency and low cost, therefore the application of FEM method for the research of component openings is widespread increasingly [3, 4].

Usually the ratio α between the maximum stress in stress concentration σ_{\max} and the benchmark stress σ_n is defined as the theoretical stress concentration factor, stress concentration factor for short, that is

$$\alpha = \frac{\sigma_{\max}}{\sigma_n} \quad (92.1)$$

where the maximum stress σ_{\max} could be calculated by elastic mechanics theory, FEM method or could be measured by tests. While the benchmark stress σ_n is the arbitrary baseline for stress ratio, the way for determining its value is not the only, could be divided into three ways roughly as following: Suppose the reason for component's stress concentration (such as holes, notches, grooves, etc.) does not exist, considers the stress of not-weakened cross section as the benchmark stress. Considers are the average stress of minimum section in stress concentration as the benchmark stress [5]. On the section far from the stress concentration, considers the stress of corresponding point as the benchmark stress. The first method is adopted in this paper, that is considering the stress of not-weakened cross section as the benchmark stress, with the help of FEM method, and then the stress concentration factor of elliptical opening in component is analyzed. Aimed at providing a reference for an accurate numerical method to solve the stress concentration problem of elliptical opening in board, and providing a guidance for the openings in components in actual engineering.

92.2 Elastic Mechanics Theory

Considering a thin board with a elliptical hole far from the boundary, bearing tension of single direction. The board's width is $2c$, length is $2l$, the elliptical hole locates in center of the board, which major axis is $2a$ and minor axis is $2b$, and $a \ll c$ (could be supposed as $a < 5c$).

Fig. 92.1 Tension along the direction of major axis

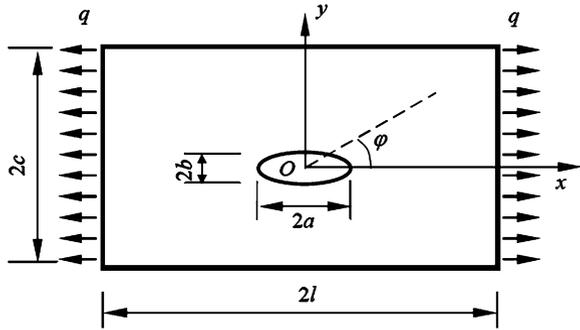
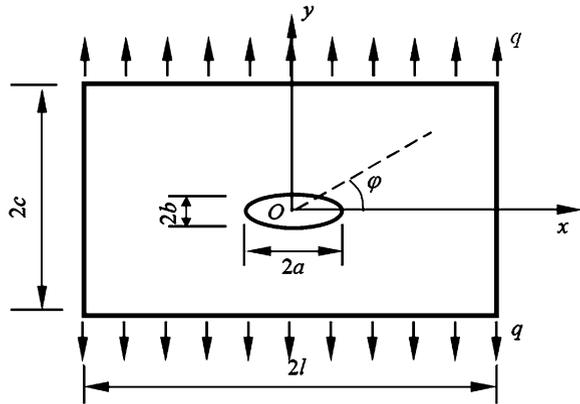


Fig. 92.2 Tension along the direction of minor axis



Tension along the direction of major axis, as showed in Fig. 92.1
On the edge of the hole

$$\sigma_{\varphi} = \frac{1 - m^2 + 2m - 2 \cos 2\varphi}{1 + m^2 - 2m \cos 2\varphi} q \tag{92.2}$$

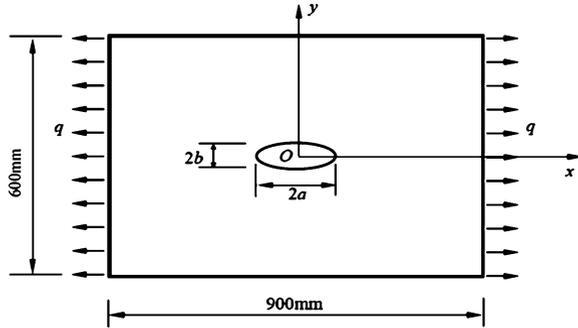
Where $m = \frac{a-b}{a+b}$

The maximum normal stress is $\sigma_{\text{Max}} = (\sigma_{\varphi})_{\varphi=\pm\pi/2} = \frac{3-m}{1+m} q = q(1 + \frac{2b}{a})$, and the corresponding stress concentration factor is $1 + 2b/a$, the factor is constantly <3 . While for the circular hole ($a = b$), the maximum normal stress is $\sigma_{\varphi} = 3q$, the corresponding stress concentration factor is 3. It can clearly be seen that for elliptical hole, when tension is along the direction of major axis, the maximum stress concentration factor is constantly less than the factor of circular hole in the same working condition,

Tension is along the direction of minor axis, as showed in Fig. 92.2.
On the edge of the hole

$$\sigma_{\varphi} = \frac{1 - m^2 - 2m + 2 \cos 2\varphi}{1 + m^2 - 2m \cos 2\varphi} q \tag{92.3}$$

Fig. 92.3 Geometric diagram of the model



Where $m = \frac{a-b}{a+b}$

The maximum normal stress is $\sigma_{\text{Max}} = (\sigma_{\varphi})_{\varphi=\pm\pi/2} = \frac{3+m}{1-m} q = q(1 + \frac{2b}{a})$, and the corresponding stress concentration factor is $1 + 2ab/b$, the factor is constantly >3 . So the stress concentration factor of elliptical hole is constantly greater than the factor of circular hole.

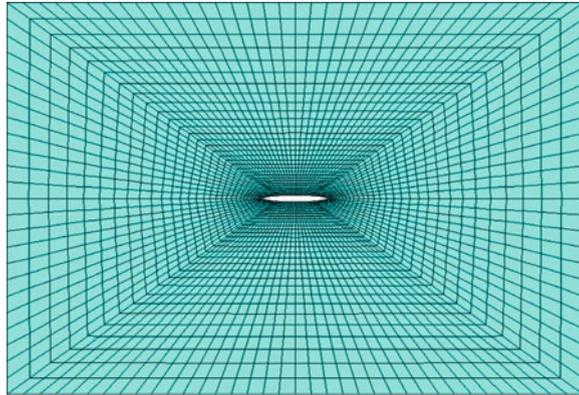
92.3 FEM Calculation

92.3.1 Calculation Model

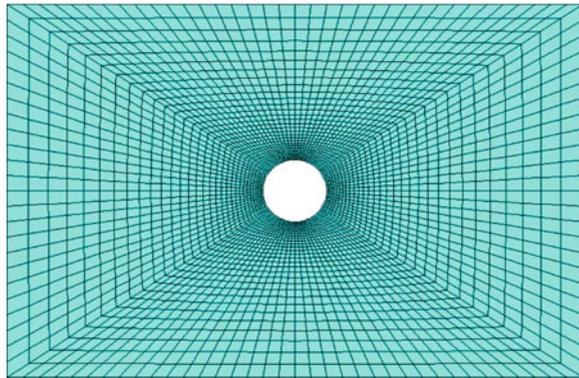
The size for calculation model is 900×600 mm, and the elliptical hole locates in center of the model. The model's material is Q235 steel, which elastic modulus is $E = 200$ GPa, and the Poisson's ratio is $\mu = 0.3$. Uniformly distributed load is applied on both sides of the model. Using Cartesian coordinate system, which origin is in center of the model, and x -axis is along the horizontal direction, right is positive, and while y -axis is along the vertical direction, up is positive. The size and coordinate system of the model is showed in Fig. 92.3.

92.3.2 FEM Model

The model is meshed by Plan82 element of plane 8 nodes. According to the different ratio of elliptical minor axis (b) and major axis (a), 10 calculation models are established in this paper, as showed in Chart 1. The hole in model X is actually a circle. The mesh mode of these models is basically the same, the node number for each model is 11040, and the element number is 3600. The FEM model of model I and model X is showed in Fig. 92.4 Table 92.1.

Fig. 92.4 FEM models

Model I



Model X

92.3.3 Calculation Condition and Constraints

According to the different direction of load, the calculation condition includes two cases that is condition 1, tension along the direction of elliptical major axis and condition 2, tension along the minor axis.

According to the symmetry, the constraint of x -direction is applied in center of the model ($y = 0$), and the constraint of y -direction is applied in $x = 0$.

92.3.4 Calculation Results

Due to space limitations, the hoop stress of model I and model X in the condition 1 is given as shown in Fig. 92.5. While the hoop stress of model I and model X in the condition 2 are given as shown in Fig. 92.6. It can be seen from Fig. 92.6 that, for condition 1 the uniformly distributed load is along the model x -direction, the

Table 92.1 Model number

model	I	II	III	IV	V	VI	VII	VIII	IX	X
b/a	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0

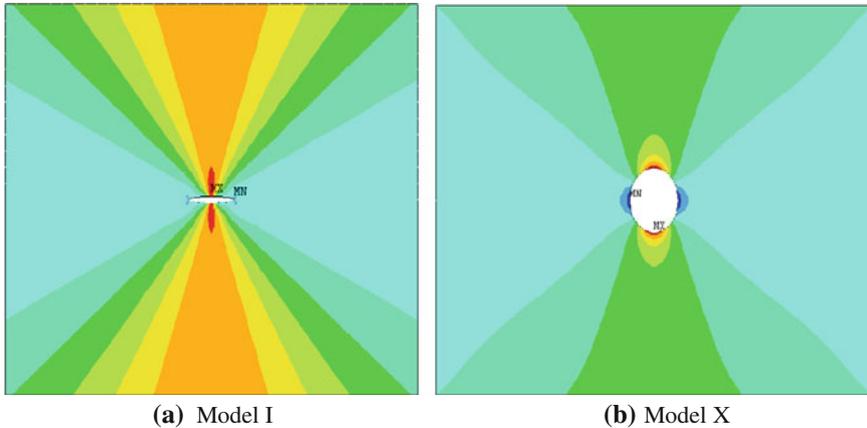


Fig. 92.5 Hoop normal stress in condition 1

maximum hoop stress near the hole occurs in the location of $\varphi = \pm 90^\circ$, and the minimum hoop stress near the hole occurs in the location of $\varphi = 0^\circ$ or 180° . It can be seen from Fig. 92.6 that, for condition 2 the uniformly distributed load is along the model y -direction, the maximum hoop stress near the hole occurs in the location of $\varphi = 0^\circ$ or 180° , and the minimum hoop stress near the hole occurs in the location of $\varphi = 90^\circ$. The distribution of hoop stress near the hole is similar with the theoretical calculation results by elastic mechanics. Compares the hoop stress of model X in Figs. 92.5 and 92.6, it can clearly be seen that the distribution of hoop stress changes with the change of load direction. In addition, it can be seen from Figs. 92.5 and 92.6 that hoop stress cloud diagram has large gradient near the hole, while in the location far from the hole, the distribution of hoop stress is much uniform, which indicates the influence of opening to the stress distribution in board.

Considering the stress of not-weakened cross section as the benchmark stress, the hoop stress of model is calculated with the help of FEM software. The calculation results of stress concentration factor for 10 models in condition 1 are given in Fig. 92.7, and the calculation results in condition 2 are given in Fig. 92.8. It can be seen from Fig. 92.7 that for condition 1, when the ratio of elliptical minor axis and major axis (b/a) increases, the maximum stress concentration factor increases linearly. When $b/a = 0.1$, the maximum stress concentration factor calculated by FEM method is

1.203, while the theoretical solution is 1.2, the error is 0.25 %. With the incensement of b/a , the error between FEM method and the theoretical solution increases too. When $b/a = 1$, the maximum stress concentration factor calculated by FEM method are 3.13, while the theoretical solution is 3, the error is 4.3 %. For

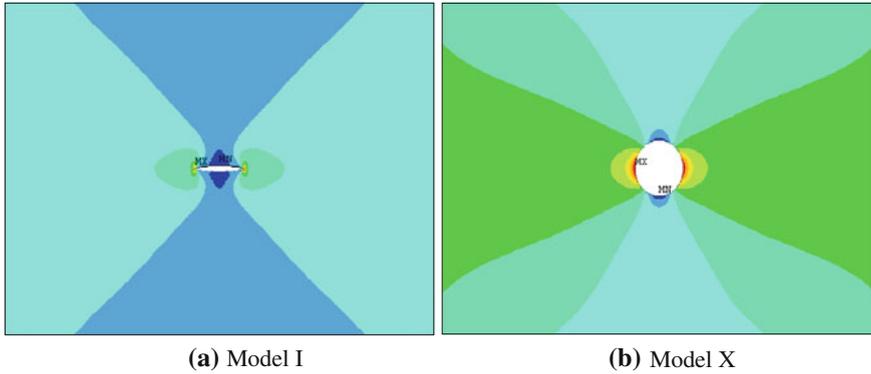


Fig. 92.6 Hoop normal stress in condition 2

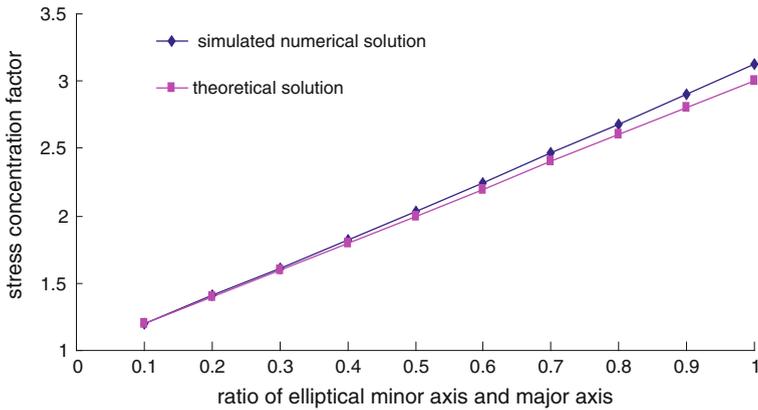


Fig. 92.7 Stress concentration factor of model in condition 1

condition 1, the error of FEM method is much small. It can be seen from Fig. 92.8 that for condition 2, when the ratio of elliptical minor axis and major axis (b/a) increases, the maximum stress concentration factor decreases rapidly. When $b/a = 0.1$, the maximum stress concentration factor calculated by FEM method are 11.84, while the theoretical solution is 21, the error is 43.6 %, which is much large. With the incensement of b/a , the error between FEM method and the theoretical solution decreases rapidly. When $b/a = 0.3$, the maximum stress concentration factor calculated by FEM method are 7.27, while the theoretical solution is 7.67, the error is 5.22 %. And when $b/a = 1$, the maximum stress concentration factor calculated by FEM method is 3.17, while the theoretical solution is 3, the error is 5.67 %. For condition 2, when $b/a = 0.3$, the error of FEM method is much small. When $b/a = 1$, the maximum stress concentration factor of the circular hole calculated by FEM method in condition 1 is 3.13, while in condition 2 is 3.17, which caused by the rectangle board in calculation model.

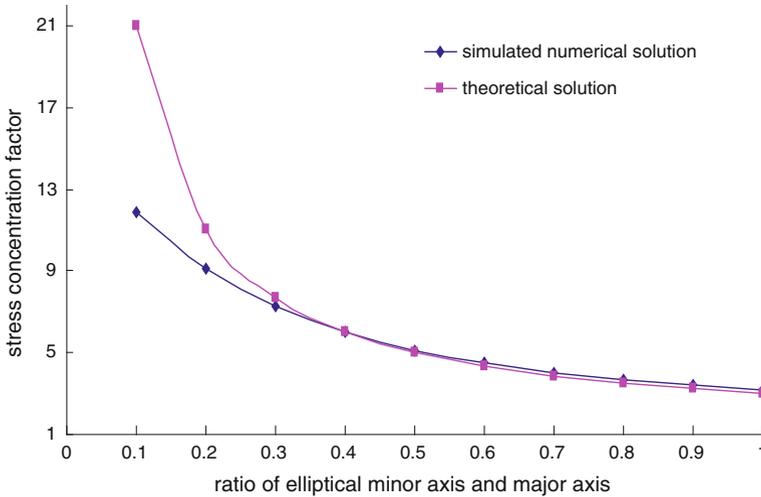


Fig. 92.8 Stress concentration factor of model in condition 2

It can be seen from Fig. 92.8 that for condition 1, the uniformly distributed load is along the elliptical major axis, with the incensement of the ratio of elliptical minor axis and major axis (b/a), the maximum stress concentration factor on the hole's edge increases linearly, and the maximum value is about 3. It can be seen from Fig. 92.8 that for condition 2, the uniformly distributed load is along the elliptical minor axis, with the incensement of the ratio of elliptical minor axis and major axis (b/a), the maximum stress concentration factor on the hole's edge decreases rapidly, and the minimum value is about 3. This indicates that the uniformly distributed load along the elliptical major axis helps to reduce the maximum stress concentration factor. And when the uniformly distributed load is along the elliptical minor axis, and then should maximize the ratio of the elliptical minor axis and major axis, to reduce the maximum stress concentration factor on the whole's edge.

92.4 Conclusion

A rectangle board with a elliptical hole was simulated with the help of FEM software, and the influence of the change of b/a and load direction to the stress concentration factor of calculation model is discussed, and compared with the theoretical solution by elastic mechanics, then conclusions are obtained as follows:

When the load is along the direction of elliptical major axis, with the incensement of the ratio of elliptical minor axis and major axis (b/a), the stress concentration factor increases linearly, and the error between FEM method and the theoretical solution increases too. When $b/a = 1$, the maximum stress

concentration factor calculated by FEM method is the max, while the error is much small in total.

When the load is along the direction of elliptical minor axis, with the incensement of the ratio of elliptical minor axis and major axis (b/a), the stress concentration factor decreases rapidly, and the error between FEM method and the theoretical solution decreases too. When $b/a = 0.3$, the error by FEM method much small.

For the calculation model, when the load is along the direction of elliptical major axis, the mesh density of FEM model meet the requirement of the stress concentration factor calculation, and when the load is along the direction of elliptical minor axis, the ratio of elliptical minor axis and major axis is <0.3 , the mesh density of FEM model has bad influence to the stress concentration factor calculation. When the ratio of elliptical minor axis and major axis is larger than 0.3, the mesh density of FEM model has good influence to the stress concentration factor calculation. Which indicates that $b/a = 0.3$ could be considered as the boundary of elliptical hole and crack in FEM calculation, when $b/a = 0.3$, the mesh of model should be re-selected or further dense the model mesh.

The uniformly distributed load along the elliptical major axis in engineering helps to reduce the maximum stress concentration factor. And when the uniformly distributed load is along the elliptical minor axis, then should maximize the ratio of the elliptical minor axis and major axis, to reduce the maximum stress concentration factor.

References

1. Guo L, Wei T (1986) Masataka Tanaka stress concentration, vol 19. Mechanical Industry Press, Beijing, pp 86–89
2. Guozheng Z (1983) Савишиг Н stress concentration. Man Haerbin Heilongjiang Press Sci Technol 13:81–83
3. Zilin L, Guirong L, Fangfang W (2002) FEM analysis on opening in board (Natural science version). Jiangsu Univ J 23(5):28–30
4. Motok MD (1997) Stress concentration on the contour of a plate opening of anarbitrary corner radius of curvature. Marine Struct 10:1–12
5. Toubal L, Karama M, Lorrain B (2005) Stress concentration in a circular hole in composite plane. Compos Struct 68:31–36

Chapter 93

Exact Two-Soliton Solutions of DNLS Equation by IST

Yaxian Liu and Jingxia Xu

Abstract In the thesis, we introduced a parameter λ^{-1} that the Cauchy integral was zero along the infinity big arc path integral according to the IST. The N-Soliton solution corresponded to solution when $r(\lambda) = 0$. Then the exact N-soliton solutions of DNLS equation under the vanishing bounding condition are obtained by IST, and the exact two-soliton solutions are given as an example. In the end of paper, the 3D graphics of two soliton solution is given.

Keywords Exact solutions · Soliton · DNLS equation

93.1 Introduction

In the field of communication, from the optical soliton concept putted forward, to the optical soliton communication eventually developed into the fifth generation of optical fiber communication, theoretical research plays a big role. As everyone knows, nonlinear Schrödinger equation (NLS) and deformation Schrödinger equation (MNLS) equation solving and strict with correction terms in the equation of micro wound treatment, is the mathematical basis of the theory of solitons in optical fibers.

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Derivative nonlinear Schrodinger equation (DNLS) is for the special case of the MNLS equation cubic is zero. DNLS is a typical 1 + 1 dimensional nonlinear integrabel equations [1].

Initially Rogister and others in the study of plasma proposed the DNLS equation can be used to describe Afen wave. In the subsequent 30 years, no matter in theory and practical application have caused a lot of concern [2, 3]. Thus solving the soliton solutions of DNLS equation has become one of the most fundamental problems need to be solved. Its multiple soliton solutions of the principle have been through a variety of methods to achieve [4]. The inverse scattering method for solving nonlinear equations is applied frequently, most system method.

Kaup and Newell in 1978 for the first time used the inverse scattering method to get the zero boundary conditions of the single soliton solution, and pointed out the single soliton solution of algebraic forms [5]. Kawata in 1979 got DNLS equation in zero boundary conditions and the non zero boundary conditions of the soliton solution [6]. But they have not given a DNLS equation in zero boundary conditions on the exact two soliton solutions. This article discusses the inverse scattering transform equation and DNLS equation with zero boundary conditions in the solution of DNLS equation, exact two soliton solutions.

93.2 DNLS Equation and ITS Jost Solution

Derivative nonlinear Schrodinger equation (DNLS)

$$i u_t + u_{xx} + i (|u|^2 u)_x = 0 \tag{93.1}$$

According to the inverse scattering method solution, a pair of linear equation, lax equation:

$$\partial_x \psi = L \psi \quad \partial_t \psi = M \psi \tag{93.2}$$

In which

$$\begin{aligned} L &= \lambda(-i\lambda\sigma_3 + U) \\ M &= -i2\lambda^4\sigma_3 + 2\lambda^3U - i\lambda^2U^2\sigma_3 - \lambda(-U^3 + iU_x\sigma_3) \end{aligned} \tag{93.3}$$

Where L, M is a linear operator, called Lax, its compatibility conditions are u satisfy DNLS equation.

$$U(x, t) = \begin{pmatrix} 0 & u(x, t) \\ -u(x, t) & 0 \end{pmatrix} \text{ is } 2 \times 2 \text{ matrix .}$$

Defining (1)'s Jost solution and its asymptotic behavior when $|x| \rightarrow \infty$.

$$\Psi(x, \lambda) \equiv (\tilde{\psi}(x, \lambda) \quad \psi(x, \lambda)) \overline{x \rightarrow \infty} E(x, \lambda) \tag{93.4}$$

$$\Phi(x, \lambda) \equiv (\tilde{\phi}(x, \lambda) \quad \phi(x, \lambda)) \overline{x \rightarrow -\infty} E(x, \lambda) \tag{93.5}$$

The matrix $E(x, \lambda) = \begin{pmatrix} e^{-i\lambda^2 x} & 0 \\ 0 & e^{i\lambda^2 x} \end{pmatrix}$ is (2)'s solution while $|x| \rightarrow \infty$ and $u \rightarrow 0$. Introducing the unitary matrix $T(\lambda) = \begin{pmatrix} a(\lambda) & \tilde{b}(\lambda) \\ b(\lambda) & \tilde{a}(\lambda) \end{pmatrix}$, then the basic solutions $\Psi(x, \lambda)$ and $\Phi(x, \lambda)$ can be expressed as the following linear relationship

$$\Phi(x, \lambda) = \Psi(x, \lambda) T(\lambda) \tag{93.6}$$

$1/a(\lambda)$ and $r(\lambda) = b(\lambda)/a(\lambda)$ are transmission and reflection coefficients.

93.2.1 IST Equation

Through the comparison with NLS equation, we can obtain $\Phi(x, \lambda)$, $\Psi(x, \lambda)$ and $a(\lambda)$ are analytic in the upper plane of the complex plane, while $\Phi(x, \lambda)$ and $\Psi(x, \lambda)$ are analytic in the lower plane of complex plane. At the same time, based on the asymptotic behavior of the solutions of the Jost equation, Jost solution is not close to zero when $|\lambda| \rightarrow \infty$. At the same time, we can obtain

$$\bar{u} = -i 2 \lim_{|\lambda| \rightarrow \infty} \frac{\lambda \tilde{\psi}_2(x, \lambda)}{\tilde{\psi}_1(x, \lambda)} \tag{93.7}$$

So we introduce a parameter λ^{-1} that the Cauchy integral along the infinity big arc path integral is zero when we structure the IST. Soliton solution corresponds to no reflection, i.e. $r(\lambda) = 0$. Defined:

$$\Theta(x, \lambda) = \begin{cases} \frac{1}{a(\lambda)} \phi(x, \lambda) & \lambda \text{ is in the first and third quadrant} \\ \tilde{\psi}(x, \lambda) & \lambda \text{ is in the second and fourth quadrant} \end{cases} \tag{93.8}$$

$a(\lambda)^{-1} \phi(x, \lambda)$ is analysis in the complex plane of the first and third quadrant except of λ_n , which has a simple pole when $n = 1, 2, \dots$

According to Cauchy formula:

$$\lambda^{-1} \{ \Theta(x, \lambda) - E_{.1}(x, \lambda) \} e^{i\lambda^2 x} = \frac{1}{2\pi} \oint d\lambda' \frac{1}{\lambda' - \lambda} \lambda'^{-1} \{ \Theta(x, \lambda') - E_{.1}(x, \lambda') \} e^{i\lambda'^2 x} \tag{93.9}$$

$$\tilde{\psi}_1(x, \lambda) = e^{-i\lambda^2 x} + \lambda \sum_{n=1}^N \frac{2\lambda}{\lambda^2 - \lambda_n^2} \frac{1}{\lambda_n} c_n \psi_1(x, \lambda_n) e^{i\lambda_n^2 x} e^{-i\lambda^2 x} \tag{93.10}$$

$$\tilde{\psi}_2(x, \lambda) = +\lambda \sum_{n=1}^N \frac{2\lambda_n}{\lambda^2 - \lambda_n^2} \frac{1}{\lambda_n} c_n \psi_2(x, \lambda_n) e^{i\lambda_n^2 x} e^{-i\lambda^2 x} \tag{93.11}$$

(93.11) and (93.12) are substituted into (93.8), get the N soliton solutions of DNLS equation:

$$\bar{u} = \frac{V}{W} \tag{93.12}$$

While $W = 1 - \sum_{n=1}^N \frac{2}{\lambda_n} c_n \psi_1(x, \lambda_n) e^{i\lambda_n^2 x}$,

$$V = - \sum_{n=1}^N 2 c_n \psi_2(x, \lambda_n) e^{i\lambda_n^2 x} \tag{93.13}$$

93.2.2 N Soliton Solutions of DNLS Equation

In order to solve N soliton solutions of DNLS equation, we introduce the matrix symbol,

$$g_n = \sqrt{2c_n} f_0(\lambda_n), \Psi_{jn} = \sqrt{2c_n} \psi_j(\lambda_n) \tag{93.14}$$

$$B_{nm} = \bar{g}_n \frac{p_m}{\bar{p}_n^2 - p_m^2} g_m, B'_{nm} = \bar{g}_n \frac{\bar{p}_n^2}{p_m(\bar{p}_n^2 - p_m^2)} g_m \tag{93.15}$$

Here g_n and Ψ_{jn} are $1 \times N$ matrixes, B_{nm} and B'_{nm} are $N \times M$ matrixes, then (13) is expressed as :

$$\bar{u}_N = -2 \frac{(\det(I + R') - \det(I + R)) \det(I + R'')}{\det(I + R) \det(I + R''')} \tag{93.16}$$

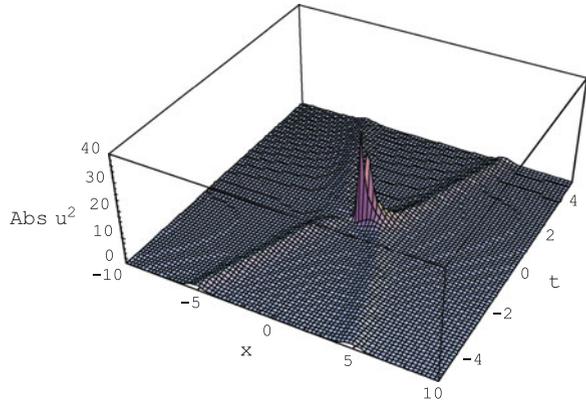
While:

$$R = \bar{B}\bar{B}'^T, R' = R + g^T g, R'' = B\bar{B}'^T, R''' = R'' + P^{-1} B g^T \bar{g} \tag{93.17}$$

At the same time, we can also get the relation type:

$$\det(I + R) = \det(I + R'''), \det(I + R) = \overline{\det(I + R'')} \tag{93.18}$$

Fig. 93.1 DNLS Equation 2 soliton motion in 3D map



As the DNLS equation of soliton solution, take the case of $N = 2$, assumed to be a simple zero. After a series of calculation, it is not difficult to get the accurate solution of two solitons:

$$\bar{u}_2 = -2 \frac{q_2 \bar{k}_2}{k_2 k_2} \tag{93.19}$$

While

$$\begin{aligned} k_2 &= 1 + |f_1|^4 \frac{\lambda_1}{\bar{\lambda}_1} \left| \frac{\lambda_1^2 - \bar{\lambda}_2^2}{\lambda_1^2 - \lambda_2^2} \right|^2 + |f_2|^4 \frac{\lambda_2}{\bar{\lambda}_2} \left| \frac{\lambda_2^2 - \bar{\lambda}_1^2}{\lambda_2^2 - \lambda_1^2} \right|^2 \\ &\quad + (f_2^2 \bar{f}_1^2 \frac{\lambda_1^2}{\bar{\lambda}_1} + f_1^2 \bar{f}_2^2 \frac{\lambda_2^2}{\bar{\lambda}_2}) \frac{(\lambda_1^2 - \bar{\lambda}_1^2)(\bar{\lambda}_2^2 - \lambda_2^2)}{(\lambda_1^2 - \lambda_2^2)(\bar{\lambda}_2^2 - \bar{\lambda}_1^2)} + |f_1|^4 |f_2|^4 \frac{\lambda_1 \lambda_2}{\bar{\lambda}_1 \bar{\lambda}_2} \\ q_2 &= -i \frac{\lambda_2^2 - \bar{\lambda}_2^2}{\lambda_2} \frac{\bar{\lambda}_1^2 \bar{\lambda}_2^2}{\lambda_1^2 \lambda_2^2} f_2^2 \left\{ \frac{\lambda_2^2 - \bar{\lambda}_1^2}{\lambda_2^2 - \lambda_1^2} + \frac{\bar{\lambda}_2^2 - \lambda_1^2}{\bar{\lambda}_2^2 - \bar{\lambda}_1^2} |f_1|^4 \frac{\bar{\lambda}_1}{\lambda_1} \right\} \\ &\quad + i \frac{\lambda_1^2 - \bar{\lambda}_1^2}{\lambda_1} \frac{\bar{\lambda}_2^2 \bar{\lambda}_1^2}{\lambda_1^2 \lambda_2^2} f_1^2 \left\{ \frac{\lambda_1^2 - \bar{\lambda}_2^2}{\lambda_1^2 - \lambda_2^2} + \frac{\bar{\lambda}_1^2 - \lambda_2^2}{\bar{\lambda}_1^2 - \bar{\lambda}_2^2} |f_2|^4 \frac{\bar{\lambda}_2}{\lambda_2} \right\} \end{aligned} \tag{93.20}$$

Fig. 93.2 DNLS Equation 2 soliton motion in 2D map as $t = 0$

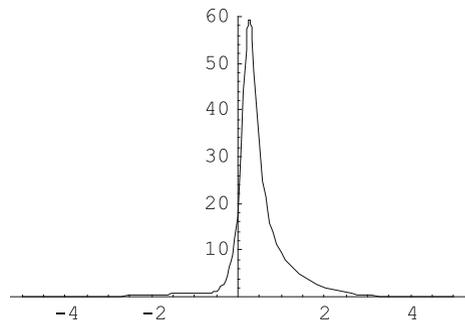
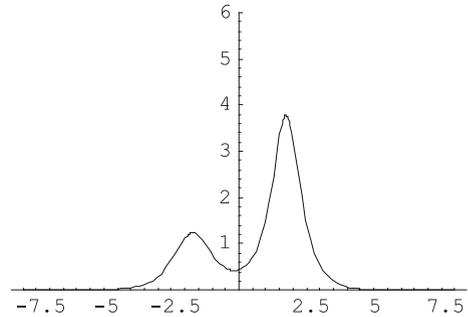


Fig. 93.3 DNLS Equation 2 soliton motion in 2D map as $t = 0.5$



Next, we use the image to display motion of two soliton.

Taking $|\lambda_1| = 1|\lambda_2| = 1.1$, $|f_1^2| = 1|f_2^2| = e^{0.1} \arg(\lambda_1) = 0.225\pi$ we obtain (Figs. 93.1, 93.2 and 93.3).

93.3 Summary

The two solitons are separated from each other; the shape and speed are the same. At the same time, through the theoretical analysis we know that happened soliton center additional displacement and additional phase shift.

Two solitons motion waveform overlap. Description of two solitons meeting in motion collision, collision waveform does not conform to the principle of linear superposition, the above condition is not established, because at the moment of collision, the waveform changes, do not keep the original wave form.

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References

1. Rogister A (1971) The height control modeling based on fan and air dynamics of seal air duct balloon. *Phys Fluids* 63:2733–2734
2. Steudel H (2003) Mathematical and general. *J Phys A* 36:1931–1946
3. Huang NN, Chen ZY (1990) The research on methods for evaluating benefits of oil and gas exploration investment. *J Phys A Math Gen* 23:439–543
4. Cai H, Liu FM, Huang NN (2005) Dark multi-soliton solutions of the nonlinear Schrodinger equation with non-vanishing boundary internal. *J Theor Phy* 44:255–265
5. Kaup DJ, Newell AC (1978) An exact solution for a derivative nonlinear Schrodinger equation. *J Math Phys* 19:798–801
6. Kawata T, Kobayashi N, Inoue H (1979) Soliton solutions of the derivative nonlinear Schrodinger equation. *J Phys Soc Jpn* 46:1008–1015

Chapter 94

Research on Psychological Chinese-Style Hatred Based on Mathematical Statistic Law

Mingxia Zhu and Chenling Li

Abstract The mental health problems are a common problem for College Students. At present, China is transforming society, the widening gap between the rich and the poor, many college students college students in such an unhealthy mental illness. The main subject of the questionnaire and the data statistics, and combined with contemporary mental health of students through experiments and surveys, analysis of reasons for hatred of psychology obtained for college students' mental health factor. Thereby eliminating this instability factor.

Keywords Psychological hatred of the rich · Mental health · College students · Impact factor

94.1 Introduction

The hatred of the rich psychological is to enter the transition period after the reform and social development, from the average assigned to the distribution according to work now, according to the allocation of factors of production change. Causing a widening wealth gap, leading some people get rich, assets reach tens of thousands, while another part of the people laid off from the cause of difficulties in life. This income gap disparity led to a huge psychological gap, However, this mentality by words and deeds of the college students, mental refracted [1–3].

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Hostile to the psychology of the main reasons attributed to mental health. Mental health, a broad sense, refers to an efficient and satisfied and sustained mental state. In a narrow sense, refers to the process of people, that is, understanding, and will, with the development of the social environment and development [4, 5]. Ying the Geli Shi said: “Mental health refers to a sustained psychological, a good reflection of those involved in any particular environment, with the can body and mind fully developed; but a rich. Not only is free from it. “ Mai Ling Siegel: “means for mutual and happy ability to adapt not only efficiency, not just satisfaction, but to get between the two mental health of people should be able to maintain calm mood, keen intelligence, suitable for the behavior of the social environment and a pleasant temperament. “contemporary college students are high quality and cultural enrichment groups, the hope of our motherland, to shoulder the mission of the motherland, their physical and psychological qualities related to the future of the motherland, to the country’s rise and fall. However, questionnaires, survey statistics, the quality of our students’ mental health level is still not optimistic. According to statistics, colleges and universities in Hunan in 1997 mental health survey (with SCL-90 scale) of which 19.52 % of the students there are psychological barriers, and the hatred of the rich psychological in these psychological problems accounted for 8.47 %. To 2007 the school re-Statistics show that 27.23 % of these students there is a different kind or psychological problems. Hatred of the rich psychological account for 13.79 %. Shown in Table 94.1:

The histogram shown in Fig. 94.1.

These statistical results have shown that, the situation of China’s Mental Health has reached a critical state. Therefore, the current through a variety of technical means and level of education to improve the psychological quality of our college students. Improve their mental level, and make them healthy development to contribute to society [6].

94.2 Research Process

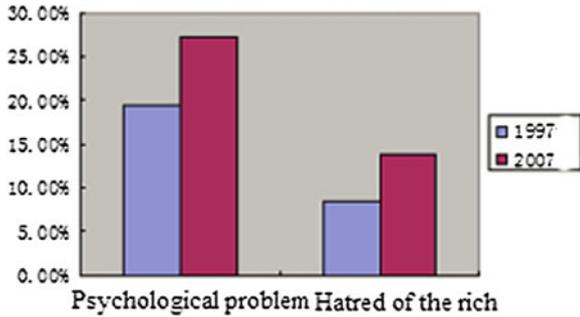
94.2.1 Research Object

Hatred of the rich psychology students and mental normal schools to the schools. Students with hatred of the rich psychological problems psychologically normal student as a reference object.

Table 94.1 The weight of psychological problems

years	Psychological problems (%)	Hatred of the rich psychological (%)
1997	19.52	8.47
2007	27.23	13.79

Fig. 94.1 The right to re-bar chart of psychological problems share



94.2.2 Research Methods

Multimedia technology is the computer technology, voice and image compression processing technology, information digitization technology, network digital transmission technology and computer system software, and other comprehensive development of the product, including audio signal processing, static images and TV image processing, the information processing and the remote communication technology [7]. The multimedia technology can fully. Motivate people’s eyes, ears, nose, tongue, hand and so on many kinds of sense organs, using these sensory organs and computer interaction, exchange information, make the person and computer communication more convenient, more friendly. In other words, the multimedia technology by stimulating the various perceptions organs, to deepen our impression of learners, stimulate learners’ interest. Interest and participation, and with computer fully interactive. But it is worth noting that the multimedia in the teaching content of rich also has certain problem, and the most outstanding problem displays in multimedia courseware. A number of students think of multimedia courseware content too much, can’t tell primary and secondary. Self-study ability is the poor are more not accustomed to, find using multimedia learning is in the bullpen. As a engaged in education workers of the multimedia teaching psychology, the author holds that the computer multi-media and not bad, but no was properly use. And the students’ cognitive ability and not got the correct understanding and play. This article take the psychology theory as a starting point, explore the multimedia teaching and courseware.

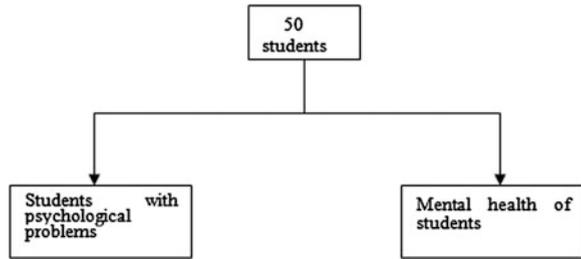
We study and reference objects, respectively, randomly selected 25 people. Regular surveys by the behavior of a semester and 50 people.

The grouping process shown in Fig. 94.2

94.2.3 The Research Process

First of all, 50 subjects were divided into experimental and control groups. Psychological tests before the study.

Fig. 94.2 Grouping process



Second, the experimental group in the psychological intervention for correction, and then during a period of one semester of psychological counseling, the control group to carry out normal activities.

Thirdly, the experimental and control groups after one semester through the line psychological tests, the test data were analyzed, the final conclusion.

The flow chart shown in Fig. 94.3.

94.3 Data Processing and Analysis

We test data obtained using the T method in mathematical statistics. Overall showed a normal distribution, the population standard deviation is unknown, but the sample size <30, then when all possible sample mean and the overall average deviation statistic was distributed.

The test is to infer the differences in the probability of occurrence distribution theory, to compare differences in the average significantly.

When the overall distribution is normal distribution, such as the population standard deviation is unknown and sample size <30, then the sample mean and the overall average deviation statistic was distribution. The test statistic is [8]:

$$t = \frac{\bar{X} - \mu}{\sigma_X / \sqrt{n - 1}} \tag{94.1}$$

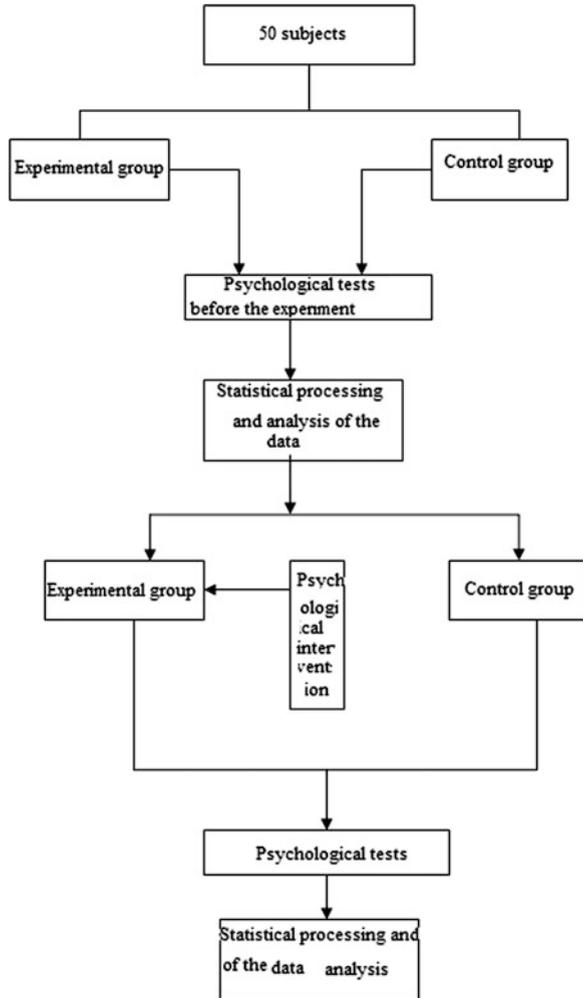
If the samples are large sample (>30) can also be written as [9]:

$$t = \frac{\bar{X} - \mu}{\sigma_X / \sqrt{n}} \tag{94.2}$$

Here, the sample mean and the overall average deviation statistics; the sample mean; overall average; for the sample standard deviation; is the sample size.

All statistical data according to the application of statistical methods to adopt SPSS1.0 statistical software for analysis and calculation. T test and Mean plus the variance of form. Significance level using ANOVA analysis obtained for Q = 0.05 [10]. Experimental results before and after the analysis as shown in Table 94.2.

Fig. 94.3 The flow chart of research



Bb From the data in Table 94.2, after a decline in the experiment, the experimental group a variety of data than before the experiment, one of the most obvious relationships, anxiety, depression, hostility, terror, after psychological intervention. The effect is obvious. Also enhanced the mutual friendship between the students [11].

94.4 Conclusion Analysis

Students are hostile to the psychological impact of physical and mental health of the students, destroy relationships, and well aware of the destruction of the family conflicts that affect social stability. College students with psychological problems

Table 94.2 The experimental group and control group before and after the experiment psychological indicators of change

Factor project	Before the experiment				After the test			
	Experimental group		Control group		Experimental group		Control group	
	\bar{X}	SD	\bar{X}	SD	\bar{X}	SD	\bar{X}	SD
Somatization	1.44	0.32	1.40	0.38	1.43	0.58	1.43	0.44
Force	2.06	0.56	1.96	0.52	1.82	0.58	1.95	0.53
Interpersonal	1.96	0.54	1.99	0.54	1.84	1.60	1.97	1.55
Depression	1.82	0.54	1.74	0.49	1.70	0.64	1.75	0.50
Anxiety	1.76	0.53	1.71	0.46	1.54	0.46	1.69	0.54
Hostility	1.62	0.54	1.60	0.48	1.56	0.46	1.67	0.52
Terror	1.69	0.53	1.72	0.54	1.48	0.40	1.75	0.56
Paranoid	1.69	0.53	1.72	0.54	1.48	0.40	1.75	1.56
Mental illness	1.57	0.49	1.54	0.48	1.51	0.43	1.58	0.59

in a timely psychological intervention and orthodontic treatment to correct the deviation of their color cognition. In addition to strengthen the ideological and political education for the students to establish the correct values of life, so as to resolve the factors of instability in the campus.

References

1. Xu B, Ni J (2011) Experimental study of mental health. Wuhan Institute of Physical Education 2(02):59–61
2. Shi Z (2007) psychological and health. Tsinghua University press, Beijing 7(9):432–433
3. Jian Ding Qing, Fang Fan (2009) The exercise prescription on the effect of the correction of students' psychological obstacles. Beijing Sports University 9(04):351–353
4. Zhang Y, Hu J (2009) The physical exercise of Students mental health education in an effective way. Hubei North Sports 11(6):245–247
5. Ma Q (2008) Mental and physical education students in Physical Education Teaching 10(04):351–352
6. Shengzu L (1999) The students' psychological health education guide. Wuhan University of Technology Press, Wuhan 12(9):1211–1213
7. Cao Y (2006) The sports psychology. People Education Press, Beijing 1(09):225–227
8. Xue Y (2009) The hatred of the rich the moment the battle of the rich and the poor. Jiangsu Literature and Art Publishing House, Nanjing 12(9):109–114
9. Tuyu L (2007) Part of the vulnerable groups of the "hatred of the rich psychological" reasons and solutions. Acad J 1(9):43–45
10. Lin Z (2007) Transformation of vulnerable groups in society, hatred of the rich Psychology. Henan Normal University 213(4):18–23
11. Qian Yang (2006) The hatred of the rich psychological and other. Psychol World 6(9):28–32

Chapter 95

Synchronization of Uncertain Chaotic System by Nonlinear Sliding Mode Method

Aijun Zhou, Guang Ren, ChengYong Shao and Yong Liang

Abstract A kind of variable gain nonlinear sliding mode adaptive method is proposed to solve the synchronization problem of chaotic systems with unknown parameters and uncertain functions. The design of nonlinear sliding mode is very skillful. It is not only make sliding surface stable but not make the control easy to be solved. Since with a constant gain, the control system will be not sensitive enough to small signals or it will be unstable to big signals. So the variable gain method is adopted to improve the control accuracy. At last, detailed numerical simulation is done to testify the rightness and effectiveness of the proposed method.

Keywords Nonlinearity · Sliding mode · Chaos · Synchronization · Variable gain · Uncertainty

95.1 Introduction

It is very important to choose a proper gain for a real system. If the gain is not proper, the system will not behave well [1–10]. For example, if the gain is too big, the system will be unstable for the situation of big errors or big input signals. So the stable field will decrease from the state space points of views. But if the gain is

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too small, the steady state error will be too big and the control accuracy is not enough. So to choose a proper gain not only the dynamic performance but also the robustness should be considered simultaneously.

In this paper, a kind of variable gain method is proposed to solve the above problem and it is integrated with a kind of nonlinear sliding mode synchronization method. The nonlinear integral sliding mode method can make the synchronization error to be small and make the system stable. But it is not easy to choose the proper gain for the nonlinear sliding mode method. So a kind of variable gain is introduced and the advantage is that it can adapt to the input signals automatically. Simulation result shows the effectiveness of the proposed method.

95.2 Problem Description

Take an universal chaos system for an example, the driven system can be described as follow

$$\dot{x} = f_x(x) + F_x(x)\theta_x + \Delta(x, t) \tag{95.1}$$

The response system can be written as

$$\dot{y} = f_y(y) + bu \tag{95.2}$$

The control objective for variable gain nonlinear sliding mode synchronization method is to design a synchronization law $u_i = u_i(k_i, S_i, \hat{d}_{ij})$, $k_i = f_{ki}(S_i, z_i)$ and $\hat{d}_{ij} = H(S_i, z_i)$ such that the synchronization can be fulfilled then it has $f_{ki}(S_i, z_i)$, where $f_{ki}(S_i, z_i)$ is a variable nonlinear function and $H(S_i, z_i)$ is the turning law.

95.3 Assumptions

To make the below context more easy to understand, it is necessary to make two assumptions for the chaotic system.

Assumption 1: the response system has the some dimension as the driven system.

Assumption 2: there exists a positive constant d_{ij} such that the nonlinearities of the driven system satisfies

$$\left| f_{yi}(y_1, \dots, y_4) - f_{xi}(x_1, \dots, x_4) - \sum_{j=1}^{p_1} F_{xij}(x_1, \dots, x_4)\theta_{x1j} - \sum_{j=1}^{q_1} \Delta_{xij}(x, t) \right| \leq d_{i1} + d_{i2}|S_i| \tag{95.3}$$

where S_i is sliding mode and it is defined as follows.

Since the driven system is a chaotic system, and chaotic systems are bounded, so it is easy to be satisfied by many common chaotic systems.

95.4 Adaptive Nonlinear Sliding Mode with Variable Gain

Define a new error variable as $z_i = y_i - x_i$, for the above driven response system, the error system can be written as

$$\dot{z}_i = f_{yi}(y_1, \dots, y_4) - f_{xi}(x_1, \dots, x_4) - \sum_{j=1}^{p_1} F_{xij}(x_1, \dots, x_4) \theta_{x1j} - \sum_{j=1}^{q_1} \Delta_{xij}(x, t) + b_i u_i \quad (95.4)$$

Design the nonlinear sliding mode surface as

$$S_i = z_i \left[w_{i1} + w_{i2} \left\{ \iint z_i dt dt \right\}^2 \right] + \left(w_{i3} + w_{i4} \left(\int z_i dt \right)^2 \right) \int z_i dt \quad (95.5)$$

where $w_{ij} > 0$.

Solve the derivative of the above sliding mode surface it holds:

$$\begin{aligned} \dot{S}_i = & \dot{z}_i \left[w_{i1} + w_{i2} \left\{ \iint z_i dt dt \right\}^2 \right] + z_i \left[2w_{i2} \int z_i dt \left\{ \iint z_i dt dt \right\} \right] \\ & + \left(w_{i3} + w_{i4} \left(\int z_i dt \right)^2 \right) z_i + 2w_{i4} z_i \int z_i dt \int z_i dt \end{aligned} \quad (95.6)$$

Design the control as

$$u_i = b_i^{-1} (u_{ic} + u_{id}) \quad (95.7)$$

Where

$$\begin{aligned} u_{ic} = & - \frac{1}{\left[w_{i1} + w_{i2} \left\{ \iint z_i dt dt \right\}^2 \right]} \left\{ z_i \left[2w_{i2} \int z_i dt \left\{ \iint z_i dt dt \right\} \right] \right. \\ & \left. + \left(w_{i3} + w_{i4} \left(\int z_i dt \right)^2 \right) z_i + 2w_{i4} z_i \int z_i dt \int z_i dt \right\} \end{aligned} \quad (95.8)$$

And design u_{id} as:

$$u_{id1} = \frac{-k_{i1} S_i - \hat{d}_{i1} \operatorname{sgn}(S_i) - \hat{d}_{i2} S_i}{\left[w_{i1} + w_{i2} \left\{ \iint z_i dt dt \right\}^2 \right]} \quad (95.9)$$

It holds:

$$\dot{S}_i S_i \leq d_{i1} |S_i| + d_{i2} |S_i|^2 - k_{i1} |S_i|^2 - \hat{d}_{i1} |S_i| - \hat{d}_{i2} S_i^2 \quad (95.10)$$

It can be simplified as:

$$\dot{S}_i S_i \leq \tilde{d}_{i1} |S_i| + \tilde{d}_{i2} |S_i|^2 - k_{i1} |S_i|^2 \quad (95.11)$$

where

$$\tilde{d}_{ij} = d_{ij} - \hat{d}_{ij} \quad (95.12)$$

Then it holds:

$$\dot{\tilde{d}}_{ij} = -\hat{\tilde{d}}_{ij} \quad (95.13)$$

Design the turning law as

$$\dot{\hat{d}}_{i1} = |S_i|, \quad \dot{\hat{d}}_{i2} = |S_i|^2 \quad (95.14)$$

Choose the Lyapunov function as

$$V_i = \frac{1}{2} (S_i^2 + \tilde{d}_{i1}^2 + \tilde{d}_{i2}^2) \quad (95.15)$$

It is easy to prove that

$$\dot{V}_i \leq 0 \quad (95.16)$$

So the system is stable. Based on the above method, a kind of variable gain method is designed to improve the dynamic performance and reduce the system gain. Design

$$k_{i1} = 20 \frac{|z_i| + \varepsilon_{i1}}{|z_i| + \varepsilon_{i2}} \quad (95.17)$$

To make it easy to understand, take a example as $\varepsilon_{i1} = 0.2$, $\varepsilon_{i2} = 0.005$. If $|z_i| \geq 0.2$, it holds

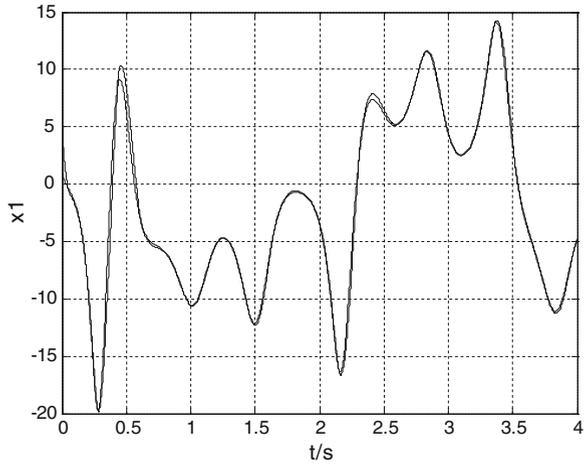
$$k_{i1} = 20 \frac{|z_i| + \varepsilon_{i1}}{|z_i| + \varepsilon_{i2}} \rightarrow 20 \quad (95.18)$$

If $|z_i| \rightarrow 0$, it holds

$$k_{i1} = 20 \frac{|z_i| + \varepsilon_{i1}}{|z_i| + \varepsilon_{i2}} \rightarrow 800 \quad (95.19)$$

It is obvious that the gain of the whole system will be very big when the input signal is small but the gain will decrease very quick if the input signal is very big.

Fig. 95.1 States x_1 and y_1



95.5 Numerical Simulation

Take a three dimension chaotic system as an example, the driven system can be written as

$$\dot{x}_1 = a(x_2 - x_1) + k_{lb}x_3 \cos x_2 \tag{95.20}$$

$$\dot{x}_2 = bx_1 + cx_2 - x_1x_3 + k_{lb}x_3 \cos x_2 \tag{95.21}$$

$$\dot{x}_3 = x_2^2 - hx_3 + k_{lb}(1 + \sin(x_2x_3))x_2 \tag{95.22}$$

where choose $a = 20, b = 14, c = 10.6, h = 2.8, k_{lb} = 0$ and the system has an attractor. a, b, c, h are unknown constants, k_{lb} items are unknown functions. The structure of response system is known, which can be expanded as:

$$\dot{y}_1 = a_y(y_2 - y_1) + u_1 \tag{95.23}$$

$$\dot{y}_2 = b_y y_1 - k_y y_1 y_3 + u_2 \tag{95.24}$$

$$\dot{y}_3 = -c_y y_3 + h_y y_1^2 + u_3 \tag{95.25}$$

Choose parameters as $(a_y, b_y, c_y, k_y, h_y) = (10, 40, 2.5, 1, 4)$, and the initial state of response system can be set as $(y_1, y_2, y_3) = (1, -1, 2)$. The simulation result can be seen in below figures.

Figure 95.1 shows the synchronization of response system state y_1 and driven system state x_1 .

Figure 95.2 shows the synchronization of response system state y_2 and driven system state x_2 .

Figure 95.3 shows the synchronization of response system state y_3 and driven system state x_3 .

Fig. 95.2 States x_2 and y_2

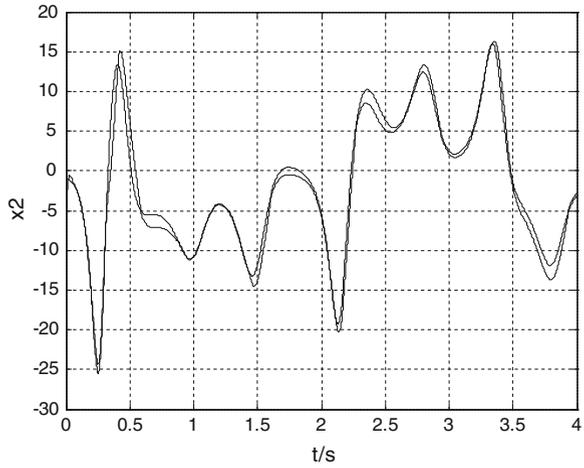
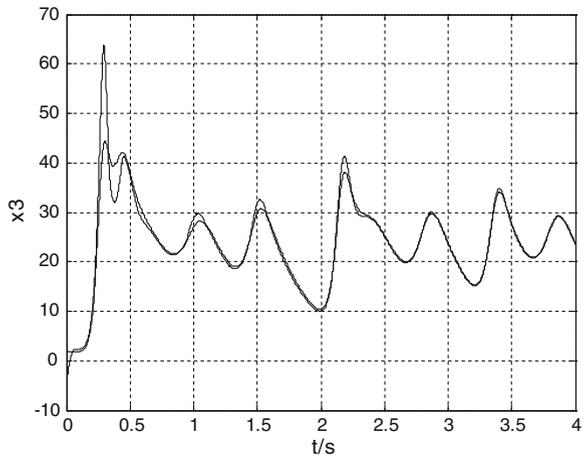


Fig. 95.3 States x_3 and y_3



With the proposed variable gain integral sliding mode synchronization method, it is obvious that the synchronization can be fulfilled but the synchronization error cannot be converged to zero that is mainly because of the disturbance of unknown nonlinear functions. With high gain controller design, the synchronization error can be decreased but it cannot be totally cancelled.

95.6 Conclusions

A kind of nonlinear integral sliding mode synchronization strategy is proposed with variable gain, which cannot only make the system to be sensitive to small signals but also can make the system to be stable with big input signals. Simulation

results shows that the proposed method is effective and synchronization can be fulfilled but the synchronization error cannot be converged to zero because of the existence of unknown nonlinear functions.

References

1. Roy R et al (1994) Experimental synchronization in laser chaos. *Phys Rev Lett* 72(22):3502–3505
2. Sugawara T, Tachikawa M (1994) Observation of synchronization in laser chaos. *Phys Rev Lett* 72(22):3502–3506
3. Jing Gao Ping et al (2003) A simple global synchronization criterion for coupled chaotic systems. *Chaos Solit Fract* 3(15):925–935
4. Yan Jianping, Li Changpin (2005) On synchronization of three chaotic systems. *Chaos Solit Fract* 32(23):1683–1688
5. Sarasola, Torrealdea FJ, Anjou AD (2003) Feedback synchronization of chaotic systems. *Int J Bifurcation Chaos* 13(1):177–191
6. Yassen MT (2005) Chaos synchronization between two different chaotic systems using active control. *Chaos Solit Fract* 23(4):131–140
7. Agiza HN, Yassen MT (2001) Synchronization of Rossler and Chen chaotic dynamical systems using active control. *Phys Lett A* 77(278):191–197
8. Ho Ming-chung, Hung Yao-Chen (2002) Synchronization of two different systems by using generalized active control. *Phys Lett A* 4(301):424–428
9. Jiang GP, Tang KS (2002) A global synchronization criterion for coupled chaotic systems via unidirectional linear error feedback approach. *Int J Bifurcation Chaos* 12(10):2239–2253
10. Bu SL, Wang SQ (2002) An algorithm based on variable feedback to synchronize chaotic and hyperchaotic systems. *Physica D* 164:45–52

Chapter 96

An Ideal Hilbert Algebras in Positive Implicative BCK-Algebras

Qiuna Zhang, Lei Zhang, Dongmei Li and LiNan Shi

Abstract The notion of BCK-algebras was formulated first in 1966 by K. Iséki, Japanese, and Mathematician. This notion is originated from two different ways. One of the motivations is based on set theory; another motivation is from classical and non-classical propositional calculi. There are many classes of BCK-algebras, for example, sub algebras, bounded BCK-algebras, positive implicative BCK-algebra, implicative BCK-algebra, commutative BCK-algebra, BCK-algebras with condition (S), Griss (and semi-Brouwerian) algebras, quasicommutative BCK-algebras, direct product of BCK-algebras, and so on. The notion of positive implicative BCK-algebras was introduced by K. Iséki in 1975. The notion of ideal in BCK-algebras was formulated by K. Iséki in 1975. The ideal theory plays a fundamental role for the general development of BCK-algebras. Before this article I give a notion an ideal of Hilbert Algebras in BCK-algebras, as well as some propositions, so, here I will give a notion of an ideal of Hilbert algebras in positive implicative BCK-algebras, and some propositions.

Keywords Hilbert algebras · Positive implicative BCK-algebra · Ideal

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96.1 Introduction

The notion of BCK-algebras was formulated in 1966 by K. Iséki, Japanese, Mathemation. This notion is originated from two different ways. They gave ideals in BCK-algebras. The ideal theory plays an important role for the general development of BCK-algebras, they discussed ideals, implicative ideals, commutative ideals, positive implicative ideals, maximal ideals, finitely generated ideals, principal ideals, prime and irreducible ideals, Varlet ideals, additive ideals, and minimal prime ideals; they also gave basic properties and some characterizations of such ideals; they considered quotient algebras, Noetherian BCK-algebras, lower BCK-semi lattices, decomposition properties of ideals and ideal lattices. Here I will give a notion of an ideal of Hilbert algebras in positive implicative BCK-algebras, and some propositions.

Definition 1.1 [1] Suppose H is a nonempty set, \rightarrow is a binary operation on H , $1 \in H$. Then $(H, \rightarrow, 1)$ is Hilbert algebras if it satisfies the following conditions for any x, y, z in H :

$$H_1 : x \rightarrow (y \rightarrow x) = 1; \tag{96.1}$$

$$H_2 (x \rightarrow (y \rightarrow z)) \rightarrow ((x \rightarrow y) \rightarrow (x \rightarrow z)) = 1; \tag{96.2}$$

$$H_3 \text{ If } x \rightarrow y = 1 \text{ and } y \rightarrow x = 1, \text{ then } x = y. \tag{96.3}$$

Lemma 1.1 [2] Suppose $(H, \rightarrow, 1)$ is a Hilbert algebras, the following conditions are satisfies for any x, y, z in H :

$$H_4 x \rightarrow (y \rightarrow z) = (x \rightarrow y) \rightarrow (x \rightarrow z); \tag{96.4}$$

$$H_5 x \rightarrow (y \rightarrow z) = y \rightarrow (x \rightarrow z); \tag{96.5}$$

$$H_6 (x \rightarrow y) \rightarrow ((y \rightarrow z) \rightarrow (x \rightarrow z)) = 1; \tag{96.6}$$

$$H_7 x \rightarrow ((x \rightarrow y) \rightarrow y) = 1; \tag{96.7}$$

$$H_8 x \rightarrow x = 1; \tag{96.8}$$

$$H_9 1 \rightarrow x = 1. \tag{96.9}$$

Lemma 1.2 a Hilbert algebras $(H, \rightarrow, 1)$ is called to be positive implicative if it satisfies $(z \rightarrow y) \rightarrow (z \rightarrow x) = z \rightarrow (y \rightarrow x)$ for all x, y, z in H .

Definition 1.2 let $(H, \rightarrow, 1)$ be a BCK-algebra and Let I be a nonempty subset of H . Then I is called to be an ideal of H if for all x, y in H

$$(I) 1 \in I, \tag{96.10}$$

$$(II) y \rightarrow x \in I \text{ and } y \in I \text{ imply } x \in I \tag{96.11}$$

Lemma 1.3 [3] $(H, \rightarrow, 1)$ is a Hilbert algebras if and only if $(H, *, 1)$ is a positive implicative BCK-algebras.

96.2 Ideal and Propositions

Definition 2.1 [4] let $(H, \rightarrow, 1)$ be Hilbert algebras in positive implicative BCK-algebra and Let I be a nonempty subset of H . Then I is called to be an ideal of H if for all x, y in H

$$(I) 1 \in I, \tag{96.12}$$

$$(II) z \rightarrow (y \rightarrow x) \in I \text{ and } z \rightarrow y \in I \text{ imply } z \rightarrow x \in I. \tag{96.13}$$

Theorem 2.1 [5] any ideal of Hilbert algebras in positive implicative BCK-algebras must be an ideal, but the inverse is not true.

Proof Suppose I is an ideal of Hilbert algebras in positive implicative BCK-algebras. If $y \rightarrow x \in I$ and $y \in I$, then $1 \rightarrow (y \rightarrow x) = y \rightarrow x \in I$, and $1 \rightarrow y = y \in I, 1 \rightarrow x = x \in I$, thus I is an ideal. The inverse is not true, for example let $H = \{1, 2, 3\}$ in which \rightarrow is given by the Table 96.1:

Then $(H, \rightarrow, 1)$ is Hilbert algebras in positive implicative BCK-algebra. $\{1, 2\}$ Is an ideal of H , but not an ideal of Hilbert algebras in positive implicative BCK-algebra?

Theorem 2.2 [6] Suppose I is a nonempty subset of Hilbert algebras in positive implicative BCK-algebras H , then the following

Conditions are equivalent:

- a) I Is an ideal of Hilbert algebras in positive implicative BCK-algebras.
- b) I Is an ideal, and for any x, y in $H, y \rightarrow (y \rightarrow x) \in I$ Implies $y \rightarrow x \in I$;
- c) I Is an ideal, and for any x, y, z in $H, z \rightarrow (y \rightarrow x) \in I$, Implies $(z \rightarrow y) \rightarrow (z \rightarrow x) \in I$;
- d) $1 \in I$ And $z \rightarrow (y \rightarrow (y \rightarrow x)) \in I, z \in I$ imply $y \rightarrow x \in I$.

Proof (a) \Rightarrow (b) If I is an ideal of Hilbert algebras in positive implicative BCK-algebras, by Theorem 3.1 I is an ideal. Suppose $y \rightarrow (y \rightarrow x) \in I$, since $1 \rightarrow y = 1 \in I$, by Definition 1.2 $y \rightarrow x \in I, (b)$

Table 96.1 $H = \{1, 2, 3\}$ in which \rightarrow

\rightarrow	1	2	3
1	1	1	1
2	2	1	2
3	3	3	1

Holds $(b) \Rightarrow (c)$ Assume (b) and $z \rightarrow (y \rightarrow x) \in I$,

$$\begin{aligned}
 & z \rightarrow (z \rightarrow ((z \rightarrow y) \rightarrow x)) \\
 &= z \rightarrow ((z \rightarrow y) \rightarrow (z \rightarrow x)) \\
 &= z \rightarrow (z \rightarrow y \rightarrow (y \rightarrow x)) \\
 &= (z \rightarrow z) \rightarrow (z \rightarrow (y \rightarrow x)) \\
 &= 1 \rightarrow (z \rightarrow (y \rightarrow x)) \\
 &= (z \rightarrow (y \rightarrow x)) \in I
 \end{aligned} \tag{96.14}$$

It follows that $(z \rightarrow ((z \rightarrow y) \rightarrow x)) \in I$, by $(b)(z \rightarrow ((z \rightarrow y) \rightarrow x)) \in I$. As

$$(z \rightarrow y) \rightarrow (z \rightarrow x) = z \rightarrow ((z \rightarrow y) \rightarrow x) \tag{96.15}$$

then $(z \rightarrow y) \rightarrow (z \rightarrow x) \in I$. which is $(c).(c) \Rightarrow (d)$ It's clear that $1 \in I$.

If

$$z \rightarrow (y \rightarrow (y \rightarrow x)) \in I, z \in I \tag{96.16}$$

then

$$\begin{aligned}
 & y \rightarrow (y \rightarrow (z \rightarrow x)) \\
 &= z \rightarrow (y \rightarrow (y \rightarrow x)) \in I \\
 &= z \rightarrow (y \rightarrow x) \\
 &= y \rightarrow (z \rightarrow x) \\
 &= y \rightarrow (z \rightarrow (y \rightarrow x)) \\
 &= (y \rightarrow y) \rightarrow (y \rightarrow (z \rightarrow x)) \\
 &= (y \rightarrow y) \rightarrow (y \rightarrow (z \rightarrow x)) \\
 & y \rightarrow (y \rightarrow (z \rightarrow x)) \in I
 \end{aligned} \tag{96.17}$$

Since I is an ideal, and $z \in I$ thus $y \rightarrow x \in I$. (d) Holds $(d) \Rightarrow (a)$ First proof I is an ideal. Suppose $y \rightarrow x \in I$ and $y \in I$, then $y \rightarrow (1 \rightarrow (1 \rightarrow x)) \in I$, and $y \in I$, by (d) $1 \rightarrow x = x \in I$. i.e., I is an ideal. Next let $z \rightarrow (y \rightarrow x) \in I$ and $z \rightarrow y \in I$,

$$\begin{aligned}
 & (z \rightarrow y) \rightarrow (z \rightarrow (z \rightarrow x)) \\
 &= z \rightarrow (y \rightarrow (z \rightarrow x)) \\
 &= y \rightarrow (z \rightarrow (z \rightarrow x)) \\
 &= y \rightarrow ((z \rightarrow z) \rightarrow (z \rightarrow x)) \\
 &= y \rightarrow (1 \rightarrow (z \rightarrow x)) \\
 &= y \rightarrow (z \rightarrow x) \\
 &= z \rightarrow (y \rightarrow x) \in I
 \end{aligned} \tag{96.18}$$

Then

$$(z \rightarrow y) \rightarrow (z \rightarrow (z \rightarrow x)) \in I. \tag{96.19}$$

Combining $z \rightarrow y \in I$ and using (d) $z \rightarrow x \in I$. This have proofed that I is an ideal of Hilbert algebras in positive implicative BCK-algebras. Thus the proof is completed.

Theorem 2.3 *supposes A and B is ideals of Hilbert algebras in positive implicative BCK-algebras H , and $A \subset B$, if A is an ideal of Hilbert algebras in positive implicative BCK-algebras, so is B . Proof Let $z \rightarrow (y \rightarrow x) \in B$ and denote $u = z \rightarrow (y \rightarrow x)$, then*

$$\begin{aligned} z \rightarrow (y \rightarrow (u \rightarrow x)) & \\ = z \rightarrow (u \rightarrow (y \rightarrow x)) & \\ = u \rightarrow (z \rightarrow (y \rightarrow x)) & \\ = 1 \in A & \end{aligned} \tag{96.20}$$

A is an ideal of Hilbert algebras in positive implicative BCK-algebras., by making use of Theorem 2.2 (c) we have

$$(z \rightarrow y) \rightarrow (z \rightarrow (u \rightarrow x)) \in A. \tag{96.21}$$

$$\begin{aligned} (z \rightarrow y) \rightarrow (z \rightarrow (u \rightarrow x)) & \\ = (z \rightarrow y) \rightarrow (u \rightarrow (z \rightarrow x)) & \\ = u \rightarrow ((z \rightarrow y) \rightarrow (z \rightarrow x)) & \\ = (z \rightarrow (y \rightarrow x)) \rightarrow ((z \rightarrow y) \rightarrow (z \rightarrow x)) \in A & \end{aligned} \tag{96.22}$$

$A \subset B$, then $(z \rightarrow (y \rightarrow x)) \rightarrow ((z \rightarrow y) \rightarrow (z \rightarrow x)) \in B$ is an ideal and $z \rightarrow (y \rightarrow x) \in B$, then it follows $(z \rightarrow y) \rightarrow (z \rightarrow x) \in B$. This means that for the ideal B , $z \rightarrow (y \rightarrow x) \in B$, implies $(z \rightarrow y) \rightarrow (z \rightarrow x) \in B$. By Theorem 2.2 (c) B is an ideal of Hilbert algebras in positive implicative BCK-algebras, this finished the proof.

References

1. Liu F, Li JZ (1997) Hilbert algebras is an anti-positive implicative BCK-algebra (Chinese). Shanxi Coll Min Technol 15(2):214–217
2. Zhang Q N (2009) An ideal of hilbert algebras in BCK-algebras. In: Proceedings of 2009 conference on communication faculty vol 88. 310–311
3. Iséki K, Tanaka S (1978) An introduction to the theory of BCK-algebras. Math Jpn 23(30): 1–26
4. Meng J, Jun YB (1994) BCK-algebras, vol 98. KYung Moon Sa Co, p 256
5. Ahsan EY, Deeba AB (1991) On prime ideals of BCK-algebras. Math Jpn 33(36):875–882
6. Chen ZM, Wang HX (1991) On simple BCI-algebras. Math. Jpn 27(36):627–632

Chapter 97

Hilbert Algebras in Positive Implicative BCK-Algebras

Qiuna Zhang, Lei Zhang, Dongmei Li and LiNan Shi

Abstract The notion of BCK-algebras was formulated first in 1966 by K. Iséki, Japanese, and Mathematician. This notion is originated from two different ways. One of the motivations is based on set theory; another motivation is from classical and non-classical propositional calculi. There are many classes of BCK-algebras, for example, subalgebras, bounded BCK-algebras, positive implicative BCK-algebra, implicative BCK-algebra, commutative BCK-algebra, BCK-algebras with condition (S), Griss (and semi-Brouwerian) algebras, quasicommutative BCK-algebras, direct product of BCK-algebras, and so on. The notion of positive implicative BCK-algebras was introduced by K. Iséki in 1975. In previous studies, scholars gave the definition of the positive implicative BCK-algebras, and its characterizations, and the relationship between other BCK-algebra, before this article I give a notion an ideal of Hilbert Algebras in BCK-algebras, as well as some propositions, so, here I will give a notion of Hilbert algebras in positive implicative BCK-algebras, and some propositions.

Keywords BCK-algebra · Hilbert algebras · Positive implicative BCK-algebra

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97.1 Introduction

The notion of BCK-algebras was formulated in 1966 by K. Iséki, Japanese, and Mathematician. This notion is originated from two different ways. There are many classes of BCK-algebras, for example, sub algebras, bounded BCK-algebras, positive implicative BCK-algebra, implicative BCK-algebra, commutative BCK-algebra, BCK-algebras with condition (S), Griss (and semi-Brouwerian) algebras, quasi-commutative BCK-algebras, direct product of BCK-algebras, and so on. They gave a theorem of estimating the number of sub algebras in a finite BCK-algebra, and gave a way extending BCK-algebras, and also provided characterizations of commutative, positive, implicative BCK-algebras. Here I will give a new class of BCK-algebra, which is called Hilbert Algebras in positive Implicative BCK-algebras and some propositions [1–3].

Definition 1 Let X be a subset with a binary operation $*$ and a constant 0 . Then $(X; *, 0)$ is called a BCK-algebra if it satisfies the following conditions:

$$BCI - 1 : ((x * y) * (x * z)) * (z * y) = 0, \tag{97.1}$$

$$BCI - 2 : (x * (x * y)) * y = 0, \tag{97.2}$$

$$BCI - 3 : x * x = 0, \tag{97.3}$$

$$BCI - 4 : x * y = 0 \text{ and } y * x = 0 \text{ imply } x = y \tag{97.4}$$

$$BCK - 5 : x * 0 = 0. \tag{97.5}$$

In X we can define a binary operation \leq by $x \leq y$ if and only if $y * x = 0$. Then $(X; *, 0)$ is called a BCK-algebra if it satisfies the following conditions:

$$BCI - 1' : (x * y) * (x * z) \leq z * y, \tag{97.6}$$

$$BCI - 2' : x * (x * y) \leq y, \tag{97.7}$$

$$BCI - 3' : x \leq x \tag{97.8}$$

$$BCI - 4' : x \leq y \text{ and } y \leq x \text{ imply } x = y \tag{97.9}$$

$$BCI - 5' : 0 \leq x \tag{97.10}$$

$$BCI - 6' : x \leq y \tag{97.11}$$

if and only if

$$x * y = 0 \tag{97.12}$$

For any BCK-algebra $(X; *, 0)$, $*$ and \leq are called a BCK-operation and BCK-ordering on X respectively.

Definition 2 A BCK-algebra $(X; *, 0)$ is called to be positive implicative if it satisfies $(x * z) * (y * z) = (x * y) * z$ for all x, y, z in X .

Definition 3 [4] Suppose H is a nonempty set, \rightarrow is a binary operation on H , $1 \in H$, then $(H, \rightarrow, 1)$ is Hilbert algebras if it satisfies the following conditions for any x, y, z in H :

$$H_1 : x \rightarrow (y \rightarrow x) = 1; \tag{97.13}$$

$$H_2 : (x \rightarrow (y \rightarrow z)) \rightarrow ((x \rightarrow y) \rightarrow (x \rightarrow z)) = 1; \tag{97.14}$$

$$H_3 : \text{If } x \rightarrow y = 1 \tag{97.15}$$

and

$$y \rightarrow x = 1, \tag{97.16}$$

then

$$x = y. \tag{97.17}$$

Lemma 1 [3] Suppose $(H, \rightarrow, 1)$ is a Hilbert algebras, the following conditions are satisfies for any x, y, z in H :

$$H_4 : x \rightarrow (y \rightarrow z) = (x \rightarrow y) \rightarrow (x \rightarrow z); \tag{97.18}$$

$$H_5 : x \rightarrow (y \rightarrow z) = y \rightarrow (x \rightarrow z); \tag{97.19}$$

$$H_6 : (x \rightarrow y) \rightarrow ((y \rightarrow z) \rightarrow (x \rightarrow z)) = 1; \tag{97.20}$$

$$H_7 : x \rightarrow ((x \rightarrow y) \rightarrow y) = 1; \tag{97.21}$$

$$H_8 : x \rightarrow x = 1; \tag{97.22}$$

$$H_9 : 1 \rightarrow x = 1. \tag{97.23}$$

We can find the proof in [2] and [3]. Given a Hilbert algebras $(H, \rightarrow, 1)$, we can define a binary operations $*$ and two binary relations \prec, \prec' on H

$$x * y = y \rightarrow x, x \prec y \Leftrightarrow x \rightarrow y = 1, x \prec' y \Leftrightarrow x * y = 1. \tag{97.24}$$

Then we know $x \prec' y$ in $(H, *, 1)$ if and only if $y \prec x$ in $(H, \rightarrow, 1)$ $*$ and \rightarrow are two opposite binary operations on H , \prec and \prec' are two opposite order relations on H .

Lemma 2 [3] $(H, \rightarrow, 1)$ is a Hilbert algebras if and only if $(H, *, 1)$ is a positive implicative BCK-algebras. We can find the proof in [3].

97.2 Definition and Propositions

Definition 4 A Hilbert algebras $(H, \rightarrow, 1)$ is called to be positive implicative if it satisfies $(z \rightarrow y) \rightarrow (z \rightarrow x) = z \rightarrow (y \rightarrow x)$ for all x, y, z in H [4–7].

Theorem 1 In any Hilbert Algebras in positive implicative BCK-algebras we have $(x \rightarrow y) \rightarrow ((y \rightarrow x) \rightarrow x) \leq (((x \rightarrow y) \rightarrow y) \rightarrow x) \rightarrow x$ for all x, y, z in H .

Proof Because

$$\begin{aligned}
 & (((x \rightarrow y) \rightarrow y) \rightarrow x) \rightarrow x \rightarrow ((x \rightarrow y) \rightarrow ((y \rightarrow x) \rightarrow x)) \\
 &= (x \rightarrow y) \rightarrow ((y \rightarrow x) \rightarrow (((x \rightarrow y) \rightarrow y) \rightarrow x) \rightarrow x) \rightarrow x) \\
 &= (x \rightarrow y) \rightarrow ((y \rightarrow x) \rightarrow ((y \rightarrow x) \rightarrow (((x \rightarrow y) \rightarrow y) \rightarrow x))) \\
 &\leq (x \rightarrow y) \rightarrow (((x \rightarrow y) \rightarrow y) \rightarrow y) = 1
 \end{aligned} \tag{97.25}$$

Hence $(x \rightarrow y) \rightarrow ((y \rightarrow x) \rightarrow x) \leq (((x \rightarrow y) \rightarrow y) \rightarrow x) \rightarrow x$.

The proof is complete.

Theorem 2 Let $(H, \rightarrow, 1)$ to be a Hilbert algebras in BCK-algebra, then the following conditions are equivalent to each other:

- (1) H is positive implicative
- (2) $(y \rightarrow x) = y \rightarrow (y \rightarrow x)$
- (3) $(x \rightarrow y) \rightarrow ((y \rightarrow x) \rightarrow x) = (((x \rightarrow y) \rightarrow y) \rightarrow x) \rightarrow x$
- (4) $y \rightarrow x = ((y \rightarrow x) \rightarrow x) \rightarrow (y \rightarrow x)$
- (5) $(y \rightarrow x) \rightarrow x = (y \rightarrow x) \rightarrow ((y \rightarrow x) \rightarrow x)$
- (6) $(x \rightarrow y) \rightarrow ((y \rightarrow x) \rightarrow x) = (y \rightarrow x) \rightarrow ((x \rightarrow y) \rightarrow y)$

Proof (1) \Rightarrow (2):

$$\begin{aligned}
 & y \rightarrow x \\
 &= (y \rightarrow y) \rightarrow (y \rightarrow x) \\
 &= y \rightarrow (y \rightarrow x)
 \end{aligned} \tag{97.26}$$

which is (2).

(2) \Rightarrow (3): In (2) if we substitute $((x \rightarrow y) \rightarrow y) \rightarrow x$ for y , then we obtain

$$\begin{aligned}
 & (((x \rightarrow y) \rightarrow y) \rightarrow x) \rightarrow x \\
 &= (((x \rightarrow y) \rightarrow y) \rightarrow x) \rightarrow (((x \rightarrow y) \rightarrow y) \rightarrow x) \rightarrow x \rightarrow x) \\
 &\leq (((x \rightarrow y) \rightarrow y) \rightarrow x) \rightarrow ((x \rightarrow y) \rightarrow y) \\
 &\leq (y \rightarrow x) \rightarrow ((x \rightarrow y) \rightarrow y) \\
 &= (x \rightarrow y) \rightarrow ((y \rightarrow x) \rightarrow y) \\
 &\leq (x \rightarrow y) \rightarrow ((y \rightarrow x) \rightarrow x)
 \end{aligned} \tag{97.27}$$

In the above proof, we use $y \rightarrow x \leq ((x \rightarrow y) \rightarrow y) \rightarrow x$. Combining Theorem 97.1 we obtain (3).

(3) \Rightarrow (4): Replacing x by $x \rightarrow y$ in (3) we obtain

$$\begin{aligned} & ((x \rightarrow y) \rightarrow y) \rightarrow ((y \rightarrow (x \rightarrow y)) \rightarrow (x \rightarrow y)) \\ & = (((x \rightarrow y) \rightarrow y) \rightarrow y) \rightarrow (x \rightarrow y) \end{aligned} \quad (97.28)$$

It follows that

$$\begin{aligned} & ((x \rightarrow y \rightarrow y) \rightarrow (x \rightarrow y)) \\ & = ((x \rightarrow y) \rightarrow (x \rightarrow y)) \rightarrow (x \rightarrow y) \end{aligned} \quad (97.29)$$

which means that $((x \rightarrow y) \rightarrow y) \rightarrow (x \rightarrow y) = x \rightarrow y$. Thus (4) holds.

(4) \Rightarrow (5): Substituting $y \rightarrow x$ for y , we get

$$\begin{aligned} & (y \rightarrow x) \rightarrow x \\ & = (((y \rightarrow x) \rightarrow x) \rightarrow x) \rightarrow ((y \rightarrow x) \rightarrow x) \\ & = (y \rightarrow x) \rightarrow ((y \rightarrow x) \rightarrow x) \end{aligned} \quad (97.30)$$

and (5) holds.

(5) \Rightarrow (6):

$$\begin{aligned} & (x \rightarrow y) \rightarrow ((y \rightarrow x) \rightarrow x) \\ & = (x \rightarrow y) \rightarrow ((y \rightarrow x) \rightarrow ((y \rightarrow x) \rightarrow x)) \\ & \leq (x \rightarrow y) \rightarrow ((y \rightarrow x) \rightarrow y) \\ & = (y \rightarrow x) \rightarrow ((x \rightarrow y) \rightarrow y) \end{aligned} \quad (97.31)$$

By symmetry, we obtain the converse inequality. Thus (6) holds.

(6) \Rightarrow (2):

$$\begin{aligned} & (y \rightarrow x) = 1 \rightarrow (((y \rightarrow x) \rightarrow x) \rightarrow x) \\ & = (x \rightarrow (y \rightarrow x)) \rightarrow (((y \rightarrow x) \rightarrow x) \rightarrow x) \\ & = ((y \rightarrow x) \rightarrow x) \rightarrow (x \rightarrow (y \rightarrow x) \rightarrow (y \rightarrow x)) \\ & = ((y \rightarrow x) \rightarrow x) \rightarrow (y \rightarrow x) \\ & = y \rightarrow (((y \rightarrow x) \rightarrow x) \rightarrow x) \\ & = y \rightarrow (y \rightarrow x) \end{aligned} \quad (97.32)$$

which are (2).

(2) \Rightarrow (1): Suppose (2) holds, then

$$\begin{aligned}
 & (z \rightarrow (y \rightarrow x)) \rightarrow ((z \rightarrow y) \rightarrow (z \rightarrow x)) \\
 & = (z \rightarrow (y \rightarrow x)) \rightarrow ((z \rightarrow y) \rightarrow (z \rightarrow (z \rightarrow x))) \\
 & \leq (z \rightarrow (y \rightarrow x)) \rightarrow (y \rightarrow (z \rightarrow x)) \\
 & = (z \rightarrow (y \rightarrow x)) \rightarrow (z \rightarrow (y \rightarrow x)) = 1
 \end{aligned} \tag{97.33}$$

Thus

$$(z \rightarrow y) \rightarrow (z \rightarrow x) \leq z \rightarrow (y \rightarrow x) \tag{97.34}$$

The converse inequality is clear, and (1) holds. This finishes the proof of the theorem.

References

1. Iséki K (1976) BCK-algebras. *Math Semin Notes* 4:77–86
2. Chen ZM, Wang HX (1991) On simple BCI-algebras. *Math Japon* 36:627–632
3. Liu F, Li JZ (1997) Hilbert algebras are anti-positive implicative BCK-algebras (Chinese). *Shanxi College Mining Technol* 15(2):214–217
4. Iséki K, Tanaka S (1978) An introduction to the theory of BCK-algebras. *Math Japon* 23:1–26
5. Meng J, Jun YB (1994) BCK-algebras. *K Yung Moon Sa Co* 88:110–120
6. Ahsan E, Deeba Y, Thaheem AB (1991) On prime ideals of BCK-algebras. *Math Japon* 55(36):875–882
7. Chen ZM, Wang HX (1991) On simple BCI-algebras. *Math Japon* 67(36):627–632

Chapter 98

Generalization of Lemma Gronwall–Bellman on Retarded Integral Inequality

Wu-Sheng Wang, Zhengfang Mo and Zongyi Hou

Abstract On the basis of the integral inequalities in [9], this paper establish several general form Gronwall–Bellman nonlinear retarded integral inequalities, which contain multi-different power terms of unknown function inside integral sign. Using integral and differential skills, we obtain some new results which provide explicit bounds on unknown functions in the integral inequalities. The explicit bounds given here can be used as tools in the study of existence, uniqueness, boundedness, stability, invariant manifolds and other qualitative properties of solutions of differential equations and integral equation. An example is given to illustrate the effectiveness of our results in estimation of solutions of some differential equations.

Keywords Integral inequality · Estimation · Differential · Equation

98.1 Introduction

Various generalizations of Gronwall–Bellman inequalities are important tools in the study of existence, uniqueness, boundedness, stability, invariant manifolds and other qualitative properties of solutions of differential equations and integral equation. In 1919 and 1943, Gronwall and Bellman gave the Gronwall–Bellman inequalities [1, 2] respectively. After that, many authors studied a number of generalizations of these inequalities (e.g., [3–9]). In this paper, we discuss a class of retarded nonlinear integral inequalities and give new upper bound estimation of the unknown function by analysis skills.

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First, we review several well-known inequalities from which we acquire inspiration of studying more general form integral inequalities.

Lemma 1 (see [5]) Let $u, f \in C([t_0, T], R_+)$. Further, let $\alpha \in C^1([t_0, T], [t_0, T])$ be nondecreasing with $\alpha(t) < t$ on $[t_0, T]$, and let c be a nonnegative constant. Then the inequality

$$u(t) \leq c + \int_{\alpha(t_0)}^{\alpha(t)} f(s)u(s)ds, t \in [t_0, T] \tag{98.1}$$

implies that

$$u(t) \leq c \exp \left(\int_{\alpha(t_0)}^{\alpha(t)} f(s)ds \right), t \in [t_0, T]. \tag{98.2}$$

Lemma 2 (see [9]) Let $u, f, g \in C([t_0, T], R_+)$, c, n be a nonnegative constant with $n > 1$. Then the inequality

$$u(t) \leq c + \int_{t_0}^t (f(s)u(s) + g(s)u^n(s))ds, t \in [t_0, T] \tag{98.3}$$

implies that

$$u(t) \leq \frac{c \exp \left(\int_{t_0}^t f(s)ds \right)}{\left(1 - (n - 1)c^{n-1} \int_{t_0}^t g(\tau) \exp \left((n - 1) \int_{t_0}^{\tau} f(s)ds \right) d\tau \right)^{\frac{1}{n-1}}}, \tag{98.4}$$

under the assumption, for all $t \in [t_0, T]$

$$(1 - (n - 1)c^{n-1} \int_{t_0}^t g(\tau) \exp \left((n - 1) \int_{t_0}^{\tau} f(s)ds \right) d\tau) \geq 0 \tag{98.5}$$

Lemma 3 (see [9]) Let $u, f_i \in C([t_0, T], R_+), i = 1, 2, \dots, n$, c be a nonnegative constant. Then the inequality

$$u(t) \leq c + \int_{t_0}^t \sum_{i=1}^n f_i(s)u^i(s)ds, t \in [t_0, T] \tag{98.6}$$

implies that

$$u(t) = \frac{c \exp\left(\int_{t_0}^t f_1(s) ds\right)}{\left(1 - (n - 1) \int_{t_0}^t \sum_{i=2}^n c^{i-1} f_i(\tau) \exp\left(\int_{t_0}^{\tau} (n - 1) f_1(s) ds\right) d\tau\right)^{\frac{1}{n-1}}} \tag{98.7}$$

under the assumption, for all $t \in [t_0, T]$

$$1 - (n - 1) \int_{t_0}^t \sum_{i=2}^n c^{i-1} f_i(\tau) \exp\left(\int_{t_0}^{\tau} (n - 1) f_1(s) ds\right) d\tau \geq 0 \tag{98.8}$$

98.2 Conclusion

On the basis of the integral inequalities in [9], we study the following integral inequalities.

Theorem 1 Let $u, f, g \in C([t_0, T], R_+)$. Further, let $\alpha \in C^1([t_0, T], [t_0, T])$ be nondecreasing with $\alpha(t) < t$ on $[t_0, T]$, and let c, n be a nonnegative constant with $n > 1$. Then the inequality

$$u(t) \leq c + \int_{\alpha(t_0)}^{\alpha(t)} (f(s)u(s) + g(s)u^n(s)) ds, t \in [t_0, T] \tag{98.9}$$

implies that

$$u(t) = \frac{c \exp\left(\int_{\alpha(t_0)}^{\alpha(t)} f(s) ds\right)}{1 - (n - 1) c^{n-1} \int_{\alpha(t_0)}^{\alpha(t)} g(\tau) \exp\left((n - 1) \int_{t_0}^{\tau} f(s) ds d\tau\right)^{\frac{1}{n-1}}} \tag{98.10}$$

under the assumption, for all $t \in [t_0, T]$

$$1 - (n - 1) c^{n-1} \int_{\alpha(t_0)}^{\alpha(t)} g(\tau) \exp\left((n - 1) \int_{t_0}^{\tau} f(s) ds\right) d\tau \geq 0. \tag{98.11}$$

Proof Inequality (98.9) can be rewritten

$$u(t) \leq c + \int_{\alpha(t_0)}^{\alpha(t)} (f(s) + g(s)u^{n-1}(s))u(s)ds, t \in [t_0, T] \tag{98.12}$$

Using Lemma 1 and (98.12), we obtain

$$u(t) \leq c \exp\left(\int_{\alpha(t_0)}^{\alpha(t)} f(s) + g(s)u^{n-1}(s)ds\right), \tag{98.13}$$

Inequality (98.13) is equivalent to

$$u^{n-1}(t) \leq c^{n-1} \exp\left((n-1) \int_{\alpha(t_0)}^{\alpha(t)} f(s) + g(s)u^{n-1}(s)ds\right), \tag{98.14}$$

Using (98.14), we obtain

$$\begin{aligned} & \frac{d}{dt} \exp\left(- (n-1) \int_{\alpha(t_0)}^{\alpha(t)} g(s)u^{n-1}(s)ds\right) \\ &= - (n-1) \alpha'(t) g(\alpha(t)) u^{n-1}(\alpha(t)) \exp\left(- (n-1) \int_{\alpha(t_0)}^{\alpha(t)} g(s)u^{n-1}(s)ds\right) \tag{98.15} \\ &\geq - (n-1) \alpha'(t) g(\alpha(t)) c^{n-1} \exp\left((n-1) \int_{\alpha(t_0)}^{\alpha(t)} f(s)ds\right), \end{aligned}$$

Integrating both sides of the inequality (98.15) from t_0 to t , we get

$$\begin{aligned} & \exp\left(- (n-1) \int_{\alpha(t_0)}^{\alpha(t)} g(s)u^{n-1}(s)ds\right) \\ &\geq 1 - (n-1) c^{n-1} \int_{t_0}^t \alpha'(\tau) g(\alpha(\tau)) \exp\left((n-1) \int_{\alpha(t_0)}^{\alpha(\tau)} f(s)ds\right) d\tau \tag{98.16} \\ &= 1 - (n-1) c^{n-1} \int_{\alpha(t_0)}^{\alpha(t)} g(\tau) \exp\left((n-1) \int_{t_0}^{\tau} f(s)ds\right) d\tau. \end{aligned}$$

Under the assumption (98.11), we have

$$\frac{\exp\left((n-1) \int_{\alpha(t_0)}^{\alpha(t)} g(s)u^{n-1}(s)ds\right)}{1 - (n-1)c^{n-1} \int_{\alpha(t_0)}^{\alpha(t)} g(\tau) \exp\left((n-1) \int_{t_0}^{\tau} f(s)ds\right) d\tau} \leq \tag{98.17}$$

Substituting (98.17) into (98.14), we get

$$u^{n-1}(t) \leq \frac{c^{n-1} \exp\left((n-1) \int_{\alpha(t_0)}^{\alpha(t)} f(s)ds\right)}{1 - (n-1)c^{n-1} \int_{\alpha(t_0)}^{\alpha(t)} g(\tau) \exp\left((n-1) \int_{t_0}^{\tau} f(s)ds\right) d\tau} \tag{98.18}$$

Namely,

$$u(t) \leq \frac{c \exp\left(\int_{\alpha(t_0)}^{\alpha(t)} f(s)ds\right)}{\left(1 - (n-1)c^{n-1} \int_{\alpha(t_0)}^{\alpha(t)} g(\tau) \exp\left((n-1) \int_{t_0}^{\tau} f(s)ds\right) d\tau\right)^{\frac{1}{n-1}}} \tag{98.19}$$

This completes the proof of the Theorem 1.

Remark 1 In (98.10), Choose $\alpha(t) = t$, (98.10) reduce to (98.4), Theorem 1 reduce to Lemma 2.

Theorem 2 Let $u, f_i \in C([t_0, T], R_+), i = 1, 2 \dots, n$. Further, let $\alpha \in C^1([t_0, T], [t_0, T])$ be nondecreasing with $\alpha(t) < t$ on $[t_0, T]$, and let c be a nonnegative constant. Then the inequality

$$u(t) \leq c + \int_{\alpha(t_0)}^{\alpha(t)} \sum_{i=1}^n f_i(s)u^i(s)ds, t \in [t_0, T] \tag{98.20}$$

implies that $\forall t \in [t_0, T)$

$$u(t) \leq \frac{c \exp\left(\int_{\alpha(t_0)}^{\alpha(t)} f(s)ds\right)}{\left[1 - (n-1)c^{n-1} \int_{\alpha(t_0)}^{\alpha(t)} g(\tau) \exp\left((n-1) \int_{t_0}^{\tau} f(s)ds\right) d\tau\right]^{\frac{1}{n-1}}} \tag{98.21}$$

under the assumption

$$1 - (n - 1)c^{n-1} \int_{\alpha(t_0)}^{\alpha(t)} g(\tau) \exp \left((n - 1) \int_{t_0}^{\tau} f(s) ds \right) d\tau > 0, \forall t \in [t_0, T]. \tag{98.22}$$

Proof Inequality (98.20) can be rewritten

$$u(t) \leq c + \int_{a(t_0)}^{a(t)} \left(f_1(s) + \sum_{i=2}^n f_i(s)u^i(s) \right) u(s) ds, \forall t \in [t_0, T] \tag{98.23}$$

By (98.2), we obtain from (98.23)

$$u(t) \leq c \exp \left(\int_{a(t_0)}^{a(t)} \left(f_1(s) + \sum_{i=2}^n f_i(s)u^i(s) \right) ds \right), \forall t \in [t_0, T]. \tag{98.24}$$

Then, for all $j = 2, 3, \dots, n$

$$\begin{aligned} u^{j-1}(t) &\leq c^{j-1} \exp \left((j - 1) \int_{a(t_0)}^{a(t)} \left(f_1(s) + \sum_{i=2}^n f_i(s)u^i(s) \right) ds \right) \\ &\leq c^{j-1} \exp \left((n - 1) \int_{a(t_0)}^{a(t)} \left(f_1(s) + \sum_{i=2}^n f_i(s)u^i(s) \right) ds \right). \end{aligned} \tag{98.25}$$

Using (98.25), we have

$$\begin{aligned} &\frac{d}{dt} \exp \left(-(n - 1) \int_{a(t_0)}^{a(t)} \sum_{i=2}^n f_i(s)u^i(s) ds \right) \\ &= -(n - 1)\alpha'(t) \sum_{i=2}^n f_i(\alpha(t))u^i(\alpha(t)) \exp \left(-(n - 1) \int_{a(t_0)}^{a(t)} \sum_{i=2}^n f_i(s)u^i(s) ds \right) \\ &\geq -(n - 1)\alpha'(t) \sum_{i=2}^n f_i(\alpha(t))c^{i-1} \exp \left((n - 1) \int_{a(t_0)}^{a(t)} f_1(s) ds \right). \end{aligned}$$

Integrating both sides of the above inequality from t_0 to t , we get

$$\begin{aligned} & \exp\left(- (n-1) \int_{a(t_0)}^{a(t)} \sum_{i=2}^n f_i(s) u^i(s) ds\right) \\ & \geq 1 - (n-1) \int_{t_0}^t \alpha'(\tau) \sum_{i=2}^n f_i(\alpha(\tau)) c^{i-1} \exp\left((n-1) \int_{a(t_0)}^{a(\tau)} f_1(s) ds\right) d\tau \quad (98.26) \\ & = 1 - (n-1) \int_{a(t_0)}^{a(t)} \sum_{i=2}^n c^{i-1} f_i(\tau) \exp\left((n-1) \int_{t_0}^{\tau} f_1(s) ds\right) d\tau. \end{aligned}$$

Substituting (98.26) into (98.24), we obtain

$$u(t) \leq \frac{c \exp\left(\int_{\alpha(t_0)}^{\alpha(t)} f_1(s) ds\right)}{\left(1 - (n-1) \int_{\alpha(t_0)}^{\alpha(t)} \sum_{i=2}^n c^{i-1} f_i(\tau) \exp\left(\int_{t_0}^{\tau} (n-1) f_1(s) ds\right) d\tau\right)^{\frac{1}{n-1}}}.$$

This completes the proof of the Theorem 2.

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References

1. Gronwall TH (1919) Note on the derivatives with respect to a parameter of the solutions of a system of differential equations. *Ann of Math* 20:292–296
2. Bellman R (1943) The stability of solutions of linear differential equations. *Duke Math J* 10:643–647
3. Bihari IA (1956) A generalization of a lemma of Bellman and its application to uniqueness problem of differential equation. *Acta Math Acad Sci Hung* 7:81–94
4. Pachpatte BG (1998) *Inequalities for differential and integral equations*. Academic Press, London
5. Lipovan O (2000) A retarded Gronwall-like inequality and its applications. *J Math Anal Appl* 252:389–401
6. Agarwal RP, Deng S, Zhang W (2005) Generalization of a retarded Gronwall-like inequality and its applications. *Appl Math Comput* 165:599–612
7. Kim YH (2005) On some new integral inequalities for functions in one and two variables. *Acta Math Sinica* 21:423–434

8. Cheung WS (2006) Some new nonlinear inequalities and applications to boundary value problems. *Nonlinear Anal* 64:2112–2128
9. Louartassi Y, Mazoudi EHE, Elalami N (2012) A new generalization of Lemma Gronwall-Bellman. *Appl Math Sci* 6(13):621–628

Chapter 99

A New Calibrating Method for Micro Inertial Measurement Unit

Jie Li, Jun Liu and Qiao Jiang

Abstract Based on analyzing to the existing calibrating methods for Micro Inertial Measurement Unit (MIMU), a new calibrating method for MIMU is proposed, and we take example for the calibrating method for gyros in MIMU, the basic principle of the new method is expounded, and the detail computing process of the new method is deduced. The core thought is that it consider there are 9 installing error angles in MIMU, and 3 corresponding zero basic voltage, and 3 scaling factors, the total num of the need calibrating parameter is 15, meanwhile, consider the correlation among the installing error angles, then, we can separate and resolve every parameter by designing the reasonable calibrating experiment, and then, compensate the error during the navigation computation. The experimental results show the new method presented in this paper is correct and effective.

Keywords MIMU · Calibration · Installing error angles · Zero basic voltage · Scaling factors

99.1 Introduction

In recent years, micro inertial measurement components, such as micro gyroscopes and micro accelerometers and so on, obtain a fast development. Micro Inertial Measurement Unit (shortened as MIMU), which is composed of the micro

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gyroscopes and the micro accelerometers, have the advantages of smaller volume, lighter weight, lower cost, longer using life, higher reliability, stronger environmental adaptability and so on [1, 2], and is widely used in all kinds of different fields including attitude measurement and control, guided weapons and other military and civil fields. So, the research on MIMU has the vital significance [3, 4].

The precision of micro inertial navigation system mainly depends on the precision of the micro inertia components. Therefore, before using it as a whole, it is necessary to calibrate MIMU in order to identify the zero basic voltage, scaling factors of each micro inertia devices and the installing error angles. With the help of these calibrated parameters, we can make use of the output information from MIMU into practical fields to resolve the linear acceleration and angular speed in carrier coordinate system and provide more accurate input information for the navigation computation and attitude solution [5–8].

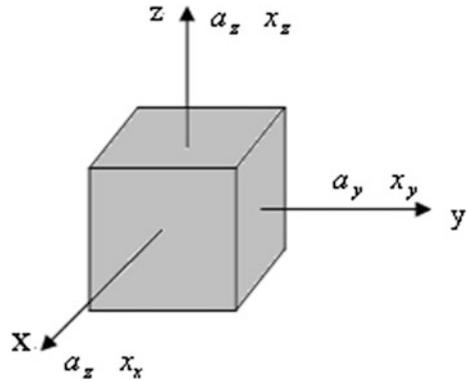
The existing calibrating methods for MIMU generally believe there are 12 parameters need to calibrate in each gyroscope or accelerometer, including 3 zero basic voltage, 6 installing error angles, and 3 corresponding scaling factors. Among them, 6 installing error angles are the angles between each sensitive axial direction of inertial sensor and other two axial directions in carrier coordinate system, 3 corresponding scaling factors are defined as proportional relationship of the output voltage value of inertia devices installed on each axial direction to linear acceleration or angular speed on the corresponding axial direction [9–11]. Different from the existing calibrating methods, the new calibrating method proposed in this article, believe the parameters of gyroscope or accelerometer need to calibrating in MIMU are 15, namely 3 zero basic voltage, 9 installing error angles and 3 corresponding scaling factors. Among them, 9 installing error angles are not only the angles between each sensitive axial direction of inertial sensor and other two axial directions in carrier coordinate system, but also the angles between the sensitive direction of inertial sensors and their own installing axial directions, 3 corresponding scaling parameters are defined as the proportion of the output voltage value of inertia devices installed on each axial direction to linear acceleration or angular speed in inertial sensor sensitive direction.

99.2 Calibrating Principle of Micro Gyroscope in MIMU

As shown in Fig. 99.1, 3 micro mechanical gyroscopes and 3 micro mechanical accelerometers, whose sensitive directions are mutually vertical, are separately installed on 3 orthogonal surfaces of the cube to measure the linear acceleration and angular speed of the carrier on 3 axes in inertial coordinate system. In Fig. 99.1. x_x , x_y and x_z stand for the micro gyroscope output, a_x , a_y and a_z are the micro accelerometer output.

In terms of the requirement of solving model for micro strap-down inertial navigation system (SINS), 3 micro gyroscopes, installed on 3 mutual orthogonal

Fig. 99.1 Sensitive direction of the micro inertia components in MIMU

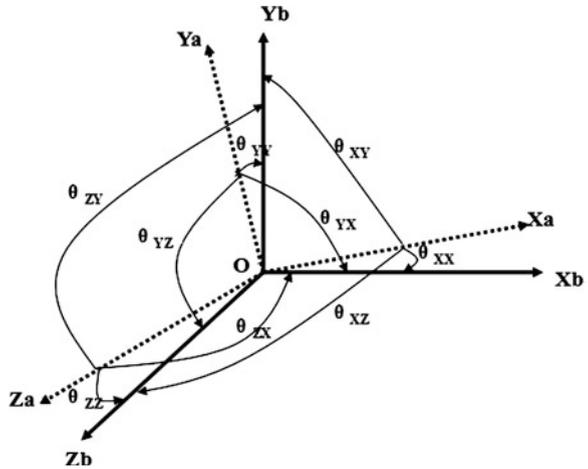


surfaces, are used for obtaining the rotating angular velocity of 3 correspondence directions in the sensitive space and output the correspondence voltage value. However, due to the existence of installing error angles in the practical application, 3 micro gyroscopes' sensitive directions actually make up of a non-orthogonal coordinates and their output voltage are not able to directly stand for the rotating angular velocity in the orthogonal coordinates. So it will give rise to a large error if we carry on the navigation resolving with the output information of the micro gyroscope without calibration. Therefore, it is necessary to design a reasonable calibrating experiment before using to calibrate the micro gyroscopes of spatial 3 directions and compensate installing error by translating output information of the micro gyroscope in the non-orthogonal coordinates into the rotating angular velocity of carrier in the orthogonal coordinates.

In the measurement of attitude and position, the zero basic voltage of micro gyroscopes has a large influence on the computed results. Therefore, it is essential to carry on the calibration and compensation before using them. Moreover, the installing errors, mainly caused by the non-orthogonality of hexahedron, will seriously affect the measurement results. The author mainly uses the output of the micro gyroscopes to carry on the calibration for various error angles. As shown in Fig. 99.2, $ox_b y_b z_b$ is the orthogonal coordinates, $ox_a y_a z_a$ is the non-orthogonal coordinates system constituted by the real sensitive directions of the gyroscopes.

In Fig. 99.2, the installing error angles of 3 gyroscopes are respectively: $\theta_{xx}, \theta_{xy}, \theta_{xz}, \theta_{yx}, \theta_{yy}, \theta_{yz}, \theta_{zx}, \theta_{zy}, \theta_{zz}$; Among them, θ_{ab} stands for the angle between a_i and b_j (namely the angle between i sensitive direction of micro gyroscope and j direction in the carrier coordinate system). The corresponding scaling factors of 3 micro gyroscopes are respectively: k_{gx}, k_{gy}, k_{gz} ; The zero basic voltage are respectively: $u_{gx0}, u_{gy0}, u_{gz0}$; 3 axial directions in the carries system are respectively b_x, b_y, b_z , the sensitive directions of 3 micro gyroscopes are respectively a_x, a_y, a_z . Let the MIMU rotate respectively around the x, y , and z axes in different and for/back rate in the carrier coordinate system, then we obtain the following 4 equations sets:

Fig. 99.2 Calibration of installing error



$$\begin{cases} u_{wx}^x - u_{gx0} = \omega_x \cdot \cos(\theta_{xx}) \cdot k_{gx} \\ u_{wx}^y - u_{gy0} = \omega_x \cdot \cos(\theta_{xy}) \cdot k_{gy} \\ u_{wx}^z - u_{gz0} = \omega_x \cdot \cos(\theta_{xz}) \cdot k_{gz} \\ u_{-wx}^x - u_{gx0} = -\omega_x \cdot \cos(\theta_{xx}) \cdot k_{gx} \\ u_{-wx}^y - u_{gy0} = -\omega_x \cdot \cos(\theta_{xy}) \cdot k_{gy} \\ u_{-wx}^z - u_{gz0} = -\omega_x \cdot \cos(\theta_{xz}) \cdot k_{gz} \end{cases} \quad (99.1)$$

$$\begin{cases} u_{wy}^x - u_{gx0} = \omega_y \cdot \cos(\theta_{yx}) \cdot k_{gx} \\ u_{wy}^y - u_{gy0} = \omega_y \cdot \cos(\theta_{yy}) \cdot k_{gy} \\ u_{wy}^z - u_{gz0} = \omega_y \cdot \cos(\theta_{yz}) \cdot k_{gz} \\ u_{-wy}^x - u_{gx0} = -\omega_y \cdot \cos(\theta_{yx}) \cdot k_{gx} \\ u_{-wy}^y - u_{gy0} = -\omega_y \cdot \cos(\theta_{yy}) \cdot k_{gy} \\ u_{-wy}^z - u_{gz0} = -\omega_y \cdot \cos(\theta_{yz}) \cdot k_{gz} \end{cases} \quad (99.2)$$

$$\begin{cases} u_{wz}^x - u_{gx0} = \omega_z \cdot \cos(\theta_{zx}) \cdot k_{gx} \\ u_{wz}^y - u_{gy0} = \omega_z \cdot \cos(\theta_{zy}) \cdot k_{gy} \\ u_{wz}^z - u_{gz0} = \omega_z \cdot \cos(\theta_{zz}) \cdot k_{gz} \\ u_{-wz}^x - u_{gx0} = -\omega_z \cdot \cos(\theta_{zx}) \cdot k_{gx} \\ u_{-wz}^y - u_{gy0} = -\omega_z \cdot \cos(\theta_{zy}) \cdot k_{gy} \\ u_{-wz}^z - u_{gz0} = -\omega_z \cdot \cos(\theta_{zz}) \cdot k_{gz} \end{cases} \quad (99.3)$$

$$\begin{cases} \cos^2(\theta_{xx}) + \cos^2(\theta_{yx}) + \cos^2(\theta_{zx}) = 1 \\ \cos^2(\theta_{xy}) + \cos^2(\theta_{yy}) + \cos^2(\theta_{zy}) = 1 \\ \cos^2(\theta_{xz}) + \cos^2(\theta_{yz}) + \cos^2(\theta_{zz}) = 1 \end{cases} \quad (99.4)$$

The equations set (99.1) demonstrates the relations between output voltage value of the micro gyroscopes on three axes and their angular velocity in the for/back speed rotating around x axis in the carrier coordinate system. Among them, ω_x and ω_y respectively express the forward and back angular velocity, u_{gx0} , u_{gy0} ,

u_{gz0} respectively express zero basic voltage values on x axis,y axis and z axis, u_{wx}^x , u_{wx}^x , u_{wx}^z respectively stand for output voltage value on 3 axes in the forward angular speed rolling around x axis in the carrier coordinate system, u_{-wx}^x , u_{-wx}^y , u_{-wx}^z respectively indicate output voltage value on three axes in the back angular speed rolling around x axis in the carrier coordinate system, θ_{xx} , θ_{xy} , θ_{xz} respectively express the angle between the sensitive directions of the micro gyroscopes in x axis and x axis, y axis and z axis in the carrier coordinate system, k_{gx} , k_{gy} , k_{gz} respectively express the proportion of the output voltage in x axis, y axis and z axis to the angular velocity in the sensitive directions. The equations set (99.2) and equations set (99.3) respectively indicate the relations between output voltage value of the gyroscopes in three axes and corresponding input of angular velocity in the for/back angular speed rolling around y axis and z axis in the carrier coordinate system, the significance of various parameters in equations set (99.2) and (99.3) are completely similar with equations set (99.1); the equations set (99.4) expresses the correlation of 9 installing error angles.

In actual calculation, use the equations set (99.1–99.3) can solve out the corresponding zero basic voltage of the 3 micro gyroscopes: $u_{gx0} = \frac{u_{wx}^x + u_{-wx}^x}{2}$, $u_{gy0} = \frac{u_{wy}^y + u_{-wy}^y}{2}$, $u_{gz0} = \frac{u_{wz}^z + u_{-wz}^z}{2}$; Then, we can solve 12 mutually independent equations like type (1) to type (12) afterwards, and obtain 12 calibrating parameters including the surplus 9 installing error angles and 3 scaling factors.

Make $\Delta_1 = u_{wx}^x - u_{gx0}$, $\Delta_2 = u_{wy}^y - u_{gy0}$, $\Delta_3 = u_{wz}^z - u_{gz0}$, $\Delta_4 = u_{wy}^x - u_{gx0}$, $\Delta_5 = u_{wy}^y - u_{gy0}$, $\Delta_6 = u_{wz}^z - u_{gz0}$, $\Delta_7 = u_{wz}^x - u_{gx0}$, $\Delta_8 = u_{wz}^y - u_{gy0}$, $\Delta_9 = u_{wz}^z - u_{gz0}$, by type (99.1)–(99.4)we can get the results:

$$\begin{cases} \omega_x^2 \cdot k_{gx}^2 = \Delta_1^2 + \Delta_4^2 + \Delta_7^2 \\ \omega_y^2 \cdot k_{gy}^2 = \Delta_2^2 + \Delta_5^2 + \Delta_8^2 \\ \omega_z^2 \cdot k_{gz}^2 = \Delta_3^2 + \Delta_6^2 + \Delta_9^2 \end{cases} \quad (99.5)$$

Then,

$$\begin{cases} k_{gx} = \frac{\sqrt{\Delta_1^2 + \Delta_4^2 + \Delta_7^2}}{\omega_x} \\ k_{gy} = \frac{\sqrt{\Delta_2^2 + \Delta_5^2 + \Delta_8^2}}{\omega_y} \\ k_{gz} = \frac{\sqrt{\Delta_3^2 + \Delta_6^2 + \Delta_9^2}}{\omega_z} \end{cases} \quad (99.6)$$

After figuring out 3 zero basic voltage of the micro gyroscopes: u_{gx0} , u_{gy0} , u_{gz0} and 3 scaling factors: k_{gx} , k_{gy} , k_{gz} , in turn, substitute them into type (99.1)–(99.3), and figure out 9 installing error angles: $\theta_{xx} = \arccos(\frac{\Delta_1}{\omega_x \cdot k_{gx}})$, $\theta_{xy} = \arccos(\frac{\Delta_4}{\omega_x \cdot k_{gy}})$, $\theta_{xz} = \arccos(\frac{\Delta_7}{\omega_x \cdot k_{gz}})$, $\theta_{yx} = \arccos(\frac{\Delta_4}{\omega_y \cdot k_{gx}})$, $\theta_{yy} = \arccos(\frac{\Delta_5}{\omega_y \cdot k_{gy}})$, $\theta_{yz} = \arccos(\frac{\Delta_8}{\omega_y \cdot k_{gz}})$, $\theta_{zx} = \arccos(\frac{\Delta_7}{\omega_z \cdot k_{gx}})$, $\theta_{zy} = \arccos(\frac{\Delta_8}{\omega_z \cdot k_{gy}})$, $\theta_{zz} = \arccos(\frac{\Delta_9}{\omega_z \cdot k_{gz}})$.

Therefore, after detecting the output voltage of 3 micro gyroscopes: u_{gx} , u_{gy} , u_{gz} in practical application, should defer to the type (99.7) to calculate angular

velocity of 3 micro gyroscopes on own axial directions firstly, namely the angular velocity on each axis in non-orthogonal coordinates like type (99.8):

$$\begin{cases} \omega a_x = \frac{u_{gx} - u_{gx0}}{k_{gx}} \\ \omega a_y = \frac{u_{gy} - u_{gy0}}{k_{gy}} \\ \omega a_z = \frac{u_{gz} - u_{gz0}}{k_{gz}} \end{cases} \quad (99.7)$$

$$\begin{cases} \omega b_x = \omega a_x \cdot \cos(\theta_{xx}) + \omega a_y \cdot \cos(\theta_{xy}) + \omega a_z \cdot \cos(\theta_{xz}) \\ \omega b_y = \omega a_x \cdot \cos(\theta_{yx}) + \omega a_y \cdot \cos(\theta_{yy}) + \omega a_z \cdot \cos(\theta_{yz}) \\ \omega b_z = \omega a_x \cdot \cos(\theta_{zx}) + \omega a_y \cdot \cos(\theta_{zy}) + \omega a_z \cdot \cos(\theta_{zz}) \end{cases} \quad (99.8)$$

99.3 Calibrating Plans for the Micro Gyroscopes

- (1) Align 3 axial directions of MIMU with 3 axial directions of 3 axial multi-purpose rotary table, and carry on the for/back speed in different angular velocity;
- (2) Measure and record each axial output voltage of micro gyroscopes when the rotary table is running stable at the hypothesis rotational speed. It is important to neglect the period of starting acceleration and finally stops;
- (3) Calculate the average output voltage of sampling point which is in correspondence with different input angular velocity and fill them into forms;
- (4) Import the experimental data which is recorded by (3), use the calibrating formulas to resolve 3 zero basic voltage, 3 scaling factors and 9 installing error angles of 3 micro gyroscopes.

99.4 Experiments and Analysis of Calibration for Micro Gyroscopes

In order to prove the accuracy and validity of the new calibrating method which proposed in this paper, the author combines with the research project in application for the micro inertial measurement system to carry on the test and calibration. Table 99.1 lists the partial data which are recorded in calibrating experiments of the micro gyroscopes on June 18, 2007. Restricted by the length of article, Table 99.1 only lists the corresponding output voltage of 3 micro gyroscopes at the angular velocity of ± 60 deg/s in the carrier orthogonal system.

According to the new calibrating method and the test data in Table 99.1, we can conveniently solve the calibrating parameters as shown in Table 99.2. There is no need to amplify the resolving process.

Table 99.1 Metrical data for micro gyroscope in MIMU

Input angular speed (deg/s)	X axis (V)	Y axis (V)	Z axis (V)
x axis 60:	Ugx1 = 3.8772;	Ugy1 = 2.5285;	Ugz1 = 2.5217
x axis -60:	Ugx2 = 1.2118;	Ugy2 = 2.5305;	Ugz2 = 2.5270
y axis 60:	Ugx3 = 2.5486;	Ugy3 = 3.8574;	Ugz3 = 2.5305
y axis -60:	Ugx4 = 2.5395;	Ugy4 = 1.2034;	Ugz4 = 2.5187
z axis 60:	Ugx5 = 2.5536;	Ugy5 = 2.4970;	Ugz5 = 3.8559
z axis -60:	Ugx6 = 2.5343;	Ugy6 = 2.5638;	Ugz6 = 1.1947

Table 99.2 Calibrating results of 15 parameters for micro gyroscopes in MIMU

15 calibration parameters	The value of 15 calibration parameters		
3 zero bias voltage (V)	Ugx0 = 2.5442	Ugy0 = 2.5301	Ugz0 = 2.5247
3 scale factors (V/deg/s)	Kgx = 1.2730	Kgy = 1.2679	Kgz = 1.2712
9 installment error angles (deg)	Θ_{xx} = 0.4480	Θ_{xy} = 0.0690	Θ_{xz} = 0.1313
	Θ_{yx} = -0.1905	Θ_{yy} = 1.4302	Θ_{yz} = -0.2475
	Θ_{zx} = -0.4054	Θ_{zy} = 1.4285	Θ_{zz} = 0.2802

Using the above calibrating results, we can calibrate and compensate the measurement information of MIMU in the practical application, then accurately resolve the angular velocity and strength on each axis in the carrier coordinate system by the output information of MIMU and provides the reliable input information for the attitude resolving and navigational computation.

The massive experimental results indicate that using the new calibrating method proposed in this article will be good for the precision of the angular velocity and strength basically enhancing 1–3 order of magnitudes compared to that before the compensation. Restricted by the article length, the author will no longer give the detailed contrast relational graph about the compensation, the reader who is interested in it can contact and exchange with the author.

99.5 Conclusions

On the basis of analyzing the existing calibrating methods of micro inertia measurement unit, this article proposes a brand-new method to calibrate the MIMU, and it is a new understanding and annotation to the calibration of MIMU. Besides the zero basic voltage, the other parameters need to calibrate has the different physics significance with the corresponding ones in the existing calibrating method. After the detailed derivation to the process of separating and resolving all the parameters need to calibrate, the author makes an essential explanation combining with practical application and elaborates the new method through theory and experiment.

It is worth to emphasize that the new calibrating method is not the denial to the existing calibrating methods. On the contrary, it is a beneficial deepening and supplement to the existing calibrating methods. Combined with the existing calibrating methods, the calibrating technology will be bound to be more substantial and perfect. All the methods can calibrate and compensate the output information of MIMU correctly and effectively and provide accurate and reliable input information for the following navigation algorithm.

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References

1. Henggao Ding (1996) Micro inertial measurement unit. *J Chin Inert Technol* 4(1):1–5
2. Liu J, Shi Y, Li J (2005) *Micro inertial technology*. Publishing House of Electronics Industry, Beijing 10(1):198–204
3. Davis BS (1998) Using low-cost MEMS accelerometers and gyroscopes as strap-down MIMUs on rolling projectiles. *Aerosp Electron Syst Soc* 11(3):594–601
4. Saurabh G (2006) Performance evaluation of low cost MEMS-based IMU integrated with GPS for land vehicle navigation application. MASTER Dissertation, Calgary, Alberta 12(2):37–45
5. Liu J (2001) The testing and measurement technology research of space-time position of Micro rate strap-down inertial measurement unit. Doctor Dissertation, Beijing Institute of Technology, 10(30):746–752
6. Eun-Hwan S (2005) Estimation techniques for low-cost inertial navigation. Doctor Dissertation, Calgary, Alberta, 102(12):1102–1108
7. Ming-li Ding, Wang Qi, Du Zu-liang (2006) An error compensation method of angular velocity of NGIMU based on grey forecasting theory. *Acta Electronica Sinica* 21(4):642–644
8. Li Jie, Liu Jun, Zhang Wendong (2006) Mems based micro inertial measurement system. *Wseas Trans Circuits Syst* 1(5):691–696
9. Miao Yan, Hai-na Weng, Ying Xie (2006) Calibration for system parameters and scaling for installation errors of IMU. *J Chin Inert Technol* 14(1):27–29
10. Zhu Rong, Zhou Zhaoying (2006) Calibration of three-dimensional integrated sensors for improved system accuracy. *Sens Actuators A* 127(1):340–344
11. Bao-lun Yuan, Gu-yin Rao (2007) A new calibration technique for RLG IMU. *J Chin Inert Technol* 15(1):31–34

Chapter 100

Wavelet Frequency Domain Weighted Multi-modulus Blind Equalization Algorithm Based on Lower Order Statistics

Jun Guo, Ye-cai Guo, Fang Xu and Qu Chen

Abstract The characteristics of multi-modulus signal and α -stable distribution noise are analyzed, wavelet transform frequency domain weighted multi-modulus blind equalization algorithm based on fractional lower order statistics (WT-FLOSFWMMA) is proposed. The proposed algorithm first uses the fractional lower order statistics to suppress α -stable distribution noise and uses the minimum dispersion coefficient criterion instead of the traditional least mean square error criterion to optimize the multi-modulus blind equalization algorithm, on the other hand, its computational loads can be reduced by using Fast Fourier Transform (FFT) technique and the overlapping retention law, and orthogonal wavelet transform is used to improve the convergence rate. The simulations in underwater acoustic channels show that the proposed algorithm has faster convergence speed and smaller steady state error, so it can be used in underwater acoustic communication.

Keywords Fractional lower order statistics · α -stable distribution noise · Weighted multi-modulus blind equalization · Orthogonal wavelet · Multi-modulus signal

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100.1 Introduction

In underwater communication system, inter-symbol interference caused by bandwidth limited multipath spread is the main factors affecting the quality of communication, equalization technology without launching periodic training sequence is required to eliminate it and can save the bandwidth, so it is an effective means of overcoming inter symbol interference. The constant modulus algorithm (CMA) proposed by Sato and Godard is the most widely used blind equalization technique and can equalize the equalizer output signal to a circle with radius R , which is the emission signal statistics module value. It has a good equalization effect for constant modulus signal, whereas for multi-modulus signal, i.e., the constellations distributed in several circles of different radius, CMA will make the equalizer output signal to a fixed circle and result in the updated error of equalizer weight vector, equalization performance are affected. While the multi-modulus blind equalization algorithm (MMA) [1] can use amplitude and phase information of equalizer input signal at the same time, it can effectively correct the multi-modulus signal phase rotation.

In the traditional communication channel equalization, the channel noise is assumed to be as Gauss noise. However, a lot of noise in actual performance is not Gauss noise, such as underwater acoustics noise, low frequency atmospheric noise, as well as many man-made noise, α -stable distribution [2] usually is used to describe this kind of noise and it is a generalized Gauss distribution, the distribution of its probability density function has a thicker tail. In the α -stable distribution noise, the performances of many algorithms based on the Gauss noise model appeared significantly degraded, even lead to erroneous results. Therefore, the CMA based on the two order statistics of signals is no exception.

In this paper, according to the α -stable distribution model proposed in literature [3] and the minimum average p norm (LMP) adaptive equalization algorithm based on fractional lower order statistics [4], on the conditions of α -stable distribution noise, after we combine the fractional lower order statistics with frequency weighted multi-modulus blind equalization algorithm and orthogonal wavelet transform [5], FWMMA based on the lower order statistics is proposed and its performance is tested by underwater acoustic channels.

100.2 Orthogonal Wavelet Transform Frequency Domain Weighted Multi-modulus Blind Equalization Algorithm

Frequency weighted multi-modulus blind equalization algorithm is to make the traditional multi-modulus blind equalization algorithm turn into the frequency weighted equalization algorithm. Firstly, time domain equalizer input signal $y(n)$ is changed into the frequency domain signal $Y(n)$. Secondly, time domain blind equalization algorithm is transformed into the frequency domain blind equalization

algorithm. According to the weight vector formula of traditional weighted multi-modulus blind equalization algorithm, Frequency weighted multi-modulus blind equalization algorithm weight vector formula can be rewritten as:

$$\begin{aligned}
 F_r(n+1) &= F_r(n) - 4\mu E_r(n)Z_r(n)Y_r^*(n) \\
 F_i(n+1) &= F_i(n) - 4\mu E_i(n)Z_i(n)Y_i^*(n)
 \end{aligned}
 \tag{100.1}$$

where, $F_r(n)$ and $F_i(n)$ represent the real part and imaginary part vector of frequency domain equalizer weight vectors, respectively. $Z_r(n)$ and $Z_i(n)$ are the real component and imaginary component of the frequency domain blind equalizer output signals, respectively. $E_r(n)$ and $E_i(n)$ are FFT of the time domain error function real part $e_r(n) = (|z_r(n)|^2 - R_r)$ and the time domain error function imaginary part $e_i(n) = (|z_i(n)|^2 - R_i)$, respectively. R_r and R_i represent the real weighted and imaginary weighted parts of signal statistical source module, respectively. Frequency weighted multi-modulus algorithm mainly changes the equalizer input signal $y(n)$ into L long block [6] (L is equalizer weight vector length), the equalizer output signal $Z(n)$ are L long block, too. Weight vector is updated using every L sample points, each updating of weight vector is controlled by the accumulation result with L error signal sample points in order that the frequency weighted multi-modulus algorithm and time constant modulus algorithm have the same convergence speed, at the same time, the (Fast Fourier Transform) technique, which replaces linear convolution with series circular convolution, is used to greatly reduce the amount of computation.

The orthogonal wavelet transform is introduced into frequency domain weighted multi-modulus blind equalization algorithm to reduce auto-correlation of the equalizer input signals. After the real part and imaginary part of signals are transformed by wavelet function, the real part and the imaginary part of signals are transformed by FFT, the transformed signals are regarded as the frequency domain equalizer input signals, at the end, the frequency domain equalizer output signals are again transformed by IFFT, so the time domain output signals are obtained. Principle is shown in Fig. 100.1.

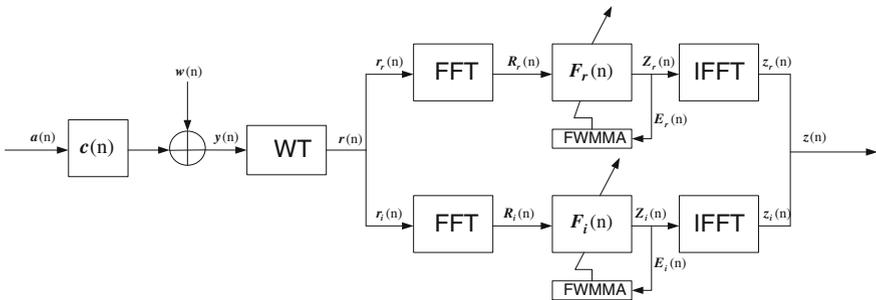


Fig. 100.1 The principle diagram of frequency domain weighted multi-modulus blind equalization algorithm based on orthogonal wavelet transform

In Fig. 100.1, $a(n)$ is input signal, $c(n)$ is channel, $w(n)$ is α -stable distribution noise, $y(n)$ is the signal with noise, $r_r(n)$ and $r_i(n)$ are the real component and imaginary component of signal after orthogonal wavelet transform, $R_r(n)$ and $R_i(n)$ are the signals after FFT, $Z_r(n)$ and $Z_i(n)$ are frequency domain equalizer output signals.

According to orthogonal wavelet theory and Fig. 100.1, we have

$$r(n) = Qy(n) \tag{100.2}$$

where Q is orthogonal wavelet transform matrix, the equalizer outputs are given by

$$\begin{aligned} Z_r(n) &= F_r(n)R_r(n) \\ Z_i(n) &= F_i(n)R_i(n) \end{aligned} \tag{100.3}$$

For frequency domain weighted multi-modulus blind equalization algorithm based on orthogonal wavelet transform (WT-FWMMMA), weight vector iteration formula can be written as

$$\begin{aligned} F_r(n+1)F_r(n) - 4\mu\widehat{R}^{-1}(n)E_r(n)Z_r(n)Y_r^*(n) \\ F_i(n+1)F_i(n) - 4\mu\widehat{R}^{-1}(n)E_i(n)Z_i(n)Y_i^*(n) \end{aligned} \tag{100.4}$$

where, $\widehat{R}^{-1}(n) = \text{diag}[\sigma_{j,0}^2(n), \sigma_{j,1}^2(n), \dots, \sigma_{j,k_j}^2(n), \sigma_{j+1,0}^2(n), \dots, \sigma_{j+1,k_j}^2(n)]$, $\text{diag}[\cdot]$ is a diagonal matrix, $\sigma_{j,k_j}^2(n)$ and $\sigma_{j+1,k_j}^2(n)$ denote the average power estimation of $r_{j,k_j}(n)$ and $s_{j,k_j}(n)$. They can be given by the following recursive equations

$$\begin{aligned} \sigma_{j,k_j}^2(n+1) &= \beta_\sigma \sigma_{j,k_j}^2(n) + (1 - \beta_\sigma) |r_{j,k_j}(n)|^2 \\ \sigma_{j+1,k_j}^2(n+1) &= \beta_\sigma \sigma_{j+1,k_j}^2(n) + (1 - \beta_\sigma) |s_{j,k_j}(n)|^2 \end{aligned} \tag{100.5}$$

where, $r_{j,k}(n)$ is wavelet transform coefficients, $s_{j,k}(n)$ is scale transform coefficients, β_σ is smoothing factor and $0 < \beta_\sigma < 1$, the value of β_σ is generally close to 1.

100.3 α -Stable Distribution Noise

α -stable distribution noise without the given probability density function, it is described by following characteristic function. I.e.,

$$\varphi(t) = \begin{cases} \exp\{jat - \gamma|t|^\alpha [1 + j\beta\text{sgn}(t) \tan(\frac{\pi\alpha}{2})]\}, & \alpha \neq 1 \\ \exp\{jat - \gamma|t|^\alpha [1 + j\beta\text{sgn}(t) \frac{2}{\pi} \lg|t|]\}, & \alpha = 1 \end{cases} \tag{100.6}$$

where, $\alpha \in (0,2]$ is characteristic index and denote α -stable distribution probability density function tail thickness, smaller is its value, thicker is its trailing γ is dispersion coefficient, which is similar to the variance of Gaussian noise, $\alpha \in R$ is location parameter and represents the mean or median of the distribution;

$\beta \in [-1, 1]$ is symmetric parameter, when $\beta = 0$, $\alpha = 0$, α -stable distribution becomes symmetric α -stable distribution, which is called as $S\alpha S$.

α -stable distribution noise has thicker statistical tailing than the Gaussian distribution noise, thus its time domain waveform has obvious peak pulse characteristics, the characteristics makes the performance of some algorithms such as LMS, CMA based on two order statistics and Gaussian noise failure. In this paper, according to the computer simulation steps of α -stable random variables, a wavelet frequency domain weighted multi-modulus blind equalization algorithm based on lower order statistics is proposed.

100.4 Wavelet Frequency Domain Weighted Multi-modulus Blind Equalization Algorithm Based on Lower Order Statistics

In the Gaussian noise environment, we usually use two-order statistics of signals as an important means of analyzing and processing signals, such as the minimum mean square error criterion [7]. In α -stable distribution noise, we use minimum dispersion coefficient criterion, which is similar to the mean square error criterion, to analyze and process signals, and realize the minimization of average amplitude of estimation error. In this paper, after we will combine the criterion with the frequency domain weighted multi-modulus blind equalization algorithm based on orthogonal wavelet transform, the cost function of wavelet frequency domain weighted multi-modulus blind equalization algorithm based on lower order statistics is written as

$$J = E(|e_r(n)|^p) + E(|e_i(n)|^p) \quad (0 < p < \alpha < 2) \tag{100.7}$$

For the α -stable noise, its two order statistics are not limited, so we define the frequency domain error function as

$$\begin{aligned} E_r(n) &= \sqrt{R_{FFTr}} - |Z_r(n)| \\ E_i(n) &= \sqrt{R_{FFTi}} - |Z_i(n)| \end{aligned} \tag{100.8}$$

According to Eq. (100.7) and stochastic gradient method [8], Eq. (100.4) can be rewritten as

$$\begin{aligned} F_r(n + 1) &= F_r(n) + \mu \widehat{R}^{-1}(n) |E_r(n)|^{(p-1)} \cdot \text{sign}(E_r(n)) Z_r(n) R_r^*(n) / |Z_r(n)| \\ F_i(n + 1) &= F_i(n) + \mu R^{-1}(n) |E_i(n)|^{(p-1)} \cdot \text{sign}(E_i(n)) Z_i(n) R_i^*(n) / |Z_i(n)| \end{aligned} \tag{100.9}$$

As the α -stable distribution noise has peak pulse [9], we use the modified method proposed in literature [10] to suppress the abnormal value of the equalizer input. Its idea is to set a threshold value (equalizer input signal power estimated value), if the equalizer input exceeds a threshold value, the pretreatment is done.

100.5 Simulation Experiment and Analysis

In order to verify the performance of WT-FLOSFWMMA, simulation experiments were done in the Gaussian noise environment and α -stable noise environment and we compared FLOSFCMA, WT-FLOSFCMA, and FLOSFWMMA with WT-FLOSFWMMA. In tests, the impulse response of channel was given by $c = [0.3132, -0.1040, 0.8908, 0.3134]$, the step size of FLOSFCMA was set to 0.00003, the step size of WT-FLOSFCMA was set to 0.0045, the step size of FLOSFWMMA was set to 0.00059, the step size of WT-FLOSFWMMA was set to 0.000599, 16QAM modulation signals were selected, the signal to noise ratio was 25 dB, Db2 wavelet was used and its decomposition level was 2, wavelet power initial value was 4, lower order statistics $p = 1.5$, equalizer tap number was 12, for FLOSFCMA, WT-FLOSFCMA, and FLOSFWMMA, their center tap were initialized into 1, the eighth tap of WT-FLOSFWMMA was initialized into 1, weighted factor $\lambda = 0.15$. The 500 Monte Carlo simulation results in the Gaussian noise environment were shown in Fig. 100.2.

Figure 100.2a shows WT-FLOSFWMMA has an improvement of about 200 steps and 100 steps for convergence speed comparison with FLOSFCMA and WT-FLOSFCMA, respectively. WT-FLOSFWMMA has a drop of about 4 dB for the steady-state error comparison with FLOSFCMA and WT-FLOSFCMA.

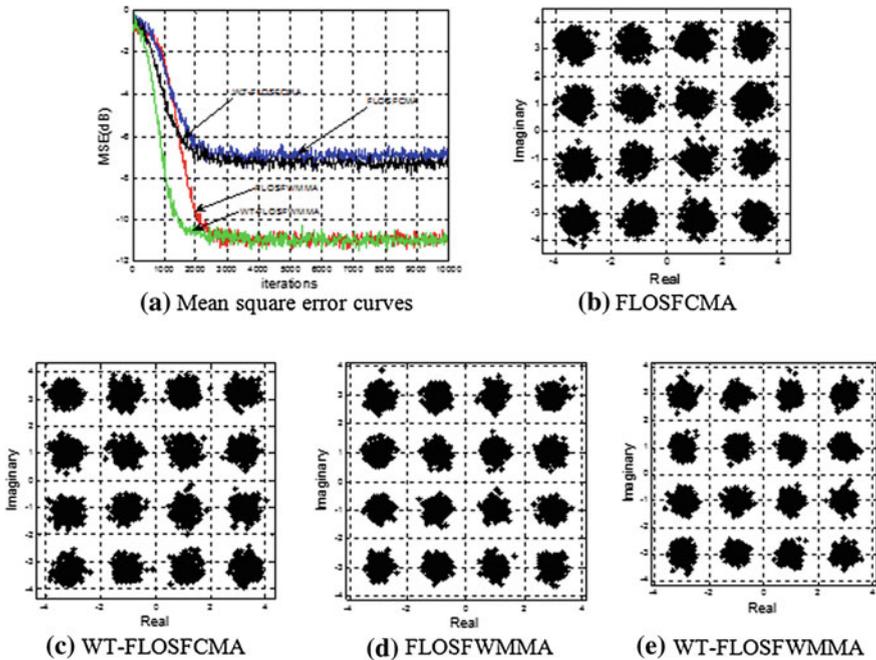


Fig. 100.2 Simulation results under the Gaussian noise. (a) Mean square error curves (b) FLOSFCMA (c) WT-FLOSFCMA (d) FLOSFWMMA (e) WT-FLOSFWMMA

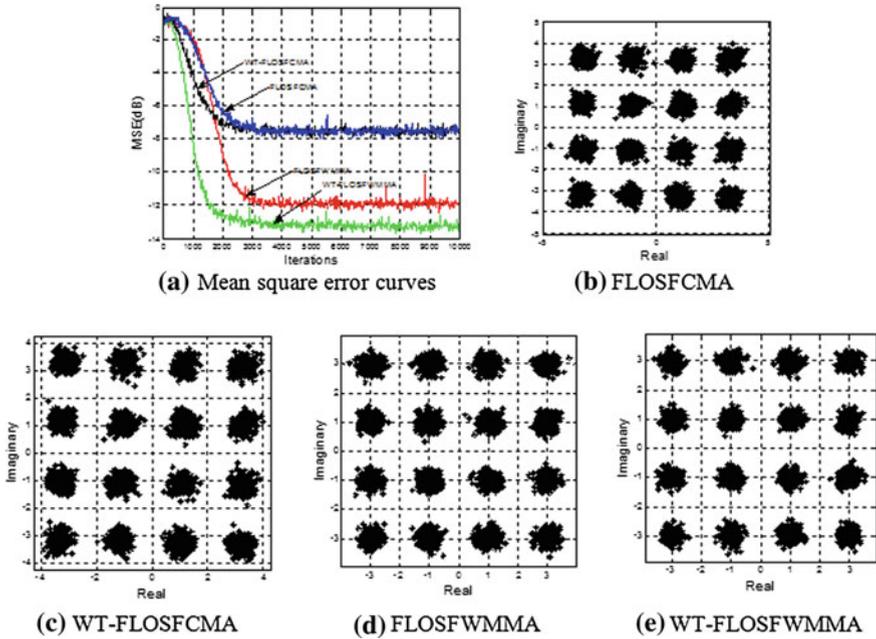


Fig. 100.3 Simulation results under the α -stable distribution noise

Figure 100.2b–e shows that the constellations of FLOSFVCMA and WT-FLOSFVCMA have phase rotation, whereas WT-FLOSFVMMA can correct phase rotation. WT-FLOSFVMMA has an improvement of about 200 steps for convergence speed comparison with FLOSFVMMA. Therefore, when the environment noise is the Gaussian noise, WT-FLOSFVMMA has the best environment adaptability and stability, whereas FLOSFVCMA has the worst environment adaptability and stability.

In the α -stable distribution noise environment, the step size of FLOSFVCMA was set to 0.00025, the step size of WT-FLOSFVCMA was set to 0.0045, the step size of FLOSFVMMA was set to 0.0005, the step size of WT-FLOSFVMMA was set to 0.006, Db2 wavelet was used and its decomposition level was 2, wavelet power initial value was 4, the impulse response of channel was given by $c = [0.3132, -0.1040, 0.8908, 0.3134]$, equalizer tap number was 12, for FLOSFVCMA, WT-FLOSFVCMA and FLOSFVMMA, their fifth tap were initialized into 1, the center tap of WT-FLOSFVMMA was initialized into 1 and the generalized signal to noise ratio (GSNR) was introduced which was defined as $GSNR = 10 \log_{10}(\sigma^2/\gamma)$, σ^2 was the variance of input signal, the GSNR was 30 dB, the characteristics index of α -stable distribution noise was 1.7, $\beta = \alpha = 0$, weighted factor $\lambda = 0.15$. The 700 Monte Carlo simulation results in α -stable distribution noise environment were shown in Fig. 100.3.

Figure 100.3 shows that WT-FLOSFWMMA has an improvement of about 1000 steps for convergence speed comparison with FLOSFWMMA, respectively. The MSE of WT-FLOSFWMMA performs a drop of about 5 dB, 5 dB and 1 dB comparison with the FLOSFMA, the WT-FLOSFMA and the FLOSFWMMA, respectively. Therefore, when the environment noise is the α -stable distribution noise, WT-FLOSFWMMA has the best environment adaptability and stability.

100.6 Conclusions

In this paper, a wavelet frequency domain weighted multi-modulus blind equalization algorithm is suitable for equalizing multi-modulus signals under the α -stable distribution noise. The performance of this proposed algorithm is greatly improved via using fractional lower order statistics, FFT, and overlap save method, as well as wavelet transform. Simulation experiments with underwater acoustic channel show that the proposed algorithm's performance is better than FLOSFMA, WT-FLOSFMA and FLOSFWMMA both in Gaussian noise and in α -stable distribution noise. So the proposed algorithm has great application prospects in underwater acoustic communication field.

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References

1. Han Y (2007) Blind equalizer design and algorithm simulation based on wavelet transform. vol 1(2), pp 98-104, Anhui University Of Science And Technology
2. Zhang JF, Qiu TS, Tang H (2007) Robustness analysis of DLMP algorithm under α -stable noise environment. *Acta Electron* 35(3):515–519
3. Li X (2006) Alpha stable distribution model and its application. *Dr Diss Huazhong Univ Sci Technol* 11(4):379–384
4. Zhao Z, Fu B, Shang J (2008) Adaptive Filter in Wavelet domain under Alpha-stable distribution pulse noise. *9th Int Conf Signal Process (ICSP2008)* 3(48):211–214
5. Yang C (2009) Combined blind equalization algorithms based on wavelet transform. Master thesis, vol 13(44), pp 182-187 Anhui University Of Science And Technology
6. Shuyu F, Heng D (2007) An improved variable step frequency-domain block LMS adaptive filtering algorithm. *Mod Electron Technol* 24(1):144–146
7. Zhang Y, Zhao J, Guo Y, Li J (2011) Blind adaptive MMSE equalization of underwater acoustic channels based on the linear prediction method. *J Marine Sci Appl* 10:113–120

8. Baojun C (2007) The research of signal processing in Alpha stable distribution noise environments. Master thesis, vol 28(2), pp 203-206 Xidian University
9. Zhao ZJ, Kehai D, Shang JN, Kong XZ (2009) Adaptive data block filtering algorithms for the α -stable distribution. *J Circuits Syst* 14(3):28–32
10. Zhang Y, Zhao J, Guo Y, Li J (2010) A improved constant modulus blind equalization algorithm of inhibition of α -stable noise. *J Northwest Polytech Univ* 28(2):203–206

Chapter 101

A Method of Changing Mathematical Model Structure of Duffing Equation

Jian-Qun Han and Hong Sun

Abstract Duffing equation is a kind of important power system. Aiming at the decomposition of this system model, structure of Duffing system is changed by the variable decomposition method. Duffing system with new structure can provide more information on chaos motion. Simulation results show the new running track. This track can describe the running process of Duffing system in details. In addition, the mathematic model established in this paper will help Duffing equation be applied to the field of secret communication and weak signal detection, and it will also be helpful for the study with the existing methods on chaotic communication.

Keywords Duffing equation • Chaos • Simulation

101.1 Introduction

As is known to all, there are many dynamics systems that can produce strange attractors, such as Lorenz system [1], Logistic mapping [2], Henon mapping [3] and Duffing system [4–8]. Definite Duffing equation is a mechanical model proposed by G. Duffing in the nineteenth century when he researched the electrical system, and later worked as an example in the study of nonlinear dynamics, especially in that of the chaos system. A book named *The Fractal Art* and written by Liu Huajie, once

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points out that Yoshisuke Ueda (1936–) at Kyoto University has been in the study of this equation for more than 30 years. A book in the title of *The Road to Chaos* indicates that he has found the chaos earlier than Lorenz, which is just less well known before. In early 1978, he ever used nonlinear inductance, capacitance and sine voltage to establish nonlinear circuit and made the simulation experiment. He discovered the chaos phenomena in nonlinear circuit described in the equation $\ddot{x} + k\dot{x} + x^3 = r \sin(\omega t)$, and opened up a way from quasi-cycle to chaos.

With the constant and further study of chaos theory, chaotic system is widely used in many fields of science and technology. The extraction of effective weak signal from high noise background is an important development direction in chaos application [5–8]. From the research object of above documents, the studies on Duffing equation are taking the form of second-order differential equation or of state equation at present. Through defining variable decomposition of nonlinear restoring force, three-order Duffing state equation is established in this paper, which will be of help to decompose nonlinear variable information from Duffing equation.

101.2 Model of Duffing System

Duffing system [9, 10] produces chaos driven by the external periodic force; its dynamic equation (101.1) is as follows

$$\begin{cases} \dot{x}_1 = x_2 \\ \dot{x}_2 = x_1 - x_1^3 - kx_2 + r \cos \omega t \end{cases} \quad (101.1)$$

where, r and ω are amplitude and frequency of the impressed periodic driving force; k is dumping ratio; $x_1 - x_1^3$ is nonlinear restoring force. Among them, x_1^3 is nonlinear vector? Equation (101.1) is two-dimensional state equation. The target of this paper is to change it into three-dimensional state equation, so that more intuitive information can be obtained from the equation.

Here, let $\dot{x}_3 = 3x_1^2x_2$, if integrate to its both sides, we can get (101.2)

$$\int \dot{x}_3 dt = \int 3x_1^2x_2 dt \quad (101.2)$$

Integral result is shown in (101.3)

$$x_3 = x_1^3 + c \quad (101.3)$$

Among them, c is undetermined constant, it can be determined by value of system initial state. Among them, c is undetermined constant, it can be determined by value of system initial state. But if we want to get the same three dimensional Duffing chaotic system as that in Eq. (101.1), it is required that $c = 0$, otherwise, the system may be non-chaotic; Since the value of c can be determined by value of

Fig. 101.1 Phase diagram of two-dimensional Duffing chaotic system

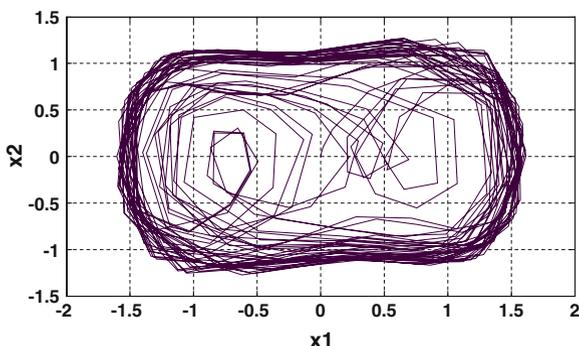
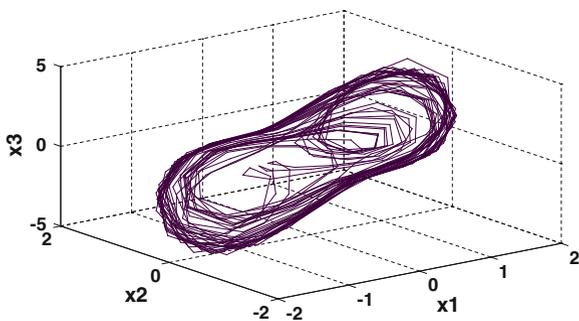


Fig. 101.2 Phase diagram of three-dimensional Duffing chaotic system



system initial state, according to Eq. (101.3), we know that if the initial state of Duffing chaotic dynamic system $x_1 = 0$ and $x_3 = 0$, then, $c = 0$. Through defining above variables, Eq. 101.1) can be modified as (101.4)

$$\begin{cases} \dot{x}_1 = x_2 \\ \dot{x}_2 = x_1 - kx_2 - x_3 + r \cos \omega t \\ \dot{x}_3 = 3x_1^2 x_2 \end{cases} \quad (101.4)$$

101.3 Simulation of System

From document [6], we know that there exists chaotic region in Duffing dynamic system. Let $k = 0.5$, $\omega = 1$, then $k_d = 0.84$; when $k = k_d$, system is not chaotic, it is at the margin. In the condition of $k > k_d$, system is chaotic. In this paper, let $r = 0.72$, system initial state $x_1 = 0$, $x_2 = 1$, $x_3 = 0$, two-dimensional Duffing system driven by sine signal produces chaotic phase diagram as shown in Fig. 101.1; three-dimensional Duffing system's chaotic phase diagram is shown in Fig. 101.2. In this figure, x_1-x_2 is xoy-plane, x_2-x_3 is yoz-plane and x_1-x_3 is projection on

Fig. 101.3 Projection of three-dimensional Duffing chaotic system on x_1 - x_2 plane

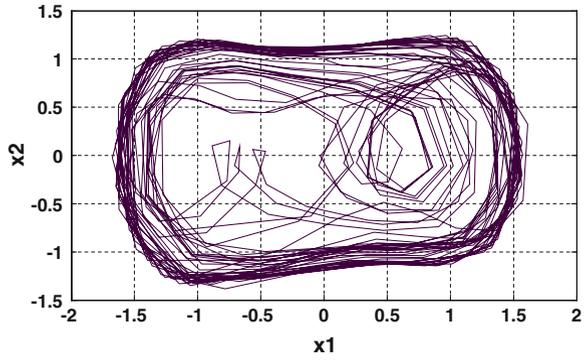


Fig. 101.4 Projection of three-dimensional Duffing chaotic system on x_2 - x_3 plane

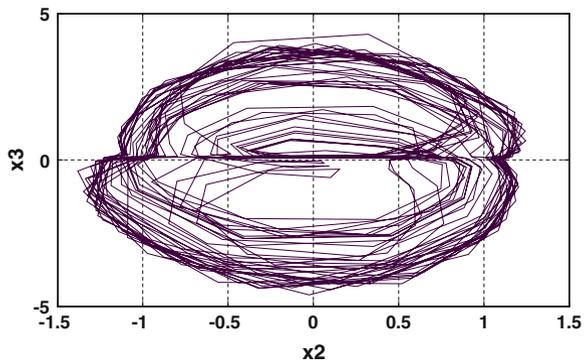
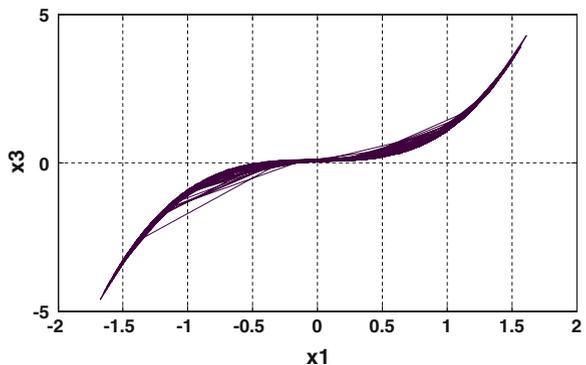
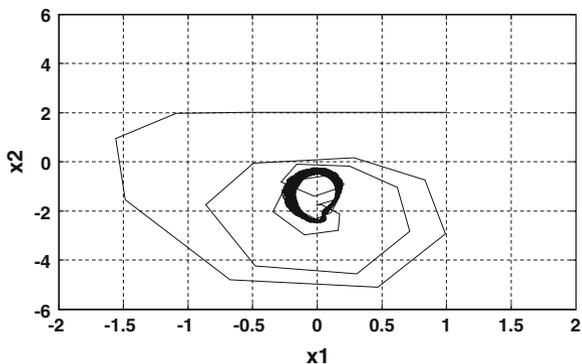


Fig. 101.5 Projection of three-dimensional Duffing chaotic system on x_1 - x_3 plane



zo z -plane as shown if Figs. 101.3, 101.4 and 101.5. From the simulation results in Figs. 101.1 and 101.3, we can see that two-dimensional and three-dimensional system are consistent. Figures 101.4 and 101.5 are results that only appear in three-dimensional Duffing chaotic system. The simulation method of Duffing system

Fig. 101.6 Projection of three-dimensional Duffing chaotic system on x_1 - x_2 plane ($c \neq 0$)



proposed in this paper required the system initial state $x_1 = 0$ and $x_3 = 0$, otherwise, system state is non-chaotic. Figure 101.6 is system state diagram when system initial state $x_1 = 0$, $x_2 = 1$, $x_3 = 2$, we can see that system is not chaotic.

101.4 Conclusions

A method of changing two-dimensional Duffing system into three-dimensional one is proved in this paper. And from the actual simulation results, the operation of Duffing system in the three-dimensional state equation is given. Therefore, it is more directly, and this three-dimensional Duffing system is equivalent to two-dimensional one. But for showing more information, Duffing system with this structure is worth further discussing in the future study of weak signal detection and secret communication.

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References

1. Lorenz EN (1963) Deterministic nonperiodic flow. *J Atmos Sci* 20:130–141
2. May RM (1976) Simple mathematical models with very complicated dynamics. *Nature* 261:459–467
3. Zhaohan S, Haijun M (2001) An introduction to nonlinear dynamic system, vol 9. Science Press, Beijing, pp 39–46
4. Guanyu W, Sailing H (2003) A quantitative study on detection and estimation of weak signals by using chaotic Duffing oscillators. *IEEE Trans Circuits Syst-I Fund Theory Appl* 50:945–953
5. Kevin MS (1996) Detection of teleseismic events in seismic sensor data using nonlinear dynamic forecasting. *Int J Bifurcation Chaos* 6(2):367–375

6. Yue L, Baojun Y (2004) The detecting theory of chaotic oscillators, vol 04. The Electronics Industry Publishing House, Beijing, pp 55–56
7. Guanyu W, Sailing H (2003) A quantitative study on detection and estimation of weak signals by using chaotic Duffing oscillators. *IEEE Trans Circuits Syst-I Fund Theory Appl* 50:945–953
8. Chunyan N, Yaowu S (2001) The research of weak signal detection based on cross-correlation and chaos theory. *Chin J Sci Instrum* 22:32–35
9. Hu J, Keren W (2006) Carrier detection method of binary phase shift keyed and direct sequence spread spectrum signals based on Duffing oscillator. In: *ITS telecommunications proceedings. 6th international conference on*, vol 7, pp 1338–1341
10. Wang YS, Ma XL, Wei Y, Fan HD (2007) A new method of weak signal detection using chaos phase change. In: *Electronic measurement and instruments. ICEMI '07. 8th international conference on*, vol 7(3), pp 812–816

Chapter 102

Study on Probability and Statistics in Practice

Baoquan Zhang

Abstract In this paper, the application of probability and statistics in practice is introduced. By focusing on classical probability model, total probability formula, normal distribution, mathematical expectation, limit theorem and other relevant knowledge, the wide applications of probability and statistics in real life are discussed, further revealing the close relationship of probability and statistics with real life, and laying a theoretical basis for solving practical problems with probability, constructing mathematical model, and transferring mathematics.

Keywords Total probability formula · Gaussian distribution · Mathematical expectation · Central limit theorem

102.1 Introduction

British logician and economist Jevons (1835–1882) said that probability theory was the real guide of life, and we would feel very difficult and had no deeds if there was no estimate of probability. This will be introduced from several specific aspects in the following.

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102.2 Application of Classical Probability Model in the Area of Gambling

On half of the fifteenth century, there had been mathematicians attempting to theoretically think about gambling. Probability problems in gambling were always discussed from “Italian mathematician Pacioli, in his book *Arithmetic* published in 1494, proposed stake distribution” to “Jerome (1501–1576) made a theoretical discussion on the stake distribution mentioned by Pacioli again”, “Galileo (1564–1642), one of the founders of natural science, solved the problem of shaking the elbows”, “Pascal and Fermat solved the gambling problem raised by French knight Blaise Pascal on July 29, 1654”, and “Dutch mathematician Huygens (1629–1695) wrote his book *Discussion on Calculation in Gambling*”.

Today, the gaming industry develops like mushroomed after rain. The example in the following is with a very good guiding role in analyzing gaming theory: In the limit of inspection time, there are totally 10 digits or sums drawing attention from people, and the interval for two adjacent digits in a sports lottery ticket “arranged in 3” with the “sum of 14” is as long as 96 terms [1]. Whether this is reasonable can be calculated theoretically. The digits in all positions can be taken into account first: in a term, the probability for a digit in a position at least not to be drawn is $p = [1 - (1 - 0.9^k)^{10}]^3$. This is abstracted as a question of probability, and is essentially solving the “probability for a digit not to appear in the k positions which were arranged by 10 digits from 0 to 9”. Primarily, the probability for a digit not to appear in one of the k positions is considered to be $(\frac{9}{10})^k$; the probability for it not to appear in all k positions is $(\frac{9}{10})^k$; the probability for it to appear in one of the k positions at least is $1 - 0.9^k$; the digit can be any of 0-9, and each digit appearing in this position is equally possible. Therefore, the probability for all 10 digits appearing in this position is $(1 - 0.9^k)^{10}$. According to probability properties, the probability for at least one digit not appearing in this position is $1 - (1 - 0.9^k)^{10}$. There are three positions like this, and thus there is $[1 - (1 - 0.9^k)^{10}]^3$. This question can be discussed repeatedly using probability properties and will be ultimately solved. An example below is given to introduce the role of total probability formula.

102.3 Application of Total Probability Formula in Practice

Total probability formula is very important in the theory of probability [2], and also has been widely applied in practice. Definition below can be introduced first.

Set B_1, B_2, \dots, B_n to be a division of sample space Ω , namely B_1, B_2, \dots, B_n are $B_i \cap B_j = \Phi$ are mutually exclusive ($i \neq j, i, j = 1, 2, \dots, n$), and $\bigcup_{i=1}^n B_i = \Omega$; if

$P(B_i) > 0 (i = 1, 2, \dots, n)$, there is $P(A) = \sum_{i=1}^n P(B_i)P(A|B_i)$ for any event A. In a world's women volleyball tournament, China, Japan, the United States, and Cuba were qualified for semi-final, and the mode of play was shown in Fig. 102.1.

According to previous results, it is assumed that Chinese team beats Japanese team, and therefore the probabilities for American team are 0.9 and 0.4 respectively [3], the probability for Japanese team to beat American team is 0.5. How is the possibility for Chinese team to win the championship? According to above assumption, uncompleted semi-final between Japanese team and American team greatly affects Chinese team to win the championship: the probability for Chinese team to win the championship is 90 % if Japanese team wins, but is only 40 % if American team wins. Before Japanese team and American team do not entered semi-final, it is necessary to give consideration to above two cases (who can win the qualification for semi-final?).

- (1) Mark “Chinese team to win the championship” as event B; “Japanese team beats American team” as event A_1 ($sP(A_1) = 0.5 = 50\%$)
- (2) “American team beats Japanese team” as A_2 ($P(A_2) = 50\%$)

It is obvious that either American team or Japanese team can win. According to probability formula, $n = 2$ can be known.

$P(B) = PA_1P(B|A_1) + P(A_2)P(B|A_2)$ is obtained, in which $PA_1)P(B|A_1)$, $P(A_2)P(B|A_2)$ are two conditional probabilities. $P(B|A_1)$ is the probability of Chinese team to win the championship under the condition that Japanese team beats American team, and there is $P(B|A_1) = 90\%$ according to question meaning; $P(B|A_2)$ is the probability of Chinese team to win the championship under the condition that American team beats Japanese team, and there is $P(B|A_2) = 40\%$ according to question meaning.

From above analysis, before Japanese team and American team do not entered semi-final, the probability of Chinese team to win the championship is estimated to be

$$P(B) = PA_1)P(B|A_1) + P(A_2)P(B|A_2) = 50\%(90\% + 40\%) = 65\%$$

Total probability formula is normal distribution which gives consideration to the entire system and is permeated in all aspects of life, and also plays an

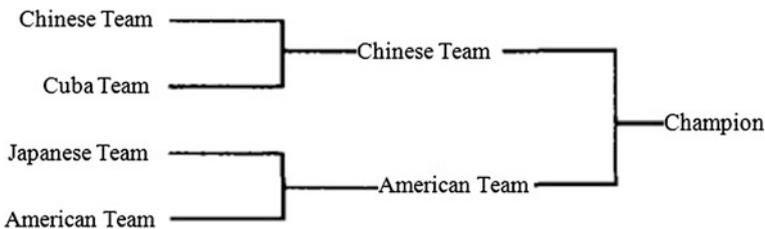


Fig. 102.1 A world's women volleyball tournament

important role in solving many practical problems. The application of normal distribution in practical problems is introduced from aspects in the following.

102.4 Application of Normal Distribution in Practical Problems

First, normal Distribution is one of the most important distributions in the theory of probability [4]. Normal distribution can be used for comparing riding time, and thus a travel route can be selected, as shown in below.

There are two routes from southern suburb to northern suburb railway station to take train. The first route is short and needs people across downtown, but is very busy in traffic. The time (unit: min) required for the first route complies with normal distribution $N(50, 10)$. The second route is long and needs people to go around ring road, but accident jams frequently occur. The time required for the second route complies with normal distribution $N(60, 16)$.

- (1) If 70 min are available, which route should you select?
- (2) If only 65 min are available, which route should you select?

In terms of probability, the first question can be considered early. The probabilities under two conditions can be respectively solved according to the nature of normal distribution if there are 70 min available, and also all normal distributions can be standardized into standard normal distributions according to certain standard. Therefore, using the nature of normal distribution or checking normal distribution table, the probabilities of reaching the destination in time by two routes can be compared. The route with a large probability of reaching the destination in time can be selected. Similarly, the method used in solving question 1 can be applicable to question 2. The solving method is shown below.

- (1) If 70 min are available, the probability of reaching the destination by route 1 is $P(X < 70) = \Phi\left(\frac{70-50}{10}\right) = \Phi(2) = 0.9772$; the probability by route 2 is $P(X < 70) = \Phi\left(\frac{70-60}{4}\right) = \Phi(2.5) = 0.9938$.

Therefore, it can be seen that route 2 should be selected.

- (2) If 65 min are available, the probability of reaching the destination by route 1 is $P(X < 65) = \Phi(1.5) = 0.9332 = \Phi\left(\frac{65-50}{10}\right)$; the probability by route 2 is $P(X < 65) = \Phi\left(\frac{65-60}{4}\right) = \Phi(1.25) = 0.8944$.

Therefore, it can be seen that route 1 should be selected.

Second, normal distribution can help job applicants make analysis and correctly estimate job application situation. For example, an enterprise plans to recruit 300 employees (280 full-time employees and 20 part-time employees) through examination, and 1657 people register for the examination (full mark: 400). After examination, it is known that the result X of applicants approximately obeys normal distribution $N(166, \sigma^2)$; 31 applicants achieve over 360 points. However,

applicant B gets only 256 points. Therefore, will he be employed? Will he be used as a full-time employee?

The solutions to the above two questions are as follows:

- Step 1 Predict the minimum points, and set the minimum points to be X_1 and result of applicants to be X . Therefore, a successful examination, there is $X \sim N(166, \sigma^2)$, because the frequency for applicants with over 360 points is $\frac{31}{1657}$. Thus, there are $P\{X > 360\} = 1 - \Phi\left(\frac{360-166}{\sigma}\right) \approx \frac{31}{1657}$ and $\Phi\left(\frac{194}{\sigma}\right) \approx 1 - \frac{31}{1657} \approx 0.981$. Checking the table, it can be known that there is $194 \approx 2.08$, solving $\sigma \approx 93$. Thus, there is $X \sim N(166, 93^2)$. Because the determination of the minimum points should make the frequency of the applicants employed by the enterprise $\frac{300}{1657}$, namely $P\{X > X_1\} = 1 - \Phi\left(\frac{X_1-166}{93}\right) \approx \frac{300}{1657}$, thus solving $\Phi\left(\frac{X_1-166}{93}\right) \approx 1 - \frac{300}{1657} \approx 0.819$. Checking the table, $\frac{X_1-166}{93} \approx 0.91$ is gained, thus solving $X_1 \approx 251$. That is, the minimum points for the enterprises to employ an applicant are 251.
- Step 2 Predict the ranking of the exam result of B for determine whether he can be employed. If $x = 256$, there is $P\{X > 256\} = 1 - \Phi\left(\frac{256-166}{93}\right) = 1 - \Phi(0.9677) \approx 1 - 0.8315 = 0.1685$ according to the table. This suggests that the frequency for exam result higher than 256 points is 0.1685. That is, the number of the applicants with higher results than applicant B takes 16.8 % of the total. Therefore, the number of the applicants ranking higher than applicant B is solved to be about $1657 \times 16.85\% \approx 280$, namely the result of B ranks about 281, indicating B can only be employed as a part-time employee.

The extensive application of normal distribution has been obvious to all. However, as expectation of numerical characteristics, the role of normal distribution in discussing the optimization of profits is also unique. Therefore, making profit with expectation is discussed below.

102.5 Application of Mathematical Expectation in Solving Maximum Profit

Set the quantity demand (Q) on a product to be 1, 2, 3, 4 & 5 respectively, and the cost producing each product is $C1 = 3\text{RMB}$; the price of each product is $C2 = 9\text{RMB}$; set the charge for each selling product stored in warehouse to be $C3 = \text{RMB}$. Therefore, how many products does the producer need produce for making maximum profit?

The solution to the question needs to set up the function of profit and sales first. Then, profit expectation can be solved, namely solving the function expectation about sales Q [5]. Then, the function about production N relative to T and the

function derivative are solved successively. Finally, result can be gained according to the relationship between primitive function and derived function and the nature of derivative. In addition, work load can be reduced if expectation idea can be applied in activities.

For example, general disease investigation implemented for N persons in an area through blood tests: the plan 1 is to check these persons one by one, and the plan 2 is to check these persons by groups. According to plan 1, checks need to be implemented for N times. Therefore, plan 2 is discussed here. If the positive in test result is “normal” and the negative is “patient”, a group is composed by k persons, and the mixture of blood of these k persons is tested. Therefore, the blood of these persons is negative if the test result is negative. However, if the test result is positive, it is necessary to test these k persons respectively, and there are two possibilities for the test implementation and its mean value can be solved if compared with plan 1.

The method is as follows. It is assumed that the illness frequency rate in this area is p, and then the possibility for test result to be negative is $q = 1 - p$. In this case, the possibilities for test result of the mixed blood of k persons to be negative and positive are q^k and $1 - q^k$ respectively. Then, the times of test for each group is a random variable subject to two-point distribution, namely, as shown in Table 102.1.

Therefore, the average test times necessary for each group is solved to be $E\xi = 1 \times q^k + (1 + k) \times (1 - q^k) = 1 + k - kq^k$ From above calculation result, it can be known plan 2 is better than plan 1 if $1 + k - kq^k < k$, namely $kq^k > 1$ & $q^k > \frac{1}{k}$, and the total test times are $1 + k - kq^k \times N/k$. In a general investigation of a medical institution, the average test times for every 100 persons were 21 because of the application of above group method, and finally work load was reduced. Practical application of center-limit theorem is introduced below.

102.6 Application of Center-Limit Theorem in Practical Problems

Center-limit theorem points out “if a random variable is caused by multitudinous random factors and plays a small role in each large change, the random variable describing the randomness can be judged to approximately obey normal distribution. Therefore, the sum of random variables falls in probability in an interval, and can be calculated approximately with normal distribution as long as it is standardized. In the following, the important role and specific application of the law of large numbers and center-limit theorem are introduced.

Table 102.1 Random variable subject on two-point distribution

ξ	1	$1 + k$
p	q^k	$1 - q^k$

10000 persons of the same age buy insurances from a life insurance company. In the same year, the mortality rate of these persons is 0.1 %, and family members of the dead can receive a pension of 2000 RMB if they pay 10 RMB in the first day of the first year. Therefore, what is the probability for the company to obtain a profit not less than 40000 RMB in a year? What is the probability for it to lose?

Solving: Set the number of the dead in a year to be X and the mortality rate to be $p = 0.001$; whether there are injuries and deaths among the 10000 insured is regarded as 10000 Bernoulli trials. The income of the insurance company is $10000 \times 10 = 100000$ RMB each year, but its expense is only 2000 RMB.

$$\begin{aligned} P(\text{profit not less than } 40000\text{RMB}) &= P\left(0 < X < \frac{10 \times 10000 - 40000}{2000}\right) \\ &= P(0 < X < 30) \end{aligned}$$

Because $np = 10000 \times 0.001 = 10$, $\sqrt{np(1-p)} = \sqrt{10 \times 0.999} \approx 3.161$.

$$\begin{aligned} \text{And } P(0 < X < 30) &= P\left(\frac{X-10}{3.161} < \frac{30-10}{3.161}\right) - P\left(\frac{X-10}{3.161} < \frac{0-10}{3.161}\right) \\ &\approx \Phi(6.327) + \Phi(-3.164) = 0.9992 \end{aligned}$$

Namely, the probability for the insurance company to gain a profit not < 40000 RMB is 0.0008.

102.7 Conclusion

The application of probability in practice can be seen everywhere. Especially in today's rapid development of science and technology and knowledge industrialization, many basic subjects begin to become a dominant element in the life of modern people, and also many aspects of probability are playing or will play their due roles.

References

1. Li G (2006) Empirical analysis on the current situation of China's lottery industry and study on the future development strategies, vol 11. PhD Thesis from Fudan University, pp 6–12
2. Chen W, Huang K et al (2003) Guidance to probability theory and mathematical statistics review—ideas, methods and techniques, vol 32. Tsinghua University Press, Beijing, pp 171–178
3. Wei Z et al (2004) Probability theory and mathematical statistics, vol 14. Higher Education Press, Beijing, pp 78–85
4. Haitao CAI et al (2003) Typical probability theory and mathematical statistics cases and solution, vol 11, issue no 5. National University of Defense Technology Press, Changsha pp 54–59
5. Du Z (2005) The total probability formula and its application. J Zunyi Norm Coll 7(5):76–77

Erratum to: Metaphor-Based Interaction Design in Lighting Area

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“Tangible Light: Back to Metaphor-Based Interaction”, *Computational Intelligence and Design (ISCID)*, 2010 International Symposium on, pp 53–55, Yan Shi; Fangtian Ying; Jinhui Yu; Pengxiang Jia.

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