

International Journal of Management Science Research

OCTOBER 2019 VOLUME2 NUMBER5

Publisher: ADWEN HOUSE PUBLISHING LIMITED
Address:Bramford House 23 Westfield Park, Bristol, United Kingdom
BS6 6LT

E-mail: editor@ijomsr.org
www.ijomsr.org



ADWEN HOUSE PUBLISHING LIMITED

CONTENTS

MULTIFRACTAL DETRENDED MONITORING METHOD FOR VIBRATION STATE OF MARINE DIESEL ENGINE.....	1
QUANTITATIVE CHARACTERIZATION OF TIGHT SANDSTONE RESERVOIR BY CONFOCAL LASER SCANNING MICROSCOPY.....	5
RESEARCH ON APPLICATION AND IMPLEMENTATION OF SPEECH RECOGNITION TECHNOLOGY IN INTELLIGENT ENTRANCE GUARD SYSTEM.....	8
DESIGN AND COMPARISON OF DIGITAL FILTER BASED ON MATLAB.....	13
STUDY THE WORKING EFFICIENCY OF TOBACCO VIBRATING SCREEN MACHINE.....	16
NUMERICAL ANALYSIS OF ICING PROGRESS ON RIB-TUBES OF SEAWATER OPEN RACK VAPORIZER.....	19
RESEARCH ON SIX DEGREE OF FREEDOM SENSOR FOR FORCE/TORQUE MEASUREMENT OF LARGE HEXAPOD PLATFORM.....	25
THE PROGRESS OF MILITARY STRESS RESEARCH AND ITS IMPACT ON PSYCHOLOGICAL IMMUNE FUNCTION.....	28
RESEARCH ON RISK PREVENTION AND EARLY WARNING TECHNOLOGY OF HIGHWAY MOBILE CONTAINERS.....	31
RESEARCH ON THE INTERPERSONAL RELATIONSHIP CRISIS OF COLLEGE STUDENTS IN THE PERSPECTIVE OF NEW MEDIA AND COUNTERMEASURES.....	34
MICROCHANNEL HEAT DISSIPATION ANALYSIS OF HIGH POWER LED.....	37
A BRIEF DISCUSSION ON THE DEVELOPMENT AND DIRECTION OF AI CONTROL SCIENCE IN AUTOMOBILE INDUSTRY.....	40
OVERVIEW OF MOVING TARGET DETECTION ALGORITHMS.....	44
THE DIFFERENCE AND CONNECTION BETWEEN TRADITIONAL ELECTRICAL CONTROL AND PLC CONTROL.....	48
DEVELOPMENT OF CAMPUS RESOURCE SHARING SOFTWARE BASED ON ANDROID PLATFORM.....	52
INNOVATION OF ENTERPRISE MANAGEMENT MODEL IN THE BACKGROUND OF BIG DATA	56
INNOVATION OF SUPPLY CHAIN FINANCE MODEL BASED ON BLOCKCHAIN TECHNOLOGY	59
MONITORING AND TRACKING TECHNOLOGY OF SENSITIVE INFORMATION IN MICROBLOG.....	64
RESEARCH AND APPLICATION OF HEURISTIC ALGORITHMS FOR NURSE SCHEDULING....	67
RESEARCH ON LANDSCAPE DESIGN METHOD BASED ON BIG DATA MINING.....	71
RISKS AND CONTROL MEASURES OF INTERNATIONAL PROCUREMENT FOR PROCESS PACKAGES IN ENGINEERING, PROCUREMENT AND CONSTRUCTION OF LIQUEFIED NATURAL GAS PROJECT.....	75
STYLE LEARNING ALGORITHM BASED ON DEEP LEARNING.....	78

CARBON TEMPERATURE DYNAMIC PREDICTION MODEL BASED ON MACQUARIE ALGORITHM.....	82
RESEARCH ON BALANCE ABILITY OF THE ELDERLY BASED ON LOGISTIC REGRESSION....	86
ENDPOINT PREDICTION OF PSO-RBF CONVERTER STEELMAKING BASED ON BIG DATA....	90
EPIDEMIOLOGICAL STUDY ON SYNTHETIC OPIOIDS.....	98
COLOR AND CONCENTRATION IDENTIFICATION BASED ON REGRESSION MODEL.....	101
ON CLINICAL VALUE OF LOW KV COARSE PITCH COMBINED WITH IRIS IN REDUCTION OF RADIATION DOSE IN CHEST MULTI-SLICE SPIRAL CT EXAMINATION.....	103
COMPREHENSIVE EVALUATION OF COLLEGE STUDENTS BASED ON SELF-ORGANIZING FEATURE MAPPING NEURAL NETWORK.....	106
APPLICATION OF ECONOMETRICS MODELS IN RISK EVALUATION OF LOGISTICS PROJECT	112
ROLLING MILL TEACHING CASE DESIGN OF CONTROL SYSTEM SIMULATION BASED ON THE PLAN FOR “TRAINING OUTSTANDING ENGINEERS”.....	126
STUDY ON STRUCTURED DESCRIPTION OF THE EQUIPMENT SUPPORT DECISION-MAKING DEMAND.....	132
VALUE OF TRADITIONAL CHINESE AND WESTERN MEDICINE NURSING IN CHILDREN’S VIRAL MYOCARDITIS NURSING.....	137
RESEARCH ON HOT SPOT KNOWLEDGE OF EQUIPMENT SUPPORT IN CHINA-A VISUALIZED STUDY BASED ON CNKI DATA WITH CITESPACE.....	140

Multifractal Detrended Monitoring Method for Vibration State of Marine Diesel Engine

Guohe Jiang, Biwen Chen*, Gang Wu, Baoyue Li, Xiangyi Zou

Merchant Marine College, Shanghai Maritime University, Shanghai 201306, China

*E-mail: chenbiwen05@stu.shmtu.edu.cn

Abstract: To explore the working condition of main engine with different influence on its running condition, we run a 500-hour comparison test at low speed main engine in our automation engine room. In this paper, we analyze the resynthesized characteristic signals of frictional vibration by utilizing the multifractal detrended fluctuation analysis algorithm to derive the spectrum and its parameters. The results show that using the multifractal detrended fluctuation analysis spectrum and its parameters can characterize the frictional vibration signals and reflect the running state of diesel engine. The proposed algorithm can provide a reference for studying vibration signal detection of diesel engine.

Keywords: vibration signal; multifractal detrended fluctuation; feature extraction

1. INTRODUCTION

The fault detection and diagnosis technology of diesel engine is developing continuously. The common fault diagnosis methods and technologies [1] include: visual detection method, temperature detection method, oil detection method and spectral diagnosis technology, vibration detection technology, noise analysis technology and indicator diagram technology. In the past two years, many scholars have tried to use new methods for fault diagnosis, such as wavelet -RBF neural network diagnosis [2]. Resonance demodulation technology [3]; Vibration time-frequency image feature fusion method [4]; Time-frequency image polar coordinate enhancement method [5]; T-s fuzzy model method [6] et al.

The multifractal detrended analysis method mentioned in this paper is an unsteady time series analysis method based on detrended wave analysis [7]. It has become a widely used technique for the characteristic detection of non-fixed and non-linear signals. At present, the multifractal detrend analysis method has been used in the processing of various time series data, such as stock market time series [8], permeability monitoring [9], weak target monitoring of sea surface [10] and wear vibration of friction pair [11]. The relative parameters obtained by the multifractal detrend method may be used as an index to calibrate the real-time running state of Marine diesel engines.

In this paper, the comparison test of Marine low-speed diesel engine running for 500 h is taken as an example. In this test, the diesel engine runs continuously for 500 h. In this paper, a group of comparative experiments

under 50% working conditions are selected. There are three groups of data in this comparative experiment, which are vibration signal data corresponding to 150 h operation time, 300 h operation time and 450 h operation time.

In view of the vibration signal data of diesel engine measured in the same working condition and different operating time, the new method of multifractal detrend method is used for signal processing and analysis, in order to realize the real-time detection of diesel engine running state, and to provide a new method and idea for the improvement of vibration detection technology.

2. BASIC PRINCIPLE OF MULTIFRACTAL DETRENDING METHOD

Suppose that x_k is a time series, and the data length is N. The generalized MFdfa procedure includes six steps [5]:

Step 1: Calculate the deviation sequence:

$$Y(i) = \sum_{k=1}^i (x_k - \bar{x}) \quad (i = 1, 2, \dots, N) \quad (1)$$

Step 2: The deviation sequence Y (i) to be divide into $N_s = \text{int}(N/s)$ nonoverlapping segments of equal length s. In order not to disregard a short part at the end of the series, the same procedure is repeated starting from the opposite end. Thereby, $2N_s$ segments are obtained altogether.

Step 3: Calculate the error of mean square for each of the $2N_s$ segments. Then work out the variance:

$$F^2(s, v) = \frac{1}{s} \sum_{i=1}^s \{ Y[v-1]s + i - y_v(i) \}^2 \quad (2)$$

For $v = 1, 2, \dots, N_s$ and:

$$F^2(s, v) = \frac{1}{s} \sum_{i=1}^s \{ Y[N - (v - N_s)s + i] - y_v(i) \}^2 \quad (3)$$

Step 4: Calculate the q^{th} -order fluctuation function:

$$F(q, s) = \left\{ \frac{1}{2N_s} \sum_{v=1}^{2N_s} [F^s(s, v)]^{\frac{q}{2}} \right\}^{1/q} \quad (4)$$

Step 5: For each value of q, analyze log-log plots $F_q(S)$ vs. s:

$$F(q, s) \sim S^{h(q)} \quad (5)$$

Generally, the exponent $h(q)$ depend on q. When q equal 2, the $h(2)$ is identical to the famous Hurst exponent.

Step 6: Calculate the singularity spectrum to characterize a multifractal time series, that is, related to $\tau(q)$ via a Legendre transform, $\tau(q)$ is the mass exponent:

$$\tau(q) = qh(q) - 1 \quad (6)$$

and

$$\alpha = \tau'(q) \quad (7)$$

We obtain:

$$\int(\alpha) = q\alpha - \tau(q) \quad (8)$$

where α is the q -order singularity exponent and $f(a)$ is the q -order singularity dimension. $f(a)$ indicates the dimension of the subset of the series that is characterized by α . The multifractal spectrum gives numerous information about the relative importance of some fractal exponents containing in the time series.

3. PROCESSING AND ANALYSIS OF EXPERIMENTAL DATA

A group of comparative experimental data under 50% working conditions of this experiment was selected. Figure 1 is the time-domain waveform of a period selected from the 40 periodic vibration signals of this set of experimental data. The time domain waveforms of vibration signals corresponding to 150 h operation time, 300 h operation time and 450 h operation time respectively are shown in the figure.

Figure 1 shows that the vibration signal of the test presents non-stationary time-varying characteristics, and the noise is too large. If the vibration signal is analyzed directly, too many noise signals will be counted, which will affect the discovery of the time-varying law of vibration signal, and further affect the extraction of vibration signal characteristics, resulting in the low accuracy of diesel engine state detection. Therefore, for the vibration signal data of 150 h, 300 h and 450 h running time selected in Figure 1, the multi-fractal detrending method is tried to be used to analyze the vibration signal.

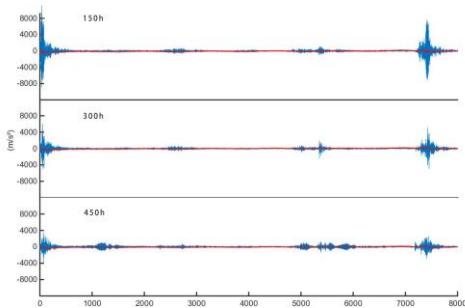


Figure 1. The domain waveform diagram of a periodic vibration signal

The mean value and root mean square of the vibration signal data were calculated, and the obtained mean value and root mean square value were displayed on the time-domain waveform as shown in Figure 2.

It can be obtained that the average value of the vibration signal data is approximately equal to 0. The RMS of the three groups of time series waveform data

is approximately equal to 13. The structures of the three groups of waveforms are quite different, indicating that the RMS value is only sensitive to the difference of change amplitude and not to the difference of waveform timing sequence

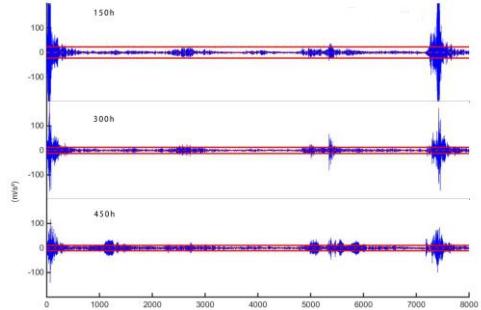


Figure 2. Mean value and mean square root of vibration signal

For a group of vibration signal data, detrend calculation of local time domain waveform is carried out to obtain the detrend waveform, as shown in Figure 3. The red dotted line in the figure is the calculated local detrending waveform line, and the distance between the red dotted line and the red solid line represents the RMS value. These local detrending waveforms are the basic elements of the multifractal detrending method.

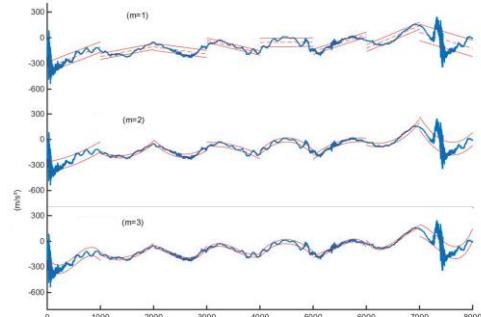


Figure 3. Detrending waveform of vibration signal
 $S = 16, 32, \dots, 1024$; The mean square root of the interval detrend waveform line was obtained by detrend calculation for each interval, as shown in Figure 4. The blue line is the RMS of each interval, and the red line is the overall RMS. It can be obtained that the RMS values of different interval lengths are significantly different. As the interval length decreases, the overall RMS becomes more accurate.

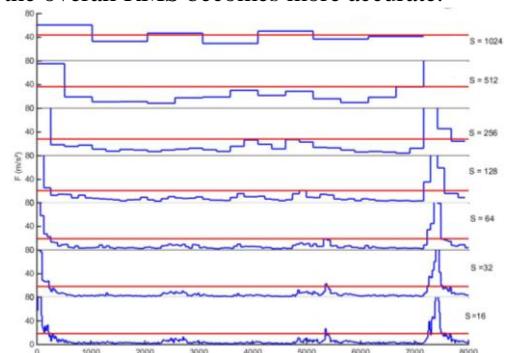


Figure 4. The RMS of interval Detrending waveform
For the three groups of vibration signal data, the total root-mean-square value under different interval lengths was calculated, and the RMS diagram of the interval length s-total root-mean-square value was obtained, as shown in Figure 5.

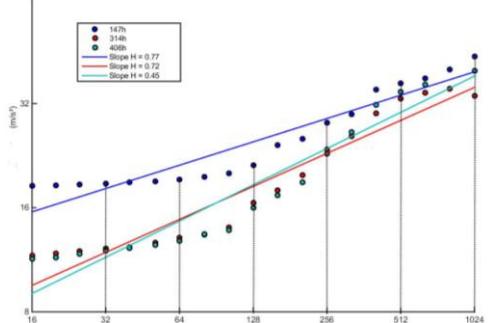


Figure 5. The figure of interval length S - total RMS
It can be obtained that the vibration signal of 150 h has larger fluctuation compared with that of 300 h and 450 h, and the vibration degree is more obvious between cells.

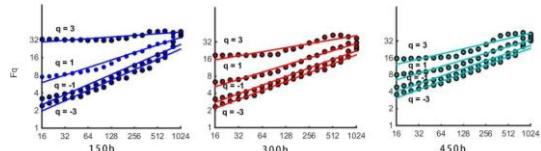


Figure 6. Double logarithmic regression line of vibration signal

The interval size s and the order q are taken as different values in turn, and the double logarithm values of the wave function $F(q, s)$ on q are repeatedly calculated to obtain the double logarithm regression line of vibration signals at 150 h, 300 h and 450 h, as shown in Figure 6. It can be obtained that if the value of order q is high, the calculated fluctuation function value will be relatively large; this is more obvious when the interval length s is small.

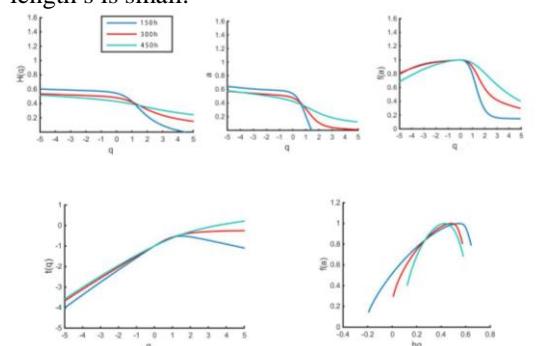


Figure 7. Spectrogram of multifractal detrended fluctuation analysis of vibration signal

The spectrum of vibration signal multifractal detrend analysis obtained by calculating the multifractal scaling index $\tau(q)$ and the multifractal singular index α and the dimension of the sequence subset determined by $F(\alpha)$, as shown in Figure 7. Where, the abscissa order q ranges from [-5,5] to 101 values. Figure 7(a) is the Hurst exponent graph, figure 7(b) is the scale

exponent graph, and figure 7(c) is the multifractal spectrum graph.

Table 1. Multifractal spectrum parameters of vibration characteristic signal

Time	$\Delta\alpha$	Δf	f_{max}	$\alpha_{f_{max}}$
150 h	0.2821	0.6457	1	0.6650
300 h	0.3356	0.7387	1	0.7051
450 h	0.3755	0.7782	1	0.7894

Table 1 shows the multi-fractal spectrum parameter width $\Delta\alpha$, dimensional difference Δf , stagnation point value $\alpha_{f_{max}}$ and maximum value f_{max} of the vibration characteristic signal. The parameters of the multifractal spectrum $\Delta\alpha$, and the stagnation value $\alpha_{f_{max}}$ showed an increasing trend. Dimensional difference, Δf there are differences in vibration signals under different working conditions; the maximum f_{max} is the same. According to the physical significance of multiple fractals [7], it can be concluded that the amplitude distribution of vibration signal is wider and its intensity decreases with the progress of test under the same working condition. There are differences in the number of amplitude distribution, the distribution of small amplitude is the majority, the intensity decreases, the vibration signal tends to be stable, that is, the vibration tends to be stable, in line with the actual running state of diesel engine. The above analysis also shows that the multi-fractal detrend spectrum and spectral parameters can extract vibration signal characteristics and effectively reflect the actual running state of diesel engine.

4. CONCLUSION

(1) In order to solve the problem that it is difficult to extract the running state information contained in the vibration signal of Marine diesel engine, this paper proposes a research method for the vibration signal analysis of Marine diesel engine based on the multifractal detrend method. The multi-fractal detrend method is used to analyze the vibration signal of cylinder head surface under different operating times under the same working condition. The multi-fractal spectrum parameters reflect the reasonable conclusion that the vibration signal tends to be stable as the test progresses under the same working condition.

(2) The multifractal detrend method proposed in this paper is a new attempt to detect the running state of Marine diesel engine, which has certain reference value for other researches on the condition detection. Since the research focus of this paper is to try to use a new Marine diesel engine condition monitoring method, the index reference system is not mature, and further refinement is needed in the following research and practical use.

REFERENCES

- [1] Tang Juan. Research on extraction method of characteristic parameters of diesel engine vibration signal and reconstruction method of cylinder pressure signal. Shandong: Shandong University, 2007.

- [2] Wang Daichao. Study on fault diagnosis method based on wavelet -RBF neural network. Shandong: Qingdao university of technology, 2018.
- [3] Yuan Jie. Research and simulation of fault diagnosis of Marine diesel engine based on resonance demodulation technology. Ship science and technology, 2008, 40(10): 103-105.
- [4] Mou Weijie, Shi Linsuo, Cai Yanping, Zheng Yong, Liu Hao. Diesel engine fault diagnosis based on the fusion of global and local characteristics of vibration time-frequency image. Journal of vibration and impact, 2008, 37(10): 14-19.
- [5] Shen Hong, Zeng Jianli, Yang Wancheng, Zhou Bin, Ma Weiping, Zhang Lingling. Diesel engine fault diagnosis based on time-frequency image polar coordinate enhancement. Vibration testing and diagnosis, 2008, 38(01): 27-33.
- [6] Chen Guo, Zhang Gang, She Daoming. Research on fault diagnosis of ship propulsion system based on t-s fuzzy model. Ship engineering, 2015, 37(07): 59-63.
- [7] Aicko Y. Schumann, Jan W. Kantelhardt. Multifractal Moving Average Analysis and Test of Multifractal Model with Tuned Correlations. Physica A: Statistical Mechanics and Its Applications, 2011, 390(14).
- [8] Yuan Pingping, Yu Jianlin, Shang Pengjian. Multifractal Detrended Analysis of Stock Market Time Series. Journal of Beijing JiaoTong University, 2007, (06): 69-72.
- [9] Zhou Bin, Li Yuanfang, Wang Xue. Application of Multifractal Trend Abatement Analysis in Monitoring Seepage of Dam Body. Hydroelectric Energy Science, 2014, 32(07): 83-85.
- [10] Fan Yifei. Study on The Detection Method of Sea Surface Faint Target Based on Fractal and Multifractal. Xi'an University of Electronic Science and Technology, 2016.
- [11] Jingming Li, Haijun Wei. Multifractal Detrended Fluctuation Analysis of Frictional Vibration Signals in the Running-in Wear Process. Tribology Letters, 2017, 65(2): 1-9.

Quantitative Characterization of Tight Sandstone Reservoir by Confocal Laser Scanning Microscopy

Wang Rong^{1,2}, Chen Lele¹, Liu Weihong¹, Xie Xingang³

¹*Langfang Branch, Research Institute of PetroChina Petroleum Exploration & Development, Langfang 065007, China*

²*Key Laboratory of Gas Reservoir Accumulation & Development, CNPC, Langfang 065007, China*

³*CCDC Drilling & Production Engineering Technology Research Institute, Xi'an, Shanxi 710018, China*

Abstract: With the deepening of oil and gas exploration, tight sandstone reservoir has become one of the primary exploration targets. Fine characterization of tight sandstone reservoirs is very important for exploring such reservoirs. In this paper, a LCSM (Laser Confocal Scanning Microscopy) is used to characterize the structure, shape and distribution of pores. Plane porosity and fracture porosity are also calculated quantitatively by this method.

Keywords: LCSM; pore; fracture; plane porosity

LCSM is a high-tech product developed in the 1980s. It has been widely used in medicine and life sciences. In the 1990s, this technology was introduced into the field of geology, and has been widely used in reservoir micro-pore structure, fluid inclusions and paleontology.

1. LCSM

Conventional polarizing microscope is based on ordinary light source to study and observe the object by naked eyes. Due to the limitation of optical resolution and human factors, the observation results tend to have large errors.

A LCSM (Laser confocal scanning microscopy) can obtain high-resolution images and data by means of high-resolution fast laser scanning (resolution 2048 × 2048, scanning speed 2600 lines/sec). The distribution, size, and shape of pores and throats, and plane porosity of reservoir can be analyzed visually and carefully using graphical analysis system, which can improve the accuracy significantly [1-5]. A LCSM equipped with three fluorescent channels can produce lasers with wavelengths of 405 nm, 458 nm, 476 nm, 488 nm, 514 nm, 543 nm, and 633 nm, so that it can meet most fluorescent samples. The system is equipped with special image processing software, which can accurately identify and measure the sizes of micro-pores and micro-fractures. In addition, slice scanning and three-dimensional imaging can be carried out to better observe pores and throats distribution and their connectivity in three-dimensional space.

2. APPLICATION IN STUDYING RESERVOIR PORE STRUCTURE

The experimental methods for pore structures in tight sandstone reservoirs include SEM (scanning electron microscopy), capillary pressure curve and thin section image. They can characterize micro-pore structures at various aspects, but they have their own limitations. LCSM compensates for the shortcomings of optical microscopy and scanning electron microscopy. It has the advantages of high magnification, high resolution and simple sample preparation. It can carry out fluorescence scanning on samples, slice scanning and three-dimensional reconstruction of sample images.

2.1. Samples and Instrument Preparation

Samples are casting thin-section rocks perfused by epoxy resin. It is found that epoxy resin can be excited to produce fluorescence signals with suitable intensity. If the fluorescence intensity of epoxy resin is insufficient, fluorescent agent can be added to the casting agent. After many experiments and comparisons, it is found that the fluorescent agent with excitation wavelength 514 nm and reception wavelength 534-580 nm can make the image clearer. The selection of objective lens is very important, which can often get twice the result with half the effort. Generally, a 5× objective lens is used to measure plane porosity. When the particle size is fine (silty or fine sandstone), a 10× objective lens will be better. A 10×, 20×, 40× or 63× high-power objective lens is used for magnification, measurement and three-dimensional reconstruction of a microzone (Luo Ping, Ying Fengxiang, 2002).

2.2. Whole Section Scan

Observation of thin sections under an ordinary microscope is local, and difficult to observe the whole picture of the sample. In this study, with the help of an automatic motor equipped on the LCSM, a whole section scan method was developed to get whole section information of samples. The particle size, porosity and fracture development of the samples were observed using this method. Figure 1 shows the whole-section scan result of a casting thin section at 5× power. It clearly shows that pores in the sample are well developed and connected, and most of them are intergranular dissolved pores and intergranular pores.

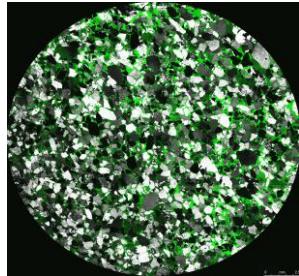


Figure 1. Whole section scan of a casting thin section: pores in green and rock grains in black and white.

2.3. Acquisition of Quantitative Parameters

In identifying thin section, there is a large error in calculating the plane porosity in terms of ocular estimation. Another better method is casting image pore analysis, but there is still a large error due to the low resolution of an ordinary microscope and unrecognized muddy absorbed pores and micro-fractures. The laser confocal scanning microscopy has the advantages of high resolution, accurate pore and fracture pickup, which can avoid errors effectively, and produce more reliable results (Figure 2). By combining the method of whole-section scan with image processing software, pores and fractures were distinguished, and the plane porosity and plane fracture percent were obtained accurately. The plane porosity refers to the percent of unfilled pore area in the whole section area; and the plane fracture percent refers to the percent of unfilled fracture area to the whole section area. To further understand the reservoir space reflected by thin sections, pore throat radius (i.e., the maximum sphere radius of a pore throat), width, length, area and distribution were counted after image processing. Table 1 and Figures 4-6 show the reservoir space parameters and the distribution of pores and fractures of a thin-section.

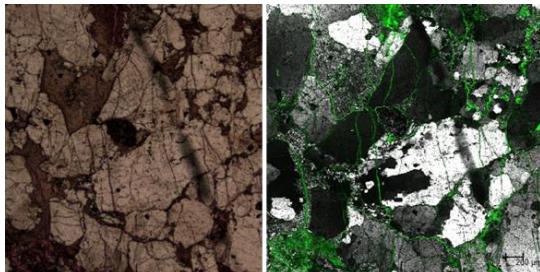


Figure 2. Observation under an ordinary microscope (left) and that under a LCSM (right)

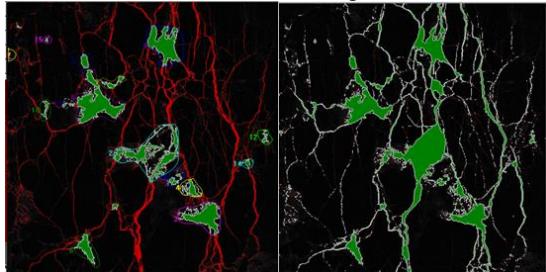


Figure 3. Pores and fractures under a LCSM

Table 1. Reservoir space parameters, um

	Pore Radius	Fracture Length	Fracture Width
Maximum	375.12	2515.35	1172.51
Minimum	13.76	100.53	30.14
Mean	95.52	600.941	210.02
Plane porosity		5.81%	
Plane fracture percent		2.67%	

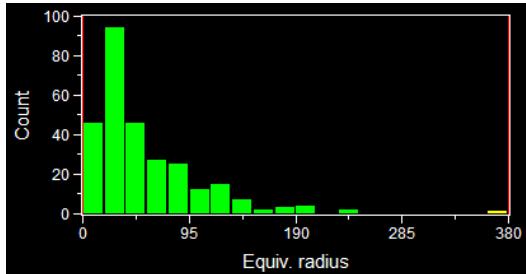


Figure 4. Distribution of pore radius, um

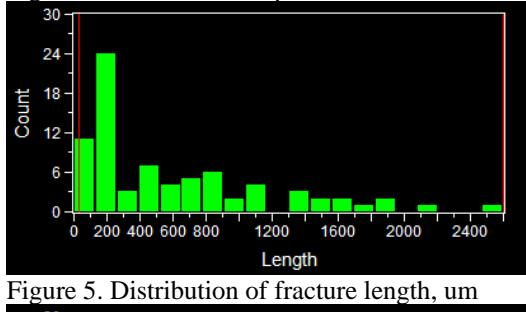
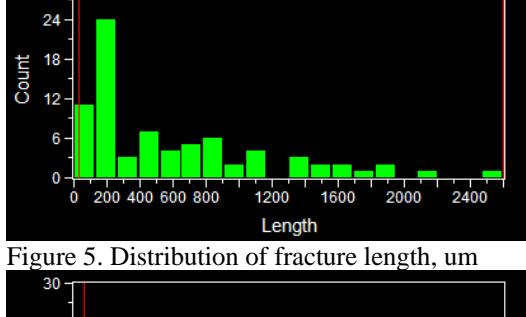


Figure 5. Distribution of fracture length, um



3. CONCLUSION

By applying a LCSM, researchers can observe tight sandstone reservoirs more visually, identify accurately the reservoir space type, distinguish the contribution of pores with different radius to the reservoir space, grasp the development of pores and fractures. It provides a technical means for studying tight sandstone reservoirs, with the following features:

A LCSM can better identify micro-pores and micro-fractures to the accuracy as high as 500 nm. Nano-pores, especially micro-pores in matrix can be identified, which are usually mistaken for adsorbed clay minerals under an ordinary microscopy, and neglected.

Compared with local observation of an ordinary microscopy, a LCSM can scan a whole section to obtain more comprehensive information of reservoir space types.

The parameters of pores and fractures can be extracted accurately, and the length, width, area and plane porosity of pores are calculated in details, and the distribution of pores with different radius in the whole section is calculated.

A LCSM can separate pores from fractures, calculate the number, width, length and plane percent of fractures, i.e. the percent of fractures to the reservoir space. In tight sandstone reservoirs, fractures can communicate with pores and greatly improve reservoir permeability, so it is particularly important for tight sandstone reservoirs. How much the fracture percent and how fractures communicate with pores are demanding problems that can be solved by a LCSM.

A LCSM can scan a sample by slices and produce a 3D image, and show better observation of the distribution of pores and throats. The maximum scanning depth is 2 mm. You can prepare a casting

thin section with any thickness to meet your requirements of scientific research.

REFERENCES

- [1] Li Nan, et al. Laser scanning confocal microtechnic. Beijing: The PLA House, 1997
- [2] Lu Huangzhang, et al. Fluid inclusions. Beijing: Science Press, 2004
- [3] Ying Fengxiang, Yang Shisheng, Zhang Min, et al. Application of laser scanning confocal microscope to the measurement of pore texture in reservoirs. *Acta Sedimentologica Sinica*, 2002, 20(1): 75-79
- [4] Sun Xianda, Suo Limin, Zhang Minzhi, et al. New progress of reservoir research by the technology of laser confocal scanning microscope analysis in the Daqing exploration area. *Acta Petrologica Sinica*, 2005, 21(5): 1479-1488
- [5] Li Rongxi, Jin Kuili, Ai Tianjie. Introduction to the research methods of organic inclusions. *Geological Science and Technology Information*, 1998, 17(Sup.): 118-120.
- [6] Zeng Daqian, Li Shuzhen. Types and characteristics of low permeability sandstone reservoirs in China. *Acta Petrolei Sinica*, 1994, 15(1): 38-46.
- [7] Zeng Daqian, Zhang Shiming, Lu Lize. Types and characteristics of fractures in tight sandstone gas reservoirs with low permeability. *Acta Petrolei Sinica*, 2003, 24(4): 36-39
- [8] Lin Senhu, Zou Caineng, Yuan Xuanjun, et al. Status quo of tight oil exploitation in the United States and its implication. *Lithologic Reservoirs*, 2011, 23(4): 25-32.
- [9] Li Weicheng, Zhang Yanmei, Wang Fang, et al. Application of constant-rate mercury penetration technique to study of pore throat characteristics of tight reservoir: A case study from the Upper Triassic Yanchang Formation in Ordos Basin. *Lithologic Reservoirs*, 2012, 24(6): 60-65.

Research on Application and Implementation of Speech Recognition Technology in Intelligent Entrance Guard System

Wen-hui Li, Bo-tao Liu*, Jian Yang, Yu-sheng Zhou, Yan-jun Guo
College of Computer Science, Yangtze University, Jing Zhou, China
*E-mail: liubotao920@163.com

Abstract: With the development of society, the demand for intelligent entrance guard systems is increasing day by day. The application of speech recognition technology to intelligent entrance guard systems has become an important development direction of intelligent security. Based on the analysis of the principle of speech recognition technology, this paper proposes an overall design scheme for implementing speech control intelligent door lock based on IFLYTEK speech platform, gives the design and implementation process of each unit module, and expounds the idea of selecting each chip type. Finally, the system unit test and integrated function test were completed. The test results show that the recognition rate of the system can reach 95%, which basically meets the requirements of intelligent door lock.

Keywords: speech recognition technology; intelligent entrance guard system; IFLYTEK

1. INTRODUCTION

Intelligent security is closely related to daily life. Combining biometric recognition technologies such as iris recognition, face recognition, fingerprint recognition and speech recognition with entrance guard systems has become an inevitable trend [1-5]. Biometric technology utilizes human physiological or behavioral characteristics for identity verification, has high security and high efficiency. Embedding biometric technology into intelligent security equipment can solve some security problems caused by document loss or identity forgery [1]. In addition, as the original means of human communication, speech is the inherent characteristic signal of human beings, with high recognition and recognizability. With the continuous maturity of speech recognition technology, intelligent entrance guard system based on speech recognition technology came into being.

Literature research shows that the initial speech recognition is mainly based on monosyllabic words, relying on template matching and dynamic time folding algorithm to identify some simple words [2]. With the development of speech recognition, HMM (Hidden Markov Model) has been introduced [3], which greatly improves the ability to recognize isolated words. At present, most of the domestic researches on speech recognition are based on more mature speech recognition systems, such as HTK,

which favors isolated words and small vocabulary, but less research on practical applications and large vocabulary recognition systems [4,5]. In general, the speech recognition and processing capabilities of IFLYTEK are much higher than other similar platforms.

In this paper, through accessing to IFLYTEK speech platform, the speech signal of the client is processed, automatically searched and matched to control the opening and closing of the door lock. As the key of speech data processing, IFLYTEK has the functions of real-time update of thesaurus, dialect optimization identification, specific voiceprint identification, etc. Combining it with intelligent entrance guard can meet the modern requirements such as high identification and low cost.

2. INTRODUCTION TO THE PRINCIPLE OF SPEECH RECOGNITION TECHNOLOGY

Speech recognition technology is a technology that enables speech signals to be converted into corresponding text or commands through a sequence of processing procedures. In essence, it is a pattern recognition system, which mainly includes several basic units such as feature extraction, pattern matching, and reference pattern library [6].

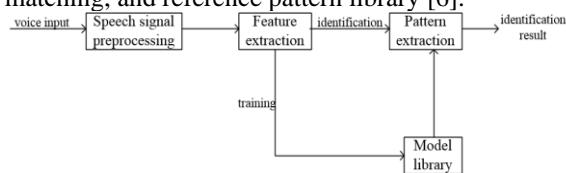


Figure 1. Principle block diagram of speech recognition technology

The basic flow of speech recognition is shown in Figure 1, speech is recorded by a microphone and converted into electrical signals. In the preprocessing stage, the module mainly implements denoising enhancement, windowing and endpoint detection of speech signals, thus making the spectrum of speech signals smoother and more effective [7]. The preprocessed speech will be sent to the recognition system. In this process, on the one hand, on the basis of extracting relevant features, the obtained voiceprint in a specific range will be trained, and voiceprint speech models will be established according to the speech characteristics of different people, so as to establish a speech data model base. On the other hand,

during speech authentication, the system will search and match the corresponding optimal model in the stored speech feature model base according to a certain search and matching strategy, and the final recognition result is given through the output terminal.

3. SYSTEM DESIGN AND IMPLEMENTATION

3.1. Overall Design

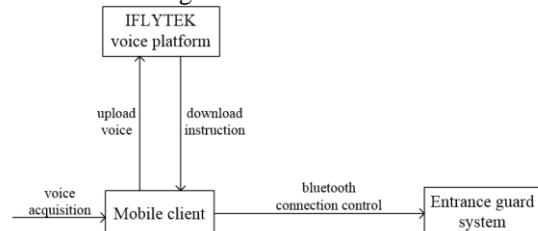


Figure 2. The overall principle block diagram of the system

As shown in Figure 2, the client collects speech information through a microphone and uploads it to the IFLYTEK speech platform. The platform performs command identification and acoustic model comparison according to the set unlocking command (e.g., open sesame), and returns the result to the client in the form of a command. Upon receiving the command, the client sends unlocking or other commands to the door lock through Bluetooth, thus realizing the switch control of the entrance guard system by speech identification.

3.2. Module Design and Implementation

3.2.1. Speech acquisition and processing

The speech acquisition phase mainly completes the following two tasks:

(1) Generating a sampling frequency of about 40 kHz. The frequency range of normal human hearing is about 20 Hz to 20 kHz. According to the Nyquist sampling theory, in order to ensure that the sound is not distorted, the sampling frequency should be higher than twice the highest input frequency, here 40 kHz is selected, which is also the sampling frequency of most electronic equipment microphones.

(2) Compressing and storing the sampled signal. Speech signals are one-dimensional signals, while computers can only process discrete signals, so the speech signal should be converted into digital signal and compressed for storage during speech acquisition, thus facilitating the transmission of speech signals. Speech compression makes it possible to transmit high quality speech signals over narrow band channels [8].

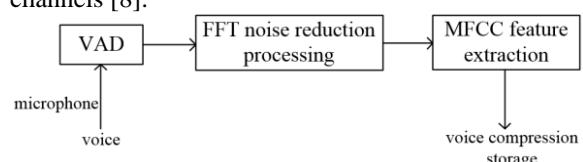


Figure 3. Schematic diagram of speech acquisition and processing

The specific implementation process of speech collection is shown in Figure 3. The speech is

collected to the audio endpoint detection module through the mobile phone microphone, and VAD (Voice Activity Detection) is detected, that is, whether speech input is detected to obtain a valid speech segment, and this segment was processed by FFT (fast Fourier transform) for noise reduction, then pre-weighted, winding-frame analysis and other operations were performed based on the characteristic parameters of MFCC (Mel Frequency Cepstral Coefficient) to form speech waveform segments. The waveform at this time has no description ability, and MFCC feature extraction is performed, then each frame is formed into a multi-dimensional vector according to the physiological characteristics of the human ear. At this time, the sound forms a matrix of M rows and N columns and is stored [9]. In the audio compression process, an encoding algorithm running at the source end and a decoding algorithm running at the receiving end or the client end are adopted.

3.2.2. Speech recognition

Speech recognition algorithm is the core of speech recognition technology. Research shows that there is a certain correlation between the two pronunciation phonemes before and after the speech, which makes it possible to predict the latter phoneme through technology [10]. In the speech recognition stage, speech is cut into small segments of equal length firstly, features are extracted for each segment, then the probability of each segment belongs to each state is calculated by Gaussian probability density function. Calculating the probability of each segment generated by each state based on the HMM state transition probability of each word [11,12], and the word with the highest probability in the HMM sequence is found by the optimal path method as the feedback result corresponding to this speech segment. The path search algorithm used is Viterbi algorithm, which is a dynamic pruning algorithm and can quickly find the global optimal path [13]. The HMM-based speech recognition process is shown in Figure 4.

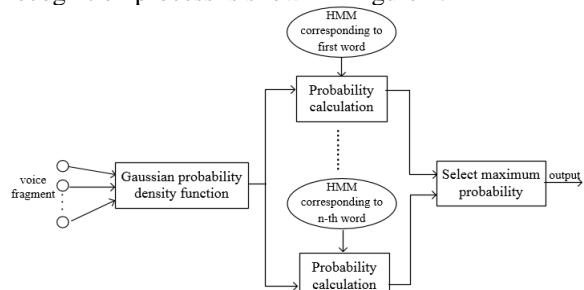


Figure 4. Schematic diagram of HMM-based speech recognition

3.2.3. Android control

The data matched by the speech recognition algorithm is sent to the Android terminal in the form of instructions, and the Android terminal filters and matches the returned data in the database. If the match is successful, the lock can be unlocked by sending an instruction to the entrance guard system; Otherwise,

the unlock instruction will not be sent and the user will be prompted for an error.

In terms of software, Android client uses Java coding, and built-in SQLite database stores user voiceprint and basic data to realize login and registration functions. In terms of hardware, the client connects the intelligent door lock through bluetooth connection protocol to control the door lock.

3.2.4. Entrance guard system simulation implementation

The entrance guard system is simulated by the three unit modules of the minimum single-chip system, bluetooth module and relay control module. As an experimental test, it can realize simple unlocking and locking function, which has high operability and representativeness.

3.2.4.1. MCU system

This design takes STC89C52 as the core, and adds bluetooth module and relay control module on the basis of the minimum system. The former facilitates the entrance guard system and mobile phone to connect with MCU through bluetooth communication protocol. STC89C52 is compatible with industry standard 51 series instruction set and output pin [14]. Its characteristics are: (1) Strong anti-interference capability; (2) The security performance is strong and it is difficult to be cracked [15]. Therefore, STC89C52 is very suitable for use as a control chip of an electromagnetic lock, and its system structure is shown in Figure 5.

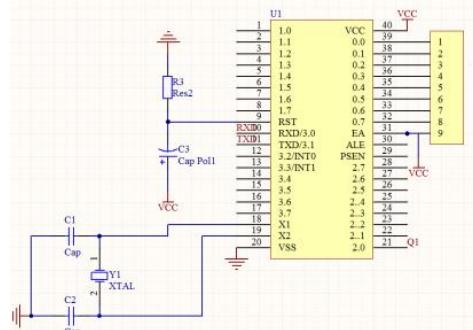


Figure 5. STC89C52 Minimum system schematic

3.2.4.2. Bluetooth module

The bluetooth module used in this paper is HC-05, which is a high-performance, master-slave bluetooth serial port module produced by ALIENTEK. It can be paired with various bluetooth-enabled computers, mobile phones and other intelligent terminals. It is compatible with 5 V or 3.3 V MCU System [16], and low price, suitable for experimental or industrial technology. The HC-05 bluetooth module is shown in Figure 6.

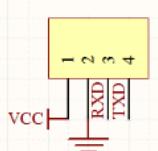


Figure 6. HC-05 Bluetooth structure diagram

In Figure 6, the pin function description is shown in Table 1.

Table 1. HC-05 pin function table

Pin	Description
VCC	A simple triode switch circuit is connected to the positive pole of the power supply, and the voltage range is 3.3 v to 5.0 v
GND	Grounding
RXD	Module serial port receiving pin (TTL level, not directly connected to RS232 level), which can be directly connected to TXD pin of MCU
TXD	Module serial port sending pin (TTL level, not directly connected to RS232 level), which can be directly connected to RXD pin of MCU

As for HC-05, it has memory. After WAKEUP is pressed, it can search for new equipment again until the pairing is successful, but as a slave, it has no special meaning.

3.2.4.3. Relay control module

In order to control the electromagnetic lock, this paper selects HK4100F-DC5V -SHG with rated voltage of 5 V as the electronic control device, which has the advantages of low price, fast conversion and strong encapsulation, can effectively and quickly control the electromagnetic lock [17]. The schematic diagram is shown in Figure 7.

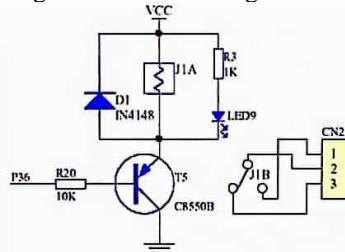


Figure 7. HK4100F electromagnetic relay drive schematic

In Figure 7, 1, 2 and 3 of CN2 are relay output connections, which are respectively connected to the normally open contact, the movable contact and the normally closed contact of the relay. When the relay receives the pull-in command, 1-2 will be switched on, which is equivalent to the switch being closed [18,19]. Thus, the opening and closing of the electromagnetic lock can be controlled.

4. SYSTEM TEST

The test in this paper is completed in Android APP. The test needs to record the speech in advance, then extract the speech features, and establish a speech library through speech recognition [20]. Finally, the speech to be recognized is matched with the speech database [21]. On the premise of establishing a sound base, the user logs in “Voice Recognition Lock APP” to record instructions (e.g., open sesame), after matching with the relevant algorithm and database, the user is fed back the “Recognition success” or “Recognition failure” instruction. If the instruction is “Recognition Success”, the user can enter the

intelligent lock operation interface to control the door lock. On the contrary, remind the user of the data error and record the instructions again. The system test diagram is shown in Figures 8-11.



Figure 8. Login and registration interface

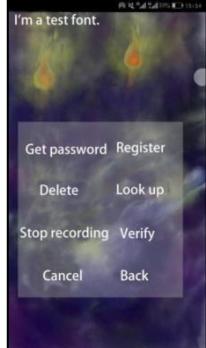


Figure 9. Recording and verification interface

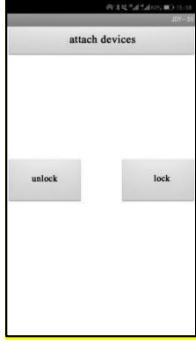


Figure 10. Door lock control interface

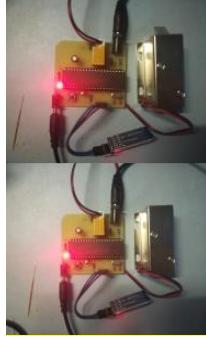


Figure 11. Locking and unlocking of door locks

The test contents of this paper include: unit tests of speech recognition accuracy, bluetooth communication stability and relay working efficiency, and integrity tests of unlocking function. After 100 tests, the normal unlocking frequency of the door lock is 95 times, and the number of identifying door locks but not unlocking reactions is 5, the experimental identification rate reaches 95%.

5. CONCLUSION

Taking the application of speech recognition technology in intelligent entrance guard system as an example, this paper expounds the algorithm principle of speech recognition and the principle of speech library selection. Based on the overall design of the system, the design of each module and the selection of chip are completed, and the corresponding mobile phone APP is developed to realize the function of speech control entrance guard system. Finally, the unit test and integrated function test of the system are completed. The test results show that the system has a high recognition rate and can basically complete the switch lock function. In this paper, the idea of combining intelligent entrance guard system with IFLYTEK speech recognition has realized the advantages of low cost, portability and strong expandability, which is worthy of reference for other intelligent entrance guard systems.

ACKNOWLEDGEMENTS

This paper was financially supported by four projects: The project of young people in the Education Hall of Hubei (No. Q20161311), The Yangtze Youth Fund (No. 2015cqn53), Teaching and research project of Yangtze University (No. JY2015038), the Yangtze University Students' Innovation and Entrepreneurship Training Program Project (No. 2017027)

REFERENCES

- [1] Yu Zhezhou, Yang Jiadong, Zhou Chunguang, Wang Gangqiao. Intelligent Instrument Embedded Voiceprint Recognition Technology. Chinese Journal of Scientific Instrument, 2004, (S2): 447-450.
- [2] R. Lawrence, J. Biing-Hwang. Fundamentals of Speech Recognition. Prentice Hall, 1999.
- [3] L.R. Rabiner. A tutorial on hidden Markov models and selected applications in speech recognition. Proc. IEEE, 1989, 77(2): 257-285.
- [4] Liu Jingwei, Xu Meizhi, Zheng Zhongguo, Cheng Gansheng. Feature Selection of Speech Recognition and Speaker Recognition Based on DTW. Pattern Recognition and Artificial Intelligence, 2005, 18(01): 50-54.
- [5] Li Jianmin, Zhao Tongqing, Zheng Fang, Fang Ditang, Wu Wenhui. Research on Speech Recognition System with Large Vocabulary Based on Chinese Speech Features. Chinese Journal of Computers, 1992, (05): 364-370.
- [6] Wu Liming, Wang Guitang, Wu Zhengguang. Speech Signal and Single Chip Microcomputer Processing. Beijing: Science Press, 2007.
- [7] Wang Zhenyu. Research on Speech Recognition Technology Based on Embedded Platform. Guizhou University, 2017.
- [8] Fu Jingwei. Design and Algorithm Experiment of Audio Compression System Based on DSP. Master's Degree Thesis of Jilin University, 2006.
- [9] Huang Zhebin. Research on Hidden Markov Algorithm for Speech Robot. Modern Information Technology, 2018, 2(04): 95-96+98.
- [10] Xiao Aimin. Design of Intelligent Home Control System Based on Speech Recognition Technology. Nanchang University, 2018.
- [11] Yang Zhiyong, Li Weifeng, Zhang Sheng. Design of Audio and Video Monitoring System Based on Android Platform. Computer Applications and Software, 2018, 35(12): 169-173.
- [12] Wang Shan Hai, Jing Xin Xing, Yang Haiyan. Research on Speech Recognition of Isolated Words Based on Deep Learning Neural Network. Application Research of Computers, 2015, 32(8): 2289-2291+2298.
- [13] Li Donglu. Design of Linux Real-time Voice Transmission System Based on RTP. Xidian University, 2006.
- [14] Dimitrios Ververidis and Constantine Kotropoulos. Emotional speech recognition: Resources, features, and methods. Speech Communication, 2006, 48(9): 1162-1181.

- [15] Wu Chaohui, Yang Yingchun. Speaker Recognition Model and Method. Beijing: Tsinghua University Press, 2009.
- [16] Li Peiyu. Application of Speech Recognition Technology in Intelligent Speaker System. China New Telecommunications, 2018, (20): 117-118.
- [17] Chen Zhiyuan, Zhu Yecheng, Zhou Zhuoquan, Zhu Lei. A Smart Home Control System Based on STM32. Application of Electronic Technique, 2012, 38(9): 138-140.
- [18] Daniel Povey, Arnab Ghoshal, Gilles Boulianne, et al. The Kaldi Speech Recognition Toolkit. Available Online: https://publications.idiap.ch/downloads/papers/2012/Povey_ASRU2011_2011.pdf.
- [19] Hu Wenjing, Zhang Guoyun, Tang Jianfeng. Research on Implementation of Speech Recognition Entrance Guard System Based on SPCE061A. Computing Technology and Automation, 2011, 30(2): 111-114.
- [20] Bai Xuemin, Wang Caixia, Sun Fenglei, Wang Xue, Liu Chong. Two-way transmission control intelligent home control system. Journal of Changchun University of Science and Technology (Natural Science Edition), 2014, 37(01): 124-128.
- [21] Long Shunyu, Zheng Zelong, Tan Dongfeng. Design of Speaker-independent Speech Recognition System Based on STM32 and SD Card File System. Modern Electronics Technique, 2013.

Design and Comparison of Digital Filter Based on MATLAB

Ke-jia Ji, Yi Sun

Institute of Information and Engineering, Zhengzhou University, Zhengzhou 450000, Henan, China

Abstract: Discussion on the design method of infinite-length unit impulse response (IIR) digital filter and finite-length unit impulse response (FIR) digital filter in digital signal processing technology. Firstly, for the IIR digital filter, starting from the analog filter, the traditional MATLAB-based design steps are proposed. The impulse response invariant method and the bilinear transformation method can be used to convert. And then analyze the advantages and disadvantages of different conversion methods. Secondly, for the FIR digital filter, according to the linear phase characteristic, it can be designed and compared by the window function method and the frequency sampling method.

Keywords: design of filter; IIR digital filter; FIR digital filter; impulse response invariant method; bilinear transformation method; window function method; frequency sampling method

1. INTRODUCTION

With the rapid development of information technology, digital signal processing technology is widely used in digital communications, image recognition and voice signal processing. As an important part of DSP, digital filter has become a research hot topic. The digital filter consists of adders, multipliers and delay units [1]. It is to process the input discrete signals in the digital domain and filter out unwanted signals. Compared with the traditional analog filter, the digital filter can process low-frequency signals with high precision, reliable performance, easy integration on a large scale [2], and parallel operation through the DSP chip.

2. DIGITAL FILTER DESIGN

According to the impulse response, it can be divided into IIR digital filter and FIR digital filter. The amplitude-frequency characteristic describes the weakening of the signal after it passes through the filter. The phase frequency characteristic describes the delay of each group of frequencies of the signal over time. If the filter is required to have phase characteristics, it is necessary to design a FIR digital filter with a linear phase.

Unlike analog filters, digital filters are cycled at 2π . Ideal filters are not achievable. The achievable filter always has a transition band between the passband and the stopband. Therefore, the main design indicators are: passband maximum attenuation a_p , stopband minimum attenuation a_s , passband cutoff frequency ω_p , stopband start frequency ω_s .

The general filter design steps are as follows: First, determine the desired technical indicators, and then

find $H(z)$ to make it infinitely approximate the required technical indicators and then implement $H(z)$ through software, such as MATLAB.

2.1. IIR Digital Filter Design

In this work, we take the design of a low-pass filter as an example.

The IIR digital filter design process is:

- (1) Converting the design specifications of the digital filter into design indicators of the analog filter.
- (2) Design a system function $Ha(p)$ of a normalized analog filter that satisfies these indicators.
- (3) Remove normalization and then convert to an analog filter system function of the same type as the digital filter $Ha(s)$.
- (4) Discretize $Ha(s)$ into a system function of a digital filter.

2.1.1. Analog filter design

Common normalized analog filters are Butterworth filters, Chebyshev filters, elliptical filters, and Bessel filters. The passband of the Butterworth filter is relatively flat. The Chebyshev filter has equal ripples in the passband. The elliptical filter has equal ripples in the passband and stopband. The Bessel filter is characterized by poor attenuation characteristics and very slow stopband attenuation, but because of its good phase characteristics, it is suitable for applications where the output signal waveform is required to be high. To achieve the same design specifications, the Butterworth filter is used with a much larger order than other types of filters, and the elliptic filter has the lowest order.

If you want to design other analog filters, such as high-pass, band-stop filters, you should first design a normalized low-pass filter. And then transform the system function of normalized low-pass filter into the system function of other types of filter by frequency transformation.

2.1.2. Convert analog filter to digital filter

The implementation methods of IIR digital filter based on MATLAB are impulse response invariant method and bilinear transformation method.

The impulse response invariant method approximates the impulse response $h(t)$ of the analog filter by the unit impulse response sequence $h(n)$ of the digital filter, so that the sequence value of $h(n)$ is equal to the sampling at the discrete point of $h(t)$ value. Since the transition from the s-plane to the z-plane is not a one-to-one mapping relationship, aliasing distortion occurs and cannot be used to design digital high-pass and band-stop filters [3].

The bilinear transformation method is implemented by the tangent transformation after the critical frequency predistortion. Since the bilinear transformation avoids frequency aliasing, it can be used to design any type of filter, but the conversion relationship between the digital angular frequency and the analog angular frequency is nonlinear.

2.2. IIR Digital Filter Design

2.2.1. Window function design

Design steps [4]:

- (1) Determine the design specifications of the filter.
- (2) Write the impulse response $hd(n)$ of the ideal filter according to the designed filter type. The cutoff frequency of the ideal filter is $\omega_0 = (\omega_p + \omega_s)/2$.
- (3) Select the window function type according to the minimum attenuation of the stop band, and then determine the window length N according to the transition bandwidth equal to the main valve width of the window function, thereby writing the window function expression $w(n)$
- (4) Find the impulse response of the actual filter: $h(n) = hd(n) \cdot w(n)$.

The window function design method is simple in design and can design filters with arbitrary frequency

Table 1. Comparison of two digital filter designs

IIR digital filter design	Advantage	<ul style="list-style-type: none"> 1. The filter can be designed using existing formulas, and the method is simple and convenient. 2. Under stable system conditions, the filter order is lower, the number of components is smaller, the volume is smaller, and the cost is lower [5]. 3. The amplitude-frequency characteristics are very good, and the transition band and stopband attenuation are easy to meet the requirements.
	Disadvantage	<ul style="list-style-type: none"> 1. Because the function equation of the filter has recursive operation, parasitic oscillation may occur. To make the system stable, the system function must satisfy all poles in the unit circle. 2. It is difficult to meet the linearity requirement in phase.
FIR digital filter design	Advantage	<ul style="list-style-type: none"> 1. The phase frequency characteristic is very good, which can meet the linear requirement and ensure the transmission of the signal without distortion [6]. 2. It can implement a convolution operation using a Fourier transform. Therefore, the filter operates faster when the order is the same. 3. Because there is no recursive operation in the system function operation, no parasitic oscillation will occur, and the system stability is good.
	Disadvantage	The amplitude-frequency characteristics are difficult to meet the requirements, the operation is complicated, and the cost is high [7].

4. CONCLUSION

According to the above, the infinite-length unit impulse response (IIR) digital filter can be designed by means of an analog filter prototype, so that some excellent characteristics of the analog filter can be preserved, such as having good amplitude-frequency characteristics, but the phase is nonlinear. And the finite-length unit impulse response (FIR) Digital filters can be designed to be strictly linear in phase to avoid phase distortion in the processed signal.

Based on MATLAB, this paper takes the design and implementation of low-pass filter as an example, analyzes the different design methods and differences of the two filters, and compares the advantages and disadvantages. Through comparative learning, we are able to make correct and clear selection and application of filters under different performance requirements.

characteristics. However, the boundary frequency of the filter passband and stopband is not easy to control, and the length of the filter needs to be designed multiple times to meet the requirements.

2.2.2. Frequency sampling method

Design steps:

- (1) According to the passband type of the given ideal filter $Hd(ej\omega)$, select the linear phase type of the FIR filter and determine the appropriate filter order N .
- (2) Sampling $Hd(ej\omega)$ at equal intervals of N points on $[0, 2\pi]$.
- (3) Perform IDFT on $H(k)$ to obtain the impulse response $h(n)$ of the FIR filter.

The advantage of the frequency sampling method is that it is designed directly from the frequency domain, which is intuitive and convenient. The disadvantage is that only the sampling values of N points are exactly the same as the frequency response of the ideal filter.

3. COMPARISON OF TWO DIGITAL FILTER DESIGNS

The design of two kinds of digital filters is shown in Table 1.

With the rapid development of technology, the application of digital filters is not limited to digital signal processing and filtering interference. It is also widely used in biomedical, command and control fields, and its functions tend to be diversified. The traditional digital filter design method has the advantages of simple principle and easy implementation, but the designed filter does not have the optimal characteristics, so it is rarely used in the actual filter design, which will advance our research on the optimization of filters.

REFERENCES

- [1] Chen Y.Z., Yang P.X., Wen S.P., Ling J.J. Digital filter design and DSP implementation. Ship Electronic Engineering, 2018, 38(8): 70-74.

- [2] Zhang S.C. Comparison of digital filters based on MATLAB. *Electronic Technology and Software Engineering*, 2018, 10: 89.
- [3] Chen Z., Wang Z. Simulation design and analysis of IIR digital filter. *Experimental Technology and Management*, 2016, 33(7): 122-125.
- [4] Xie L.Y., Fang L.M. Design of FIR digital filter based on MATLAB. *Journal of Guangdong Second Normal University*, 2018, 38(5): 61-66.
- [5] Yu D., Jiang Y.F., Chen P. Design and implementation of IIR digital filter. *Science and Information*, 2018, 12: 70-71.
- [6] Shun T.Y., Shi J. Optimized FIR digital filter design with improved genetic algorithm. *Computer Engineering and Applications*, 2017, 53(17): 108-111.
- [7] Wang L., Lai C.L. Minimization design of maximum weighted phase error of FIR digital filter under amplitude-frequency response constraints. *Electronic Journal*, 2018, 11: 2781-2786.

Study the Working Efficiency of Tobacco Vibrating Screen Machine

Hai Huang, Xiaobo Dong, Xianhui Meng, Chengzhi Guan, Yanshu Wang, Guoliang Qi, Yu Gao, Xiaoxia Niu*,
 Xiaoman Liu
 YanShan University, Qinhuangdao 066004, China
 *E-mail: xiaoxia@ysu.edu.cn

Abstract: In this paper, through the controllable design and experimental study of the two-way amplitude of the upper and lower tanks and the bottom plate of the double-layer high-frequency vibrating screen machine, combined with the physics conservation of momentum and the two-degree-of-freedom spring mass system of vibration mechanics, the modeling is studied from both vertical and horizontal directions. The controllable parameters of the vibrating screen tank design are obtained, and on-site test analysis and demonstration are carried out to improve the screening efficiency of the double-layer vibrating screen machine in the tobacco industry.

Keywords: vibrating screen machines; working efficiency

1. INTRODUCTION

Tobacco vibrating screen machines, as the most important screening machines, are widely used in many production practices [1-3]. Increasing the processing capacity and improving the screening efficiency have always been the research goals and motivation of the tobacco vibrating machine technicians [4].

2. EXPERIMENTAL

2.1. Screening Efficiency Calculation

Industrially, screening efficiency is an important feature for evaluating screening performance. In the screening operation, the product classification is theoretically achieved based on the relationship between the particle size and the mesh size. In industrial production, due to factors such as material properties, vibration characteristics and production management, the sieve material still contains some fine particles that can be sieved.

Q: Total mass of incoming material; D: Total quality of the product on the sieve; C: Total quality of the product under the sieve; α : The particle size in the feed is less than the content of the separated particle

Table 1. Sample grading

	0.7 mm	0.7-0.8 mm	0.8-0.9 mm	0.9 mm
Mass	160 g	40 g	60 g	40 g
Total mass	300 g			

The sample grading is made up of factors such as the ratio of the integrated industrial sand feedstock and the size of the new composite tobacco vibrating screen machine.

size; β : The portion of the undersize product that has a particle size smaller than the separation particle size; θ : The portion of the product in the sieve having a particle size smaller than the separation particle size. Define n_1 is the portion of the screening product whose particle size is smaller than the separation particle size;

$$n_1 - \frac{C\beta}{Q\alpha} \times 100\% \quad (1)$$

Define n_2 is the part of the screening product whose particle size is larger than the separation particle size;

$$n_2 - \frac{C(100-\beta)}{Q(100-\alpha)} \times 100\% \quad (2)$$

Define n_3 as comprehensive screening efficiency;

$$n_1 - n_2 - \frac{C[100(\beta-\alpha)]}{Q[\alpha(100-\alpha)]} \quad (3)$$

In this way, the comprehensive screening efficiency n takes into account the actual situation of different particle size products under the sieve and the products on the sieve, and can better evaluate the screening operation.

2.2. Sample Grading Determination

The samples (incoming particles) used for the experimental studies must be identical and reasonable. The samples were obtained by standard sieve tobacco shaker. The standard screen is equipped with a set of sieves of different mesh sizes, with the largest sieve opening being the largest and the downward screening layer being smaller. The standard sieve uses square woven mesh holes, and the opening ratio of the screen surface is standardized. A three-layer screen was placed on the standard sieve, and the sieve holes were 0.7 mm, 0.8 mm, and 0.9 mm from top to bottom. The industrial sand was placed on the top screen surface, the standard sieve was run, four products were sorted, and the samples were configured according to Table 1.

2.3. Relationship between Vibration Parameters and Screening Efficiency under Combined Vibration

2.3.1. Relationship between swing angle and screening efficiency

In the composite vibration mode, the larger the swing angle, the larger the kinetic energy obtained by the sieved particles, and the better the looseness of the material layer. Other conditions are the same, design 5 sets of composite sieve swing angle: 0.5, 0.68, 0.74, 0.87, 1.10 for single factor experiment, use the Table 2. Efficiency of each group of experiments

Screening efficiency %	Swing angle				
	0.5	0.68	0.74	0.87	1.10
Separation particle size 0.8mm	56.40	58.32	60.06	62.84	56.10

Between the screening efficiency and the swing angle, there is a law of increasing first and then decreasing [5]. When the swing angle is less than 0.880, the screening efficiency increases as the swing angle increases. When the swing angle is greater than 0.880, as the swing angle increases, the screening efficiency decreases and the rate of decline is fast. This is mainly because: as the swing angle increases, the more energy the particles obtain, the better the loose effect will increase the permeability probability; however, the excessive swing angle will make the interaction between the particles too strong, resulting in The speed of movement is greatly increased, and the chance of being sieved by the sieve particles is reduced, so that the screening efficiency is greatly reduced. Therefore, in industrial practice, according to this law and process requirements, a suitable swing angle can be selected for screening operations.

Table 3. Fitting function correlation term coefficient and error

Separation particle size	xc	w	A	y0	Adj. R-Square
0.8 mm	0.11978	0.29506	3.57058	59.21373	0.98186

The screening efficiency and the swing frequency show a law of increasing first and then decreasing. In the range where the wobble frequency is less than 10 Hz, the sieving efficiency increases as the wobble frequency increases. In the range of swing frequency greater than 10 Hz, as the swing frequency increases, the screening efficiency decreases and the falling speed is gentle. This is mainly because: the swing frequency increases, the number of collisions between the particles and the screen surface increases per unit time, and the screening efficiency increases; but after a certain amplitude, the larger the swing frequency, the larger the number of vibrations on the screen rises, resulting in excessive loosening, weakening of the interaction between the particles, but reducing the contact of the particle screen, resulting in reduced screening efficiency [6]. Similarly, in industrial practice, the appropriate swing frequency should be selected for screening operations according to this law and process requirements.

Table 4. Screening efficiency at different swing frequencies

Screening efficiency %	Swing frequency				
	8	9	10	11	12
Separation particle size 0.8 mm	58.82	66.51	74.53	69.82	65.55

Between the screening efficiency and the vibration direction angle, there is a law of increasing first and then decreasing. In the range where the direction angle is less than 500, the screening efficiency

standard sieve scale to measure the required data, according to formula 3 to solve the screening efficiency of each group of experiments, such as as shown in Table 2, the screening effect of separating the particle diameter of 0.8 mm was analyzed.

2.3.2. Relationship between swing frequency and screening efficiency

The swing frequency is related to the frequency of contact between the screen surface and the particles being sieved. If the swing frequency is low, the particle vibration on the sieve is insufficient, the material layer is very dense, and even the hole may be blocked. When the oscillating frequency is too high, the particles on the sieve are excessively oscillated, and it is difficult to achieve a stable screening state, and dust is likely to occur. Five sets of composite sieve swing frequencies were designed: 8, 9, 10, 11, 12 Hz for single factor experiments. Similarly, obtain the required data and solve the screening efficiency of each set of experiments according to the formula, as shown in Table 3.

2.3.3. Relationship between vibration direction angle and screening efficiency

The direction of the vibration direction largely determines the speed at which the particles on the screen move along the screen [7]. In the industrial practice of linear tobacco vibrating screen machine, the smaller the vibration direction angle, the faster the moving speed of the particles on the sieve, and there may be cases where the sieve particles have not been fully sieved and discharged [8]. The greater the vibration direction angle, the slower the moving speed of the particles on the screen, and the number of contact with the screen surface will increase. Colleagues may have material stacking phenomenon or even block the hole. Five groups of composite sieve vibration direction angles were designed: 45, 50, 55, 60, 650 for single factor experiments. The experimental data was obtained, and the screening efficiency under each set of parameters was solved according to the formula, as shown in Table 4.

increases as the direction angle increases. In the range of the orientation angle greater than 500, the screening efficiency decreases as the direction angle increases. This is mainly because: after the direction

angle becomes larger, the moving speed of the particles on the sieve is lowered, the sieve on the sieve is more sieved, and the screening efficiency is increased; but after a certain extent, the vibration direction angle is larger, and the particles on the sieve are forwarded. The speed of movement is too slow and hoarding, so the loose effect is very poor, which is not conducive to the sieving, resulting in reduced screening efficiency. Similarly, in industrial practice, according to this law and process requirements, the appropriate vibration direction angle should be selected for screening operations.

2.3.4. Relationship between amplitude and screening efficiency

Table 5. Amplitude under different numbers of shrapnel components

	1	2	3	4	5	6	7	8
20	785	664	849	725	3246	3329	3179	3418
19	709	845	790	825	3717	3575	4025	3663
18	623	705	525	742	4068	3543	5107	3621

According to the analysis data, under the 19 sets of shrapnel components, the amplitude of the vibrating screen machine is larger, the amplitude of each point is relatively average, and the overall operation of the machine is stable. Similarly, in industrial practice, the appropriate number of shrapnel assemblies should be selected for screening operations based on this rule and process requirements.

3. CONCLUSION

Through the single factor experiment of vibration parameters in the form of composite vibration, the experimental data was processed, the relationship between vibration parameters and screening efficiency was calculated, the variation law was analyzed, and the mathematical model between vibration parameters and screening efficiency was established. The vibration characteristics of the new composite tobacco vibrating screen machine verified and perfected the screening theory. Through the comparison experiment between the composite vibration form and the single vibration form, it is concluded that the composite vibration form screening performance is significantly better than the single vibration form. The experimental results show that the development of the new composite tobacco vibrating screen machine will have great industrial significance.

As the amplitude increases, the clogging of the mesh hole will be greatly reduced, and the stratification of the material is also facilitated. However, too large amplitude is also destructive to the device. The choice of amplitude is determined by the particle size and nature of the material being screened. At the same time, the amplitude can be controlled within the desired range by controlling the number of shrapnel assemblies. Four test points were selected on each layer of the two-layer vibrating screen to record the amplitude of the different shrapnel components. The obtained data is shown in Table 5.

REFERENCES

- [1] Zhou Bi. Optimization design and experimental research of new composite vibrating screen. Huaqiao University, 2016.
- [2] Bu Wenzhuo. Dynamic analysis and application of double vibrating motor linear multi-layer vibrating screen. Jiangsu University, 2017.
- [3] Fang Xinlei. Study on Dynamic Characteristics of Tobacco Vibrating Sorting Screen. Zhengzhou University, 2012.
- [4] Fang Rui, Liu Zuwang. Measures to Improve the Working Efficiency of Vibrating Screen in Feed Mills. Feed Industry, 2009, 30(07): 3-6.
- [5] Ruan Jinglan, Ruan Shaolan, Wu Yi. Analysis of the Influence of Vibrating Screen Parameters on Working Efficiency. Cereal & Feed Industry, 2000, (01): 15-17.
- [6] Zhao Huanshuai. Numerical Simulation Analysis of Main Technical Parameters of High Frequency Vibrating Screen. Coal Science and Technology, 2012, 40(10): 88-91.
- [7] Wang Feng. Development and Prospect of Screening Machinery. Mining Machinery, 2004, (01): 37-39.
- [8] Wei Lubin, Chen Qingru. Research on mathematical model of probability grading sieve for coal. Journal of China Coal Society, 1995, (01): 57-62.

Numerical Analysis of Icing progress on Rib-Tubes of Seawater Open Rack Vaporizer

Shu-rong Yu¹, Hou-de Su^{1,2,*}, Xing Wei²

¹Department of Petrochemical, Lanzhou University of Technology, Lanzhou 730050, China

²LANPEC Technologies Limited, Lanzhou 730070, China

*E-mail: suhoud@lanpec.com

Abstract: The Open-Rack Vaporizer (ORV) is an important large-scale gasification equipment in the LNG receiving terminal. Its gasification performance and efficiency directly affect the load capacity of the LNG terminal. In this paper, on the basis of literature research at home and abroad, through the open-type seawater gasification structure with the method of numerical simulation, the flow and freezing process in the tube of open-type seawater gasifier are studied, and more reasonable structure and operation parameters are discussed to improve the gasification rate of open-shelf seawater gasifier.

Keywords: Open-Rack Vaporizer; numerical simulation; freezing process

1. INTRODUCTION

As the heating source of the open-type gasifier, seawater will drop in the temperature of the seawater through the heat exchange tube, and freeze formation will occur. In this process, the salinity of the seawater will also change, so the thermal properties of the seawater will also change. Compared with fresh water, the thermal properties of seawater are much more complicated. The main thermophysical properties of seawater vary greatly with temperature and salinity, and many of its thermophysical properties are not simple linear laws [1,2].

2. HYDRODYNAMIC MODEL

Considering that the liquid film is evenly distributed along the circumference of the heat transfer tube, a two-dimensional simplified model can be employed. Due to structural rules, they are modeled directly in Gambit, and all use structured quadrilateral meshes, as shown in Figures 1 and 2. For a 5 mm liquid membrane model, the total number of meshes is 12,500; for a 10 mm liquid membrane model, the total number of meshes is 25,000.

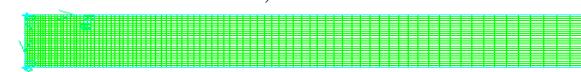


Figure 1. 5 mm liquid membrane local grid graph



Figure 2. 10mm liquid membrane local grid graph

3. BOUNDARY CONDITIONS AND FLOW FIELD CALCULATION SETTINGS

The boundary conditions and flow field calculation settings of the two calculation models are consistent. Define the boundary conditions for the model in Gambit, as shown in Figure 3.

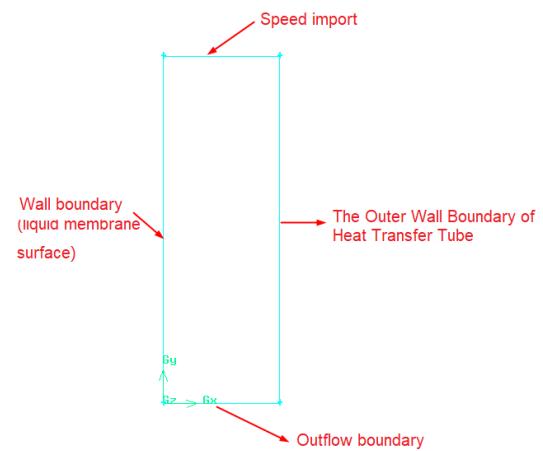


Figure 3. Model boundary setting

Import the grid file generated by Gambit into Fluent 6.3 for calculation. Select the 2D pressure-based solver, consider the influence of gravity acceleration, the operating pressure is 1 atmosphere, the turbulence model is set as the turbulence model, and the material properties involved in the definition calculation are as shown in Table 1, and the boundary conditions are set. Since the total flow rate of seawater and the number of heat transfer tubes in the working process are known, the flow rate allocated on a single heat transfer tube can be obtained, and the velocity of the inlet boundary conditions of different liquid membrane models can be calculated by the flow rate and the thickness of the liquid membrane. Since seawater provides a heat source for LNG gasification in the tube, the heat flux on the outer wall surface of the heat transfer tube is calculated according to the total heat transfer amount requirement, and the virtual thickness of the wall surface is set to a heat transfer tube radius of about 0.02 m, to consider the thermal conductivity of the outer wall of the tube. The specific boundary is set as shown in Table 2.

Table 1. Material setting

	Density (kg/m ³)	Viscosity (mPa·s)	Specific heat at constant pressure (J/kg·K)	Heat Transfer Rate (W/(m·K))	Relative molecular mass	Phase transition temperature (K)	Atent heat of phase transformation (J/kg)
Seawater	1017	1.23	4316	0.5903	18.02	271	333146
Al6063	2680	—	900	201	—	—	—

Table 2. Liquid membrane model boundary condition setting

	5 mm liquid membrane	10 mm liquid membrane
Speed import	V = 1.293902 m/s T = 285.15 K	V = 0.646951 m/s T = 285.15 K
Outflow boundary	No parameter setting	No parameter setting
Wall boundary (liquid film surface)	Heat insulation	Heat insulation
Outer wall boundary	Flux = -5991.7 w/m ² The wall thickness is 20 mm	Flux = -5991.7 w/m ² The wall thickness is 20 mm

In the solution setting, PISO algorithm is used to calculate the relationship between pressure and velocity, second-order upwind difference scheme is used for momentum equation, and first-order upwind difference scheme is used for energy equation. [3-5] Since the PISO algorithm also requires relaxation factors, after multiple operations, the basic selection is as follows: the pressure relaxation factor is 0.2, the momentum equation relaxation factor is 0.8, the energy equation relaxation factor is 1, density and volume force relaxation factor are set to 1. For the unsteady calculation, it is appropriate to determine the time step by 0.01s after trial calculation. Considering that the liquid film takes about 6 seconds from the top to the bottom in the actual process, the total time of unsteady state calculation is set to 12 seconds.

4. FLOW FIELD CALCULATION RESULTS AND ANALYSIS

Since the ratio of the length and width of the liquid film model is too large, only the temperature field distribution of the bottom liquid film is intercepted. Since the liquid film flows from top to bottom and

continuously supplies heat to the LNG in the tube, freezing is most likely to occur at the bottom of the liquid film. Figures 4-8 show the temperature distribution of the bottom of a 5 mm liquid film at different temperature seawater inlet conditions. It can be seen from these figures that the temperature field in the liquid film is gradually changed from the outer layer to the inner layer. The closer to the outer wall of the heat transfer tube, the greater the temperature gradient. This is because the sea water under working conditions provides heat source for the gasification process in the tube, the seawater temperature decreases, releases heat, and the heat flux enters the inner part of the heat transfer tube through the heat conduction process on the wall.[6] It can be seen from the temperature field distribution under different inlet conditions that the temperature drop in the whole process is about 1 K, that is, under the heating condition in the working process, the temperature change of the 5mm liquid film at the bottom end of the heat transfer tube is about 1 K. The specific temperature values are shown in Table 3.

Table 3. Average outlet temperature of liquid film 5 mm model under different boundary conditions

Inlet temperature	285.15 K	280.15 K	277.15 K	274.15 K	273.15 K
outlet temperature	284.62 K	279.48 K	276.28 K	273.55 K	272.37 K

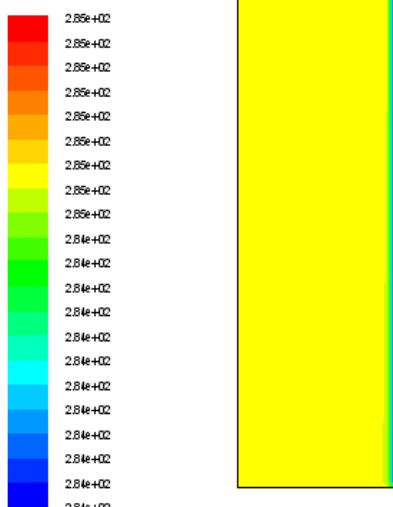


Figure 4. Cloud map of temperature distribution at the bottom of liquid film at T = 285.15 K

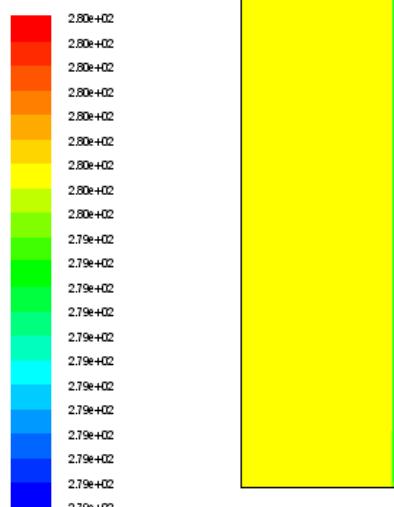


Figure 5. Cloud map of temperature distribution at the bottom of liquid film at T = 280.15 K

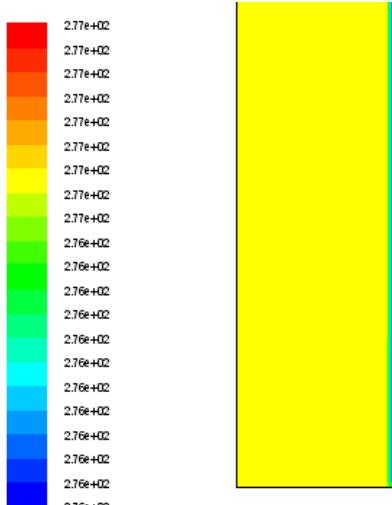


Figure 6. Cloud map of temperature distribution at the bottom of liquid film at $T = 277.15\text{ K}$

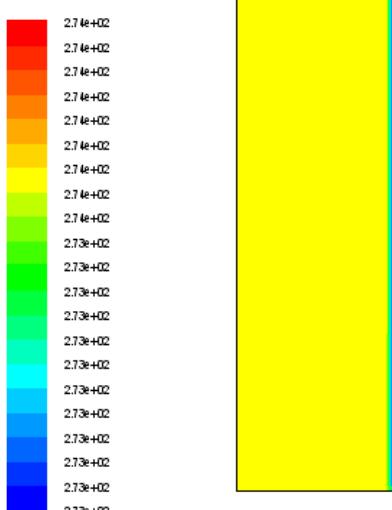


Figure 7. Cloud map of temperature distribution at the bottom of liquid film at $T = 274.15\text{ K}$

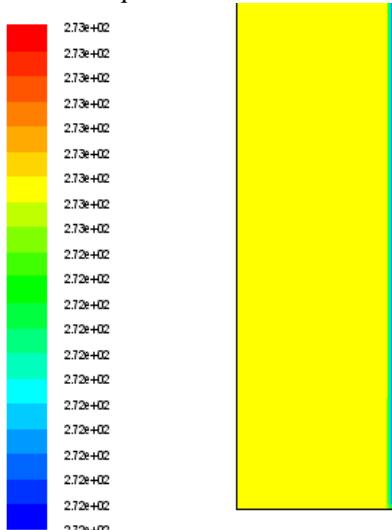


Figure 8. Cloud map of temperature distribution at the bottom of liquid film at $T = 273.15\text{ K}$

After trial calculation of different temperature boundary conditions, it is found that when the inlet

seawater temperature is 273.15 K , freeze formation will begin to appear inside the liquid film. [7] Since the outer wall of the tube will affect the heat transfer process of the heat transfer tube after it freezes, which affects the gasification process of LNG, the freezing phenomenon should be avoided as far as possible in the actual working process, only the unsteady state calculation of the liquid film under the critical condition is needed to observe the freezing change in the liquid film. This calculation assumes that the flow of seawater liquid membrane outside the tube has been stabilized, that is, the stable flow field is solved under the current inlet conditions, and then the solidification/thaw model is opened to calculate the freezing process.

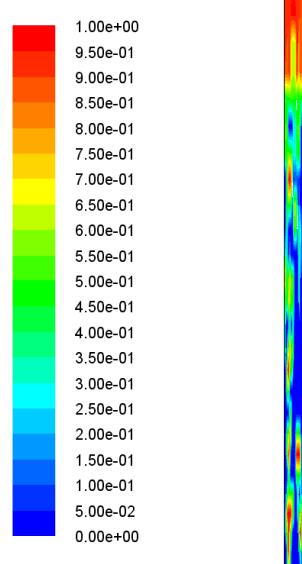


Figure 9. Cloud map of liquid volume fraction distribution at $T = 0.5\text{ s}$

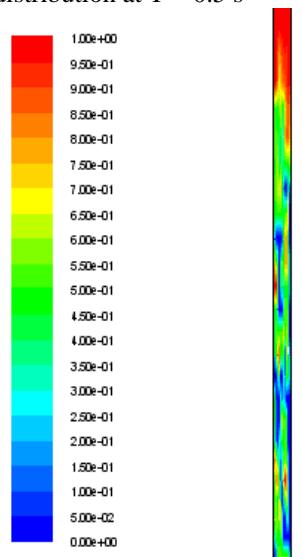


Figure 10. Cloud map of liquid volume fraction distribution at $T = 1.5\text{ s}$

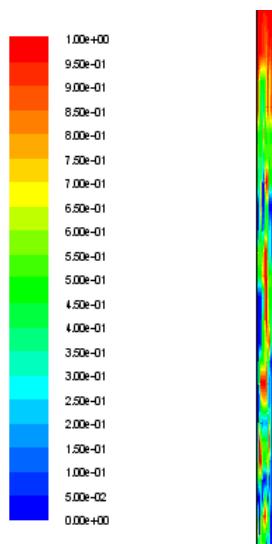


Figure 11. Cloud map of liquid volume fraction distribution at $T = 2.5$ s

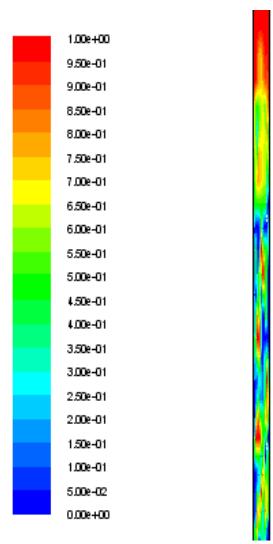


Figure 14. Cloud map of liquid volume fraction distribution at $T = 5.5$ s

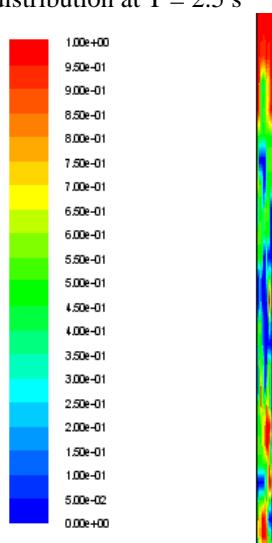


Figure 12. Cloud map of liquid volume fraction distribution at $T = 3.5$ s

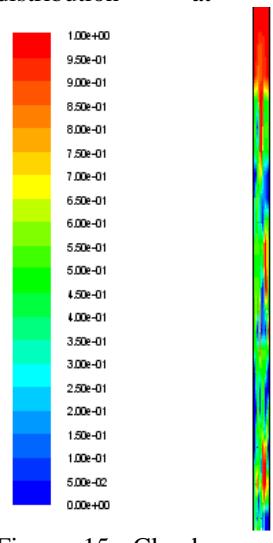


Figure 15. Cloud map of liquid volume fraction distribution at $T = 6.5$ s

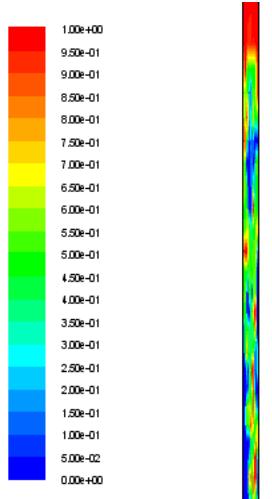


Figure 13. Cloud map of liquid volume fraction distribution at $T = 4.5$ s

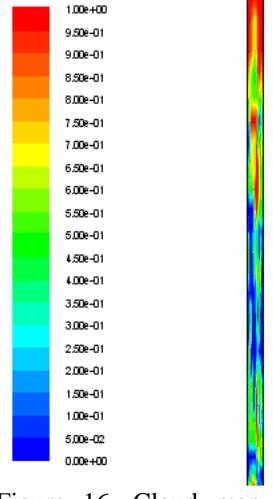


Figure 16. Cloud map of liquid volume fraction distribution at $T = 7.5$ s

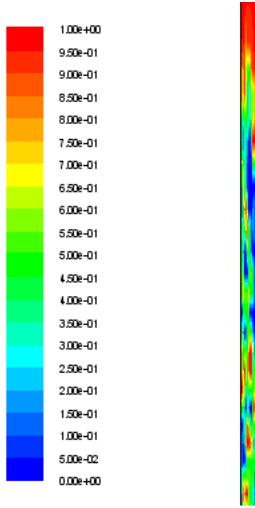


Figure 17. Cloud map of liquid volume fraction distribution at $T = 8.5$ s

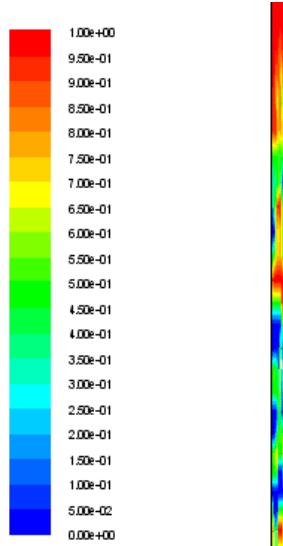


Figure 20. Cloud map of liquid volume fraction distribution at $T = 11.5$ s

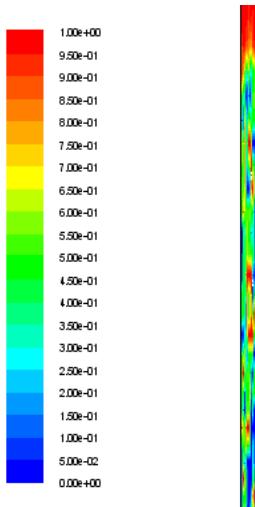


Figure 18. Cloud map of liquid volume fraction distribution at $T = 9.5$ s

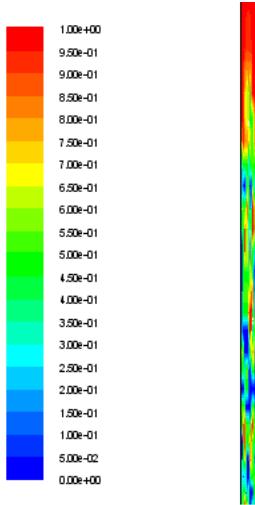


Figure 19. Cloud map of liquid volume fraction distribution at $T = 10.5$ s

Figures 9-20 show the liquid volume fraction distribution at the liquid-solid interface in the liquid film at different times. In the upper section, all the uncut parts are liquid seawater. Ice phenomenon begins to appear downward from the interface. Red liquid phase region and blue solid phase region. By observing the liquid volume fraction distribution at different times, it is possible to clearly see the freezing of seawater during the course of time. Since the seawater is continuously flowing, there is ice formation at the solid-liquid interface, and there is also ice melting. The freezing condition changes dynamically with different time, and the position of the solid-liquid interface changes little.

5. CONCLUSION

5.1. The temperature distribution at the bottom of the 5 mm liquid film under different temperature seawater inlet conditions shows that the temperature field in the liquid film changes gradually from the outer layer to the inner layer. The closer to the outer wall of the heat transfer tube, the larger the temperature gradient and the working process is satisfied. Under the heating condition, the temperature change of the 5 mm liquid film at the bottom end of the heat transfer tube is about 1 K. After trial calculation of different temperature boundary conditions, when the inlet seawater temperature is 273.15 K, ice formation will begin to appear inside the liquid film.

5.2. There are freezing and melting phenomena at the solid-liquid interface. The freezing situation changes dynamically with different time, and the position of the solid-liquid interface basically fluctuates little.

REFERENCES

- [1] Luo Chao, Ma Weibin, Gong Yulie. An experimental study for falling-film outside a vertical tube. Chemical Industry and Engineering Progress, 2010, 29(5): 821-824.

- [2] Lu Huixia, Ma Xiaojian. Experimental on heat transfer of falling film evaporation on horizontal tubes. *Chemical Industry and Engineering Progress*, 2009, 28(2): 203-204.
- [3] Wang Tong, Gu Chuangang, Yang Bo. PISO algorithm for unsteady flow field. *Journal of Hydrodynamics*, 2003, 18(2): 233-239.
- [4] Lin Weidong, Wang Zhenguo, Zhou Jin. APPLICATION OF A SECOND-ORDER UPWIND SCHEME TO PISO ALGORITHM. *Journal of Aerospace Power*, 1998, 13(1): 81-84.
- [5] Huang Na. Numerical Research on Influence of Flow Field Environment on Gas (Vapor) Liquid Two Phase Flow and Heat Transfer Characteristics. North China Electric Power University (Beijing), 2016.
- [6] Wang Yanqing. Experimental Investigation and Numerical Simulation on Fluid Flow and Heat Transfer in Submerged Combustion Vaporizer. Dalian University of Technology, 2017.
- [7] Zhao Zuoguang. Drag reduction flow of gas-liquid two-phase polymer in horizontal pipe. Jiangsu University, 2009.

Research on Six Degree of Freedom Sensor for Force/Torque Measurement of Large Hexapod Platform

Weijia Li¹, Yun Lu^{1,*}, Yaohzhong Wu¹, Hanxiang Fu²

¹School of Naval Architecture and Ocean Engineering, Huazhong University of Science and Technology, Wuhan, Hubei 430074, China

²School of Electronic Engineering, Xinjiang University, Urumqi, Xinjiang 830047, China

*E-mail: 61525963@qq.com

Abstract: Aiming at solving the problem of measurement of six dimensional force for heavy load operating equipment based on static first order coefficient matrix, vigorously parallel load distribution principle and piezoelectric force measuring principle, this study put forward a kind of force sensor based on the quartz crystal. Structure optimal design, manufacture, assembly and debugging of the six dimensional force sensor is researched in this study. At the end, the static calibration experiment is carried out. The experiment result shows the sensor could be further enhanced with knowledge regarding error model based on accurate error analysis and the six-axis force of heavy load equipment can be measured with this type of sensor.

Keywords: six degree of freedom; force/torque; hexapod platform; sensor calibration

1. INTRODUCTION

SIR company in America designed the modular structure for sensor in 1973. Because its design, processing and assembling precision has great influence on it, the accumulated error is large [1]. A three vertical rib structure six axis force sensor was designed by P.C Watson in 1975 [2]. Brussel and Kroll of Israel also developed a four vertical rib structure of six axis force sensor [3,4]. Yoshikawa and Uchiyam and Bayo analyzed leMaltese structure type of six axis force sensor, [5-7]. Hatamura developed a ring structure of six axis force sensor [8]. Little studied for a small cylindrical force sensor [9]. Kaneko proposed a kind of double heads type six axis force sensor [10]. Hirose studied six axis force sensor using the photosensitive element [11]. Kerr, Nguyen [12], Ferraresi, Dwarakanath [13], Youlun Xiong in Huazhong University of Science and Technology and Chen Bin in Peking University carried out six axis force sensor design problem on the Stewart platform. At present, the measurement of these six axis force sensors are mostly confined to a small range. A six dimensional detection method to measure the load of 20 KN or above has not been proposed. In this study, by using the quartz crystal sensor as sensitive element, a new method for the measurement of the force/torque

of large equipment based on parallel load distribution principle is put forward.

2. PARALLEL FORCE DIVISION PRINCIPLE AND MODEL FOR THE SENSOR

In the present study, in order to implement the dynamic measurement of the large space load on operating shaft, it is not feasible to load directly in the piezoelectric quartz group for the reason that the maximum bearing capacity of piezoelectric quartz is about 130 N/mm², even if the large size of piezoelectric quartz is used, which can bear the load limit of about 12.5 t, it is hard to meet the requirements of the operating load of hundreds of tons from the giant machines. That is to say the direct load type is not advisable. The sensor should use the load division mechanism, to make it acceptable in the range of a direct effect on the force sensing element. The measuring principle of parallel force division is similar to the principle of DC high current shunt measurement, as is shown in Figure 1a, the elastic model is shown in Figure 1b.

It is not feasible to use galvanometer directly to measure large DC current. The current division principle is used to solve the problem, which shows that the algebraic sum of currents in a network of conductors meeting at a point is zero. According to this principle, When $R_1 \ll R_2$, we have:

$$I \approx \frac{R_2}{R_1} I_2 = C_r I_2 \quad (1)$$

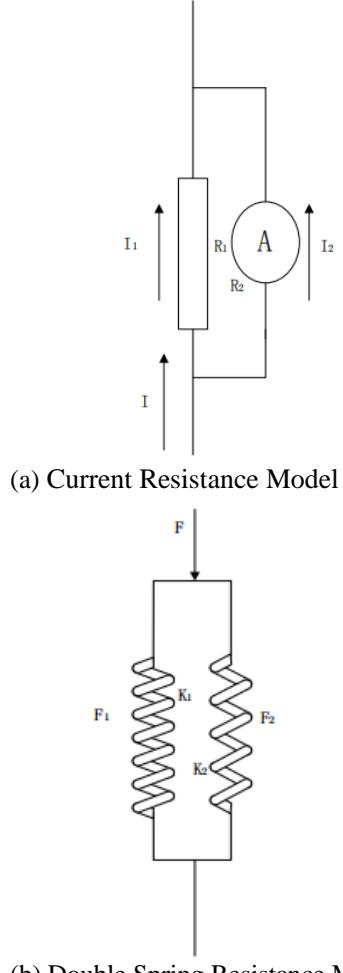
Similarly, parallel force division principle for heavy load measurement is realized due to the stiffness force distribution principles of parallel mechanism. It is described as following:

$$F = \left(\frac{k_1}{k_2} + 1 \right) F_2 = \frac{1}{C_r} F_2 \quad (2)$$

$$C_r = \frac{F_2}{F} = \frac{1}{\frac{k_1}{k_2} + 1} = \frac{k_2}{k_1 + k_2} \quad (3)$$

where k_1 represents the stiffness of parallel mechanism and k_2 represents the stiffness of force-sensitive element. C_r is defined as the load

division ratio of the load measurement mechanism, that is, the ratio of load on force sensitive element in total load.



(b) Double Spring Resistance Model

Figure 1. Model of heavy load division

Piezoelectric quartz is chosen as force sensitive element because of its wide frequency band and small dynamic measurement error. Compared with other types of sensors, quartz force sensor also has advantages of static rigidity, high sensitivity, high resolution, good linearity, small hysteresis repeat-ability error and good stability. Piezoelectric quartz force sensor is mainly based on the piezoelectric effect, various cutting types of piezoelectric quartz that is sensitive to different directions of load can be designed according to the piezoelectric quartz matrix. X0 types which are sensitive to longitudinal load and Y0 types which are sensitive to shear loading are most commonly used. In order to improve the sensitivity of piezoelectric sensors and simplifies the structure, it is generally designed with two chips of same cutting type to form a crystal group, then a certain structure of a sensor is decided by assembling several crystal groups mentioned above.

3. SPITAL STRUCTURE AND MATHEMATICAL MODEL AND CALIBRATION EXPERIMENT

It can be learned from the model that when the

amount of distribution point is odd, there must be a point in the coordinate axis of the sensor which may lead asymmetry of layout spatial structure. It may not only increase the amount of calculation, but also more error in the measurement results. With the increase of support points, quartz crystal groups also increased in number which will increase the cost. To determine the support point, it depends on the measurement requirements, appropriate spatial layout structure points should be chosen according to the measurement requirements. The four point support type is selected in this study for the reason of avoiding affection on the measurement results when the large change occurs on the action point of external force. It can also reduce the cross interaction to sensors. By changing the installation location of force sensing element, it can get two kinds of layout for four point supporting type in structure: the rhombus layout, shown in Figure 2, and the square layout, shown in Figure 3. The six axis force of rhombus layout can be expressed as following:

$$\begin{cases} F_X = F_{1x} + F_{2x} + F_{3x} + F_{4x} \\ F_Y = F_{1y} + F_{2y} + F_{3y} + F_{4y} \\ F_Z = F_{1z} + F_{2z} + F_{3z} + F_{4z} \\ M_X = a(F_{2z} - F_{4z}) \\ M_Y = a(F_{3z} - F_{1z}) \\ M_Z = a(F_{1y} - F_{3y} + F_{4x} - F_{2x}) \end{cases} \quad (4)$$

According to the analysis above, the rhombus is chosen in this study for easy calculation.

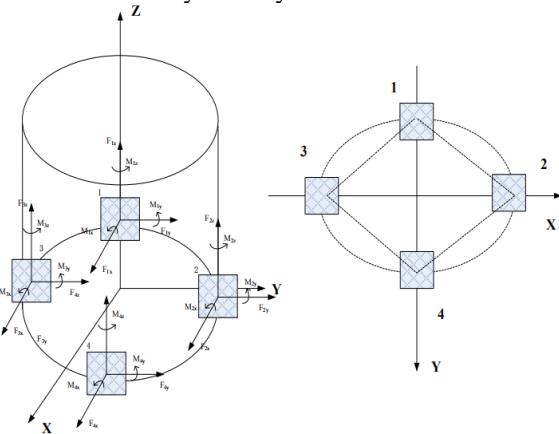


Figure 2. Model of the rhombus layout

Comprehensive performance appraisal should be carried out according to the design index after the sensor assembly is completed. Figure 4 shows the result of the calibration. To determine the relation between the sensor input and output through the experiment and get the calibration curve, the data obtained according to the measured results of the sensor's performance should be analyzed with its' sensitivity, linearity and repeat-ability.

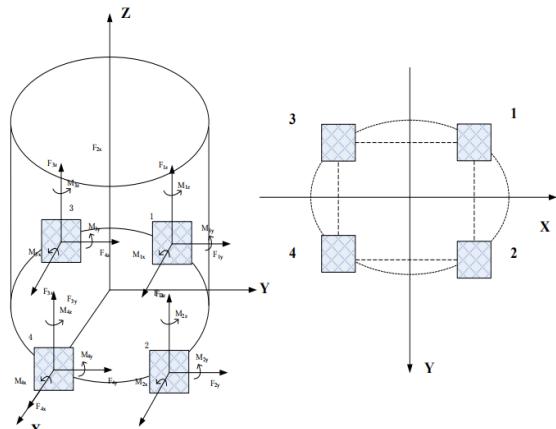


Figure 3. Model of the square layout

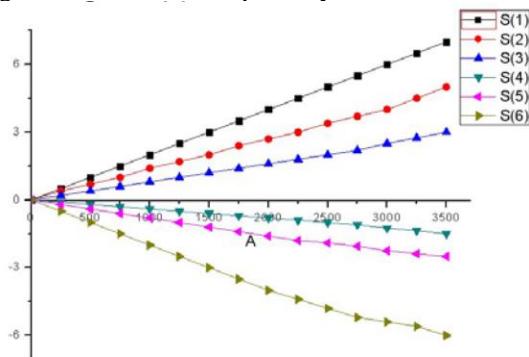


Figure 4. Result of the calibration

4. CONCLUSION

Aiming at solving the problem of measuring six-axis heavy load and improving measuring accuracy in fatigue test of large structure, this study presents a new type of six-axis force sensor based on the heavy load division principle. The sensor is made with piezoelectric quartz which is used as force sensitive element. This study proposes a type of four point support structure and the spatial mechanical model is deducted for the sensor. Finally, the static calibration experiment is carried out in this study. Experimental results show that the six-axis force of heavy load equipment can be measured with this type of sensor. The basic performance of the sensor shows that it can meet the engineering requirements well.

The conclusion of the study are as follows:

- (1) The spatial structure of six dimensional force sensor is determined based on the measuring principle. The mechanical model and mathematical model of the sensor is also given out.
- (2) The static calibration experiments is done in the specific calibration device and the calibration curve of good linearity is obtained. The decoupling matrix of sensor si also obtained on the basis of the experimental data.

For the future development of proposed scheme, self decoupling method could be researched for the sensors. In addition, sensors with complex structures

could also be researched to improve the performance. The sensor could be further enhanced with knowledge regarding error model based on accurate error analysis.

REFERENCES

- [1] Folchi, George Arthur, Shelton Jr., Glenmore Lorraine, Wang, Sherman Sheau-ming. Six degree of freedom force transducer for a manipulator system. US Patent 3948093, 1975-06-30.
- [2] P.C. Watson, S.H. Drake, Pedestal Wrist. Force Sensors for Industrial Assembly. Proc. of the 5th Int. Symp. on Industrial Robots, Chicago, 1975, pp. 501-511.
- [3] H.V. Brussel, H. Belien, H. Thielemans. Force Sensing for Advanced Robot Control. Proc. of the 5th Int. Conf. On Robot Vision and Sensory Controls, Bedford, England, 1980, pp. 279-288.
- [4] E. Kroll. Decoupling Load Components an Improving Robot Interfacing with an Easy-to-use 6-axis Wrist Force Sensor. Theory of Machines and mechanisms. Proc. of the 7th world Congress, Seville, 1986, pp. 327-331.
- [5] T. Yoshikawa, T. Miyazaki. A Six-axis Force Sensor with Three-dimensional Cross-shape Structure. Proc. of IEEE Conf. on Robotics and Automation, Scottsdale, 1989, (1): 249-255.
- [6] M. Uchiyama, E. Bayo, E. Palma Villalon. A Systematic Design Procedure to Minimize a Performance Index for Robot Force Sensors. Journal of Dynamic Systems Measurement and Control. 1991, 113(1): 388-394.
- [7] E. Bayo, J.R. Stubbe. Six-axis Force Sensor Evaluation and a new Type of Optimal Frame Truss Design for Robotic Applications. Journal of Robotic Systems, 1989, 6(2): 191-208.
- [8] Y. Hatamum. A Ring-Shape 6-axis Force Sensor and Its Application. int. Conf. On Advanced Mechatronics, Tokyo, Japan, 1989, pp. 647-652.
- [9] R. Little. Force/Torque Sensing in Robotic Manufacturing Sensors. The Journal of Machine Perception, 1992, 9(11): 346-348.
- [10] M. Kaneko. Twin-Head. Six-axis Force Sensors. IEEE Transactions on Robotics and Automation. 1996, 12(1): 146-154.
- [11] S. Hirose, K. Yoneda. Robotic Sensors with Photo Detecting Technology. Proc. Of the 20th ISIR, Tokyo, 1989, pp. 271-278.
- [12] S. Hirose, K. Yoneda. Development of Optical 6-axis Force Sensor and Calibration Considering Non-Linear Interface. Proc. of IEEE Int. its Signal Conf. On Robotics and Automation, Scottsdale, 1989, (1): 45-63.
- [13] T.A. Dwarakanath, Bhaskar Dasgupta, T.S. Mruthyunjaya. Design and Development of a Stewart Platform based Force-Torque Sensor. Mechatronics, 2001, (11): 793-809.

The Progress of Military Stress Research and Its Impact on Psychological Immune Function

Xiaofeng Li^{1,*}, Haihua Yu^{1,2}

¹Ministry of Education and Training for Political Officers, Dalian Naval Academy, Dalian 116001, China

²Genetic Disease Laboratory, Dalian Maternal and Child Health Care Hospital, Dalian 116001, China

*E-mail: 50157080@qq.com

Abstract: It is a major feature of military profession to perform tasks in extreme combat environments with high danger, high harshness and multiple pressures. The existence of extreme combat environment will greatly interfere with the performance of military operators and have a great impact on their psychological state, which will make the operators continue to be in a serious state of military stress, and eventually lead to a significant decline in the combat effectiveness of military operators and psychological non-combat attrition. At present, the evaluation and grading of military stress mainly relies on clinical symptomatology standards. There are many problems, such as unclear mechanism, inaccurate targeting, less training intervention and medical support programs. According to sensitive early warning indicators of stress, psychological training and psychological intervention should be strengthened, and scientific supplements of drugs or nutrients should be combined to formulate a systematic and standardized military stress protection program in line with the actual situation of our army. Experiments show that the scheme can prevent the harm of military emergency to a certain extent.

Keywords: military emergency; psychological response; psychological immunity; extreme combat environment

1. MILITARY STRESS HAZARDS AND CURRENT SITUATION

With the rapid development of science and technology, the current and future military operations are becoming more and more rapid, efficient and intense. The stress level of soldiers is significantly increased, and the stress performance is more complex. U.S. military researchers point out that in previous wars, the ratio of mental illness reduction to war casualties reduction is 1:3, while in future wars, the ratio may increase to 1:2. In modern warfare, non-combat attrition caused by psychological panic and other military stresses will seriously affect the combat effectiveness and morale of the army, and has become one of the important factors determining the victory or defeat of the war. In the Gulf War, 896 U.S. military casualties were reported, while 547 cases of mental illness were reported. Military stress medicine has gradually become a major research field in military medicine. Especially after the Gulf War, the

increasing number of post-traumatic stress syndrome (PTSD) caused by stress has made countries attach great importance to military stress medicine.

2. EFFECT OF MILITARY STRESS ON IMMUNE FUNCTION INDICATORS

Military stress is a comprehensive life activity involving the body's neuroendocrine and immune system, and the change of immune function is one of the main effects of stress response. Documents [1] reported that the T cells, suppressive T cells (Ts), helper T cells (Th), natural killer cells (NK), B lymphocyte and Th/Ts ratio of officers and soldiers after tank professional training were detected. It was found that tank professional training could affect T cells and B cell immunity and cause T lymphocyte. The immune level decreased while the number of B lymphocyte increased. Other studies [2] When analyzing the psychological stress characteristics and peripheral blood immune function of recruits during training, it was found that the percentage of NK cells in peripheral blood of recruits in training group was significantly lower than that of control group, and the percentage of B lymphocyte was significantly higher than that of control group. The total score of SCL-90 was positively correlated with the percentage of T lymphocyte and subsets, and the percentage of NK cells. The score of interpersonal sensitivity factor was positively correlated with the percentage of B cells. Fanlong Zhongzhong [3] reported that the levels of CD3+, CD4+, CD16+, CD56+, CD4+/CD8+, CD19+, CD8+, T lymphocyte, Ts cell, NK cell and Th of the officers and soldiers stationed on the reefs in the South China Sea were significantly lower than those before the reefs were guarded. The ratio of T/T decreased, while the level of B lymphocyte and Th cell increased. T lymphocyte mainly mediates cellular immunity. Its subsets CD4 + and CD8 + lymphocyte have the function of promoting and suppressing immunity respectively. The ratio of CD4 + to CD8 + decreases, reflecting the decline of immunity. B lymphocyte has the function of recognizing antigen, mediating fluid immunity, synthesizing and secreting antibody. The increase of B lymphocyte reflects the enhancement of humoral immunity. NK cells do not depend on antigen sensitization, kill target cells independently, mediate cellular immunity, NK cell reduction suggests that NK cell mediated cellular immune function is inhibited. But there are also

different opinions reported in the literature. The immune indexes such as T lymphocyte and B lymphocyte were affected by different stress intensity. In addition, the immune function of officers and soldiers could be significantly affected by factors such as working environment, electromagnetic radiation and noise. It has been reported in the literature [4] that the number of helper T lymphocyte increased after special forces training, which led to the enhancement of cellular immune response ability after training. Schwanghong et al. [5] studied the immune function of the new and old soldiers under parachute jumping stress. The results showed that the immune function of the recruits was inhibited under parachute jumping stress. The immune function of the veterans was not decreased, but some immune indexes were also increased, suggesting that the parachute jumping stress response of the veterans was moderate, and severe parachute jumping stress could be alleviated by repeated training. In addition, the results showed that the recruits were still in a state of stress after 10 days of training. The sympathetic-adrenal medullary system reacted strongly and the level of catecholamine consumption increased. However, no changes in humoral and cellular immune functions were observed. Military stress can cause changes in endocrine hormone levels after it inhibits the immune system. Cheng Chuanmiao et al. [6] Serum levels of interleukin-2 (IL-2), interleukin-6 (IL-6), interleukin-8 (IL-8), tumor necrosis factor (TNF), serum cortisol and aldosterone were measured before and after military exercises. The results of serological tests were compared with those of the soldiers' Psychological Stress Self-Assessment Questionnaire (PSET). The results showed that the serum levels of IL-2, IL-6, IL-8 and TNF were significantly decreased, the levels of IL-2, IL-6 and I were significantly increased, and the levels of PSET scores (>70) were decreased. The levels of L-8 and TNF increased significantly, and the levels of serum cortisol and aldosterone increased after military exercises. Gao Juan et al. [7] chose military exercise troops and found that the level of serum TNF-alpha and the expression of TNF-alpha in gastric mucosa increased significantly after the exercise. Ye Lu et al. [8] detected the levels of peripheral blood cytokines, serum IgG, IgM and T cell subsets in recruits of Armed Police Forces. The results showed that the levels of serum IL-2 and IL-6 and IL-8 in recruits during training stress period were significantly lower than those in the basic period, and the levels of serum IgG in recruits during training recovery period were significantly higher than those in the basic period. In the basic period.

3. STUDY ON THE MECHANISM OF MILITARY STRESS AFFECTING IMMUNE FUNCTION

Psychological stress regulates immune function mainly through hypothalamus-pituitary-adrenal axis (HPA) and hypothalamus-pituitary-sympathetic

nervous system (SNS). It has been proved that there are many neurotransmitters and endocrine hormone receptors in immune cells. The existence of these receptors has become the material basis of neuroendocrine system acting on immune system cells. The influence of stress on immune function is complex. Under stress conditions, the body often produces different immune responses depending on the type, intensity, duration and individual differences of stressors. The main manifestation of military stress is the weakening of immune function, which is closely related to the increased secretion of glucocorticoids (GC), growth hormones and salt corticosteroids. GC has an effect on many aspects of immune response. It mainly inhibits macrophage phagocytosis and treatment of antigens, hinders DNA synthesis and mitosis of lymphocytes, destroys lymphocytes, reduces the number of peripheral lymphocytes and damages plasma cells, thus inhibiting cellular immune response and humoral immune response. In addition, GC can inhibit the increase of capillary wall permeability, the proliferation of collagen fibers and capillaries, and the neutrophil migration to inflammatory foci. These effects can inhibit the inflammatory response. At present, it is believed that GC may directly affect lymphocyte by binding with cortisol receptor in lymphocyte cytoplasm, so as to reduce the number of lymphocyte and NK cell activity. In addition to directly acting on lymphocytes, GC can also exert immunosuppressive effects by regulating the release of other active substances, such as central excitatory amino acids, opioid peptides and sex hormones. In addition, GC can inhibit the production of many lymphokines, such as interferon, IL and TNF. The decrease of phagocytic antigen ability of monocytes and the change of the number and ratio of T lymphocyte subsets are also one of the reasons for the decrease of cellular immune function. Military stress can reduce the levels of IgA, IgG and IgM, and change the body's humoral immune function. In a word, the mechanism of immune system function changes induced by psychological stress reaction is very complex. Although there are many related studies, further studies are still needed.

4. MILITARY STRESS PREVENTION AND CONTROL MEASURES

In recent years, military stress medical researchers in our army have gone deep into the grass-roots level, widely popularized the knowledge of stress injury protection, and helped officers and soldiers to solve psychological stress problems. At present, the research on the prevention and treatment of military stress mainly focuses on psychological assessment, psychological counseling and psychological strengthening training. Many researchers at home and abroad have begun to focus on the biological basis of military stress, the regulators of stress, the markers of early warning and drug therapy. The development of

anti-stress drugs or nutrients, especially immune preparations to delay or weaken stress-induced is one of the important directions of stress prevention and treatment research. The main drugs used to treat military stress abroad are glucocorticoid and salt-corticoid antagonists, dehydroepiandrosterone and 5-hydroxytryptamine inhibitors. These drugs have a single target, limited therapeutic effect and obvious adverse reactions. Xia Nan et al. [9] reported that Schisandra chinensis and compound Schisandra chinensis had significant and lasting inhibition on HPA axis after stress, which weakened the increase of cortisol and adrenocorticotrophic hormone levels induced by stress response, while salidroside could significantly reduce the increase of IL-2 levels induced by stress. In another study, Yuejubaohé Pill, Shenling Baizhu Pill and Acupuncture and Moxibustion were used to treat the officers and soldiers of the anti-terrorism drill troops, which effectively inhibited the adverse reactions caused by psychological stress. Other researchers used zinc gluconate, Bailong Jieyu granules and paeoniflorin to intervene in the treatment of stress response, and achieved certain results. Other researchers used zinc gluconate, Bailong Jieyu granules and paeoniflorin to intervene in the treatment of stress response, and achieved certain results.

5. SUMMARY AND PROSPECT

Stress is necessary for life activities, but strong psychological stress or long-term chronic psychological stress will seriously affect people's mental and physical health, resulting in emotional and behavioral abnormalities, low immune function, stress ulcer and neuroendocrine dysfunction [10]. Military stress refers to the process in which soldiers react to a variety of military operations, including extremely harsh living environment, mental overload, stress and intensive operations, including psychological and physiological changes, in the course of accomplishing military tasks. Moderate military stress response can often activate thinking, improve alertness and operational efficiency of soldiers, and better adapt to the environment. But when the stress response leads to changes in their cognitive, emotional and behavioral, resulting in military stress obstacles, it will seriously reduce the efficiency of military operations, and even cause non-combat reduction of troops. In recent years, the research on military stress mainly focuses on the occurrence, manifestation and harmfulness of military stress response, and prevention and treatment are mostly limited to psychological counseling, psychological training and so on. At present, the main trend of research on

prevention and treatment of stress injury abroad is the application of anti-stress drugs or nutrients, especially the development of immune preparations to alleviate stress injury. At the same time, we should strengthen psychological training and psychological intervention according to sensitive early warning indicators of stress, and formulate a systematic and standardized military stress protection program in line with the reality of our army, combining with scientific supplements of drugs or nutrients, so as to avoid the harm of military stress better.

REFERENCES

- [1] A.A. Aldridge, S.C. Roesch. Developing coping typologies of minority adolescents: A latent profile analysis. *Journal of Adolescence*, 2008, 31(4): 499-517.
- [2] Cheng Chuanmiao, Li Zhaoshen, Huang Wen, et al. Effects of Military Stress on the Psychological and Immune Endocrine System of Soldiers. *PLA Medical Journal*, 2007, (3).
- [3] Fanlong Zhongzhong, et al. Mental health level and related factors of 1077 recruits. *Journal of Second Military Medical University*, 2004, (6).
- [4] R. Cieslak, C.C. Benight, V.C. Lehman. Coping self-efficacy mediates the effects of negative cognitions on posttraumatic dis-tress. *Behaviour Research and Therapy*, 2008, 46(7):788-798.
- [5] Lechner M.E., Stucky K.J. A Hospital Medical Staff Psychology Department: The Interface of Medical Education, Postdoctoral Psychology Training, Clinical Practice, and Medical Staff Membership. *Journal of Clinical Psychology in Medical Settings*, 2000, 7(2): 141-148.
- [6] Andysz A., Merecz D. Psychological consequences of chronic lungs diseases. The role of medical staff in treatment of psychological problems. *Pneumonologia I Alergologia Polska*, 2012, 80(4): 329-338.
- [7] Nichols K.A. Psychological care by nurses, paramedical and medical staff: essential developments for the general hospitals. *British Journal of Medical Psychology*, 1985, 58(Pt 3)(3): 231.
- [8] Chinese Editorial Committee of Behavioral Medicine Sciences. *Manual of Behavioral Medicine Scale*, 2005.
- [9] B.-H. YAIR, L. Dominique, G. Shlomit. Attentional bias in anxiety: a behavioral and ERP study. *Brain and Cognition*, 2005, 59(1): 11-22.
- [10] C.D. Sipelberger. *Theory and Research on anxiety. Anxiety and behavior*, 1966.

Research on Risk Prevention and Early Warning Technology of Highway Mobile Containers

Yu-fu Zhang, Hou-de Su*, Xing Wei, Nan Jiang
LANPEC Technologies Limited, Lanzhou, 730070, China
*E-mail: suhoude@lanpec.com

Abstract: This article uses GPS, Internet plus, multi parameter sensor, self-locking pump and other equipment to constitute a risk prevention and control early warning system. This system implements risk prevention and early warning for highway mobile containers and demonstrates the application of LNG tanker in selected provinces. The results show that the risk prevention and control system can identify, warn and control the danger of LNG tank truck.

Keywords: internet plus; multiparameter sensor; risk prevention and control; mobile container

1. INTRODUCTION

With the rapid development of China's gas industry and the increasing demand for energy, especially the wide application of clean energy, the production of cryogenic liquids such as liquefied natural gas, liquid hydrogen, liquid oxygen, liquid nitrogen and liquid ammonia has increased rapidly, which has promoted the rapid development of road mobile container equipment such as pumped tank trucks and cryogenic tank trucks. Ensuring the safe and effective operation of road mobile container equipment such as pumped tank trucks and cryogenic tank trucks has become the focus of common concern of the government, manufacturers and users. However, in the design and manufacture of cryogenic containers in China, the risk prevention and control in the use of road mobile containers are often neglected. As a result, accidents such as explosion, combustion and leakage often occur in road mobile containers, and with the increase of the number of mobile containers in China, the frequency of such accidents is on the rise. From 2012 to 2018, 100 accidents occurred in road mobile containers, causing huge losses to people's lives and property [1,2].

2. INTRODUCTION OF PREVENTION AND CONTROL EARLY WARNING TECHNOLOGY

Risk prevention and early warning technology for highway mobile containers is the use of GPS, Internet plus, multi parameter sensors and other equipment integration, through the control program automatically identify the risk factors of mobile containers, and automatic processing. The main purpose of "platform" construction is to build a public service platform for monitoring information of fixed-point unloading of tank trucks with pumps

based on satellite positioning technology, which consists of vehicle-borne satellite positioning terminal equipment, wireless transmission network, GIS/satellite positioning and monitoring center, and to realize real-time monitoring and supervision of fixed-point unloading of tank trucks with pumps. With satellite positioning technology and GIS geographic information technology as the core technology, the system seamlessly integrates GPRS or CDMA 1X wireless data communication technology, computer network technology and industrial control technology to meet the needs of positioning, monitoring, tracking, unloading, alarming, supervision, management and information services of tank trucks with pumps. This realizes the two-way communication between the information management center and the tank truck with pumps, and monitors the position and status information of the tank truck with pumps in real time on the electronic map of the information management center [3,4]. The vehicle GPS positioning schematic diagram is shown in Figure 1.



Figure 1. Principle map of vehicle-borne GPS positioning

3. SYSTEM COMPOSITION

The system is logically divided into hardware part and software part. The software part includes satellite positioning communication server software for receiving and sending wireless communication information and satellite positioning monitoring and scheduling software for monitoring and management. The hardware part mainly refers to the satellite positioning and monitoring terminal equipment installed on the tank truck with pumps. Other parts include servers, network environment and so on. As a basic part of the system operation, they also have a

major impact on the stability of the system [5]. Figure 2 shows the hardware structure of the system and Figure 3 shows the software structure of the system.

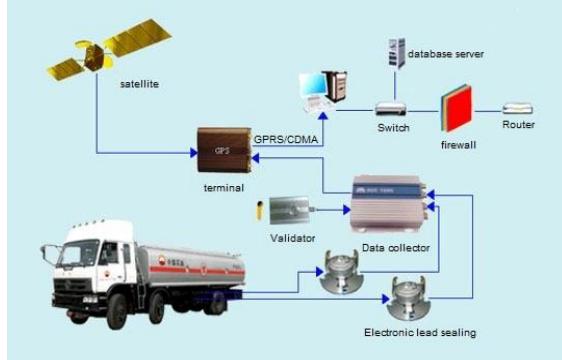


Figure 2. Schematic diagram of system hardware structure

In the satellite positioning monitoring and dispatching system, the global satellite positioning system (GPS) is used to locate, track and monitor the tank truck

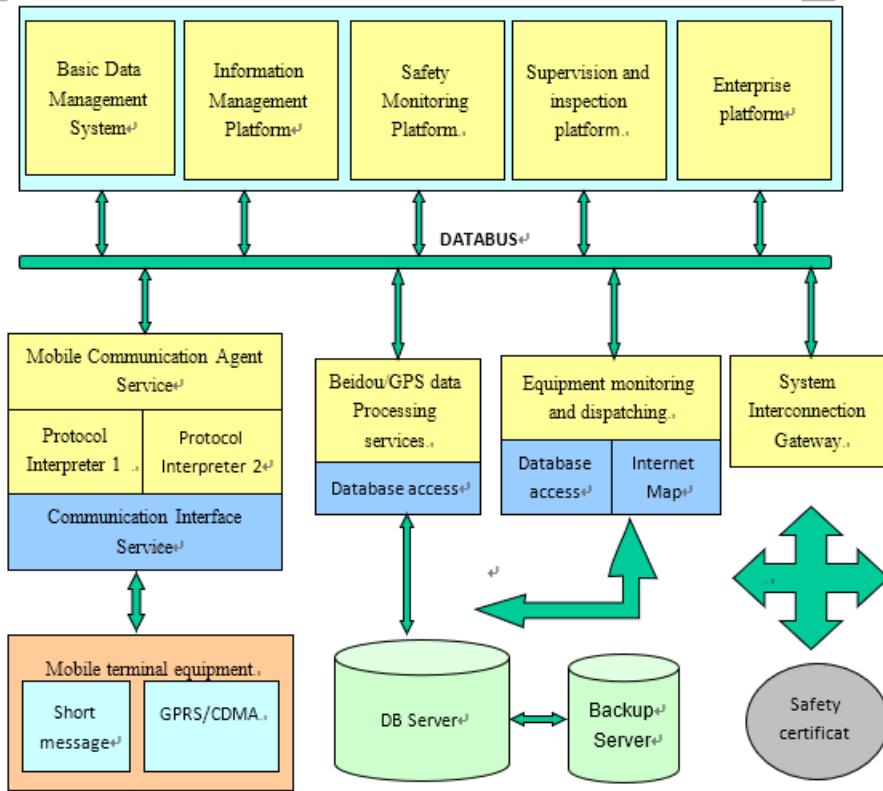


Figure 3. System software structure diagram

4. FUNCTIONS AND ADVANTAGES OF THE SYSTEM

The operation platform system of tank truck with pump adopts the advanced product design idea. The whole system adopts modular design and has good encapsulation, which makes the system have strong expansibility and realizes “plug and play” of each module. The system can assemble different modules of software, such as Web service module, GIS module, satellite positioning module, data storage module, communication module (GSM/GPRS), and run on a single machine. The system can also run on different

machines separately to complete the functions of the whole platform system. Figure 4 is a schematic diagram of the working principle of the system. If necessary, each module can also be separated and run on different servers to achieve load sharing (distributed computing). At the same time, the service monitoring module of the system can dynamically monitor the services of different hosts and complete fault switching in real time, so as to avoid single point of failure. Therefore, the system can be customized according to the needs and user's mode of use.

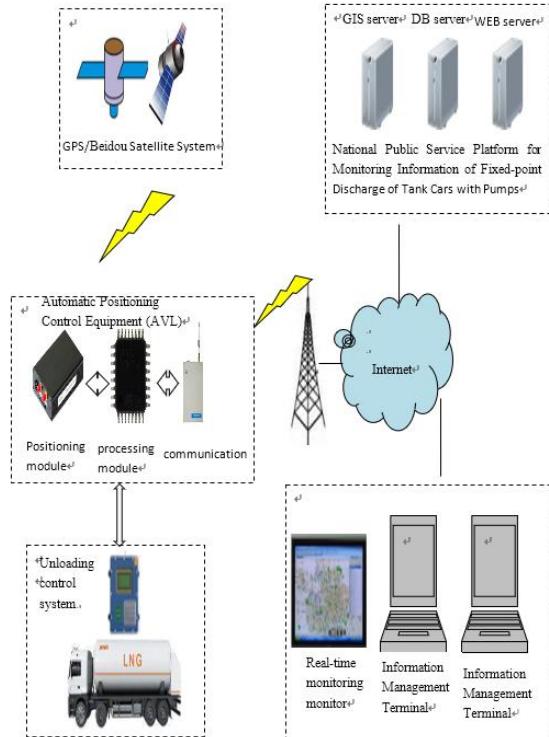


Figure 4. Schematic diagram of working principle of the system

ACKNOWLEDGMENT

This work was supported in part by National Key Research and Development Plan of China (No.

2016YFC0801906).

REFERENCES

- [1] Wang Chengyin. Safety Analysis and Emergency Disposal of Mobile Pressure Vessel. China Special Equipment Safety, 2012, (7): 11-13.
- [2] Liu Qiang, Gao Hui. Probe into and Tentative Plan of Unified Monitoring Platform for Safe Transportation of Dangerous Chemicals. China Safety Science Journal (CSSJ), 2006, 16(2): 59-64.
- [3] Ma Yue. Research on Key Technologies for Server Software in Vehicle Monitoring and Management System. Zhejiang Normal University, 2010.
- [4] Jiang Daimei, Liu Yang, Zhou Xiaobing. Technology of Logistics Transportation Management System Based on GPS/GIS. Journal of Beijing Polytechnic University, 2005, 31(4): 443-448.
- [5] Zhai Zhanqiang, Cai Shaohua. PDA-based Mobile Self-navigation System: Study and Implement. Bulletin of Surveying and Mapping, 2003, (11): 32-34.
- [6] Wang Mingji, Chen Linan, Zhang Chen. Supervision System for Remote Lock Control of Light Oil Tankers Based on GPS. Control and Instruments in Chemical Industry, 2014, (11): 1277-1280.

Research on the Interpersonal Relationship Crisis of College Students in the Perspective of New Media and Countermeasures

Huihua Zhao

Guangdong University of Science and Technology, Dongguan, 523000, China
E-mail: 65338020@qq.com

Abstract: Interpersonal relationship is a kind of social relationship established by human beings in the process of production and living activities. For college students, when they enter the campus, they must carry out various interpersonal interactions with teachers and students. College students' interpersonal relationship. Nowadays, new media is popular, as a modern means of communication, because of its unique and novel form, it is favored by college students. College students are increasingly interpersonal through new media, and the interpersonal relationship of college students is also changed by this way of communication. There have been some new crises. This paper analyzes the meaning, characteristics and causes of the interpersonal relationship of college students in the new media era, and proposes solutions to the interpersonal relationship crisis of college students.

Keywords: new media; college students; interpersonal relationship; crisis

1. INTRODUCTION

Interpersonal communication is an inevitable outcome of social development and a basic prerequisite for social development. Without the various new media relations formed in the process of interpersonal communication and the various social roles that people play, society will not become a society, and development cannot be discussed. Interpersonal communication is inseparable from us and runs through our entire life [1]. Good interpersonal communication is the starting point for the socialization of young people, the need to survive in society in the future, and the ability to contribute to society. With the rapid development of new media technologies, the traditional interpersonal communication model has been hit by new media interpersonal communication. New media has become one of the most important extracurricular lifestyles for college students and the main source of information for learning, entertainment and life. The emergence of electronic shopping malls, e-banking, etc. has greatly facilitated people's lives. The advantages of interpersonal communication in new media are obvious: broad, accurate, convenient, etc. We still attach importance to realistic interpersonal communication and take the lead in real life

interpersonal communication. The interpersonal communication of new media will greatly reduce the opportunities for face-to-face interaction between people, resulting in alienation and affection. Retreat, moral indifference. Sociality is the essential attribute of human beings. Sociality relies on direct interaction between people and face-to-face conversations. Therefore, interpersonal communication in reality is indispensable. For the new media interpersonal relationship, we can't rely too much on it. For this double-edged sword, we must make good use of it, use our strengths to avoid weaknesses, and use new media interpersonal relationships to open up our horizons and exert our imagination and creativity.

2. THE POSITIVE INFLUENCE OF INTERPERSONAL COMMUNICATION IN NEW MEDIA ON COLLEGE STUDENTS

2.1. New Media Makes College Students' Interpersonal Communication More Broad and Helps to Establish Good Interpersonal Relationships

Traditional campus interpersonal communication is limited to the actual interaction between classmates and classmates, between roommates and roommates, between teachers and students, between friends and relatives. When new media is born and popular on campus, the interpersonal relationship of our college students is not limited to real-life contacts. We can use new media to communicate with people from different fields, different genders, different ages, different regions and even different countries. The new media interaction makes the interpersonal communication no longer limited by time and space. The interpersonal communication of college students is expanded, and the timeliness, convenience and accuracy of interpersonal communication and information transmission have been improved as never before. New media interpersonal interactions enable us to break through the narrow circle of real-life interactions and cross the mountains and rivers, bringing the students of the whole earth to the new media. The reality of society is a "face-looking" society, but because of the virtual, anonymous and indirect contact characteristics of new media interpersonal relationships, there is no high or low level of hierarchy and status in life in new media interpersonal relationships. The shackles of various etiquettes and concepts in the reality make it easier

for college students to break through the constraints of traditional, realistic social influence factors such as gender, age, identity, family conditions, appearance and ugliness in the new media interpersonal relationship, and establish a more harmonious, Democratic, free and equal interpersonal relationships. Psychologists generally believe that good interpersonal relationship is one of the standards of mental health, and the good interpersonal relationship formed in the new media is conducive to the healthy development of college students themselves.

2.2. New Media Interpersonal Communication is Conducive to the Formation of an Atmosphere of Dare to Speak, Improve the Creativity and Self-Confidence of College Students

In the actual interpersonal communication, college students may be driven by authority, material and social interests, or personal courage or psychological fear. They dare not express their opinions, ideas and suggestions in real life, and so on. Too much, my ideas are not fully expressed and recognized, and self-confidence will be hit. On the relatively equal and open platform of new media, everyone acts as an independent unit. Without prejudice to law and morality, we do not have to succumb to authority, do not need to observe the words, and can express our own true thoughts. Express your opinions and opinions about things that you dare not express in real life. This kind of interpersonal habits in new media will also affect our interpersonal interactions in reality in a long time, so that we can be more active and active in real interpersonal interactions, improve the success rate of interpersonal communication, and enhance us. Confidence. In addition, the new media platform also provides a place for college students to display their talents, which helps to improve the curiosity, imagination and creativity.

3. THE NEGATIVE IMPACT OF NEW MEDIA INTERPERSONAL COMMUNICATION

3.1. Barriers to Interpersonal and Interpersonal Relationships

Some college students "exported into chapters" and "suddenly hang on the river" in the new media, but in reality interpersonal communication is a "new media autism patient". New media autism is over-reliance on new media, diluting the interactions between individuals and society and others, away from the surrounding partners, and slowly losing the sense of sensibility and participation in the colorful real life, becoming more and more isolated [2]. Its main features are obstacles to social functions and communication skills, abnormal movements, and complex and diverse behaviors. By putting too much energy and time into new media interpersonal communication and new media, the ability of realistic interpersonal communication has been weakened, and the interpersonal relationship in reality has been diluted. And in the new media, the self-centered and real life contrasts, causing people to develop cognitive

and emotional disorders. In the long run, they will rely more and more on new media. This will not only be detrimental to psychology, but will also affect learning and even influenced graduation.

3.2. Barriers to Personality

Personality disorder refers to a behavior that is clearly deviated from normal and deep-rooted, has a maladaptive nature, and its personality is abnormal in content, quality, or overall personality. There are mainly two personality, multiple personality, performance personality and impulsive personality. Because the new media has certain anonymity and virtuality, many college students will perform "role play" in interpersonal communication on new media, give themselves a "net name", put on their favorite avatar, and create a virtual one of their own. Identity, some students in the new media interpersonal interactions often play a very different or even opposite role in their actual identity. It is also very common for men to be women and women to be males in new media interpersonal relationships. The "mother sister" you meet in the new media may be a big five in the real life. When such so-called multiple roles conflict or the frequency of conversion is too fast, over time, it affects real life in a subtle way, causing psychological crisis and even obstacles to personality splitting. Because of the anonymity of interpersonal communication in new media, many college netizens think that they don't need to take any responsibility for their words and deeds. They are very direct and candid in their words and deeds, even when they are "unblocked" as a "keyboard man". However, once this habit is developed, it may be transformed into a person's personality traits. The use of offensive language in new media may also strengthen the aggressive nature of personality and form an aggressive personality.

3.3. Initiating a Crisis of Trust, Security Anxiety and New Media Crimes

Because of its anonymity and virtual nature, the new media can make the new media interpersonal contacts change their personal information of age, gender, occupation, etc., so that the two sides of the new media interpersonal relationship lack mutual trust, who is also divided. It is unclear who said it is true or not, so many college students only regard interpersonal communication in the new media as a way to send loneliness and kill time. This kind of random new media interpersonal communication will make college students emphasize more emotional thinking than rational logical thinking.

Some college students think that it is safe to close the door and keep their favorite mobile phones and computers. In fact, in this era of big data, each of us is basically "naked" in new media. The characteristics of physical contact often create a false sense of security, which puts them on the alert to let new media criminals take advantage of it. In the new media, there are actually crises. The endless stream of

new media viruses, hackers and other new media crimes make people feel exhausted. They are afraid that when hackers and viruses will “see” themselves.

4. COUNTERMEASURES AGAINST THE NEGATIVE IMPACT OF INTERPERSONAL COMMUNICATION IN NEW MEDIA

4.1. How Should the School Respond?

First of all, the school should improve the mental health education and psychological counseling system. When college students encounter difficulties or psychological setbacks in dealing with interpersonal relationships, they can get the help of the school's psychological counselors in the first time, and adjust the mentality of interpersonal communication in time. Therefore, it is very urgent and necessary for schools to set up mental health education courses, establish mental health counselors, and train or introduce professional psychologists. Students can establish correct three views through course study or expert consultation. Through the psychological test and psychological counseling for freshmen, the school can establish a complete freshman mental health record, class group construction activities, and community activities to adapt the freshmen to the new interpersonal communication model.

4.2. What Should the Teacher Do?

Teacher-student relationship refers to the relationship between teachers and students in the process of education and teaching, including the status, role and attitude of each other. As a teacher, a role in teaching and educating must have a noble moral sentiment, a warm and kind heart, and a positive and serious work attitude. Respecting the personality of students in dealing with students [3], a good teacher-student relationship is a guarantee for improving the quality of school education, and an important aspect of social spiritual civilization. The new teacher-student relationship should be that teachers and students are equal in personality, democratic in interaction, and harmonious in the atmosphere of getting along. Strengthen the education of college students' new media interpersonal communication, and guide students to establish the correct principle of making friends and making friends. Teachers should also visit the student dormitory frequently to give necessary help when students encounter difficulties in learning, life, interpersonal communication, etc., and become close friends of students.

4.3. How Should College Students Do it Themselves?

As a college student, it is necessary to establish a healthy and correct concept and principle of interpersonal communication, and to exercise reasonable control, catharsis and moderate adjustment of their own emotions, so that they are more active in real interpersonal communication and new media interpersonal interactions. Rationalization and health. A mentally healthy person can feel the meaning of his existence. As a college student, as a person, we can't be perfect. We must learn to overcome self-esteem

and accept ourselves. I can understand myself, accept myself, and have a comprehensive and objective evaluation of all aspects of myself. I will not feel inferior because of my shortcomings, appearance, family background, economic situation, etc. I am hesitant, indifferent, lonely, self-enclosed when I interact with others, and I dare not show up in public. This is our home. Said “social phobia”, and this is very unfavorable to the normal development of the relationship between people. Therefore, college students must overcome this inferior and indifferent social psychology. If they feel that they are not good enough, they will strive to advance in the direction of excellence, foster strengths and circumvent weaknesses in interpersonal communication, actively engage in real life, and open a closed mind. The classmates, teachers, and friends around us develop pure friendship and beautiful love, truly experience the true, good, beautiful and colorful of the world, get rid of the troubles of loneliness and inferiority, shape a healthy personality, develop good interpersonal relationships, and achieve a beautiful life [4].

5. SUMMARY

The above is my description of the status quo of interpersonal communication among college students in the new media era and my own suggestions in the face of this situation. Our society is constantly evolving, and the interactions and relationships between people are constantly changing. We must choose the appropriate way of interpersonal communication according to the background of the times and the changes of the times. Interpersonal communication is a very deep study, and there are many, many things we have to learn to study.

ACKNOWLEDGMENTS

This topic is the 2018 project of Guangdong University of Science and Technology, “Research on the status quo and countermeasures of college students' crisis management under the harmonious vision” and the research results of the Guangdong Provincial Department of Education's 2018 key platform and scientific research project “Current situation and countermeasures of college students' crisis management under harmonious vision”.

REFERENCES

- [1] Chen Chaoyang. The psychological influence of new media on interpersonal communication. *Psychological Science*, 2006, 29(4): 1019-1021.
- [2] Wu Yue. Psychological Analysis of Student Communication Model in Network Environment. *Teaching and Management*, 2008(21).
- [3] Li Chunlei. Preliminary study on the moral education of college students in famous universities using new media. *School Party Construction and Ideological Education*, 2003, (1): 62-63.
- [4] Chen Zhixia. Deep analysis of interpersonal communication in new media. *Research on natural dialectics*, 2000, 16(11).

Microchannel Heat Dissipation Analysis of High Power Led

Qiyian Yan

College of Mechanical and Electrical Engineering, Guangdong University of Science & Technology, Dongguan, 523083, China

E-mail: yanqiyian@126.com

Abstract: The microchannel heat dissipation technology discussed in this paper is a new method to solve the heat dissipation of high power led. Compared with traditional light source, led has many performance advantages, but the problem of heat dissipation has been restricting the development of led industry. On the basis of analyzing the basic characteristics of high power led, the heat dissipation technology of microchannel is analyzed emphatically in this paper. Compared with traditional heat dissipation methods such as natural convection forced convection thermoelectric cooling and so on, microchannel heat dissipation has the advantages of stable structure and high reliability. It can be seen that microchannel heat dissipation technology is a promising led heat dissipation method.

Keywords: microchannel; high power LED; heat dissipation; thermal resistance

1. INTRODUCTION

With the development of society and the progress of science and technology, the demand for energy is increasing [1,2]. There are fewer and fewer renewable energy sources on the earth, and the depletion of resources will be a problem facing mankind in the future. Finding new alternatives to renewable energy and energy saving and emission reduction is the main way to solve energy depletion.

As the fourth generation light source, led has been widely used in daily life, such as freeway street lamp, scenic spot lamp, daily life lighting, daily traffic light, various signs of public facilities, mobile phone, various life appliances display screen and so on [3]. The main part of led is the internal PN junction. Under the action of forward voltage, the electrons are injected into the p region from the n region and the hole is injected into the n region from the p region, which results in the recombination of the minority carriers on one side and the majority carriers on the other. Compared with the ordinary light source, the luminous efficiency of the led light source is higher. A 2w led is equivalent to the lighting effect of a 15w ordinary incandescent light bulb. However, in practice 70-80% of led's electricity is converted to heat [4,5]. The temperature at which the current flows through the PN junction is called the junction temperature of the LED [2]. The lifetime of LED is affected by the increase of junction temperature. The luminescence

intensity decreases by about 1 when the junction temperature increases by 10°C at room temperature. When the junction temperature is more than 85°C and the junction temperature is more than 85°C , the LED lifetime decreases exponentially. The led junction temperature problem is generally solved by chip internal packaging technology and external radiator.

2. RESEARCH STATUS OF LED HEAT DISSIPATION

2.1. Encapsulation Technology

Led heat dissipation technology includes internal packaging technology and external radiator technology [6,7]. The internal packaging technology mainly uses advanced processing technology or new materials to encapsulate led chip to reduce the internal thermal resistance of led and thus reduce the junction temperature of led chip from the source. The technology of external radiator mainly includes natural convection heat dissipation forced convection heat dissipation semiconductor thermoelectric cooling heat dissipation heat pipe heat dissipation liquid cooling heat dissipation and microchannel heat dissipation.

2.2. Microchannel Heat Dissipation Technology

At present, the common heat dissipation technology is mainly suitable for the small power led, which is generally connected with the radiator by the led chip, through heat conduction, thermal convection, thermal radiation and so on to achieve the purpose of heat dissipation. For high power led, microchannel heat dissipation technology will be a good heat dissipation scheme [8,9].

The thermal resistance of the led microchannel heat dissipation system designed in this paper can be divided into: led PN junction and solder layer R_1 , solder layer to aluminum substrate thermal resistance R_2 , aluminum substrate and thermal conductive adhesive R_3 , heat sink resistance R_4 , convection heat transfer resistance R_5 . T_c represents led chip temperature and TA represents ambient temperature. The thermal resistance encapsulated in the lamp is called internal thermal resistance R_{in} . The heat resistance outside the lamp is called R_{out} . It is clear that the internal thermal resistance includes R_1 , R_2 , R_3 , and the external thermal resistance includes R_4 , R_5 . Assuming that the total thermal resistance of the entire heat dissipation system is R_{Total} . If the thermoelectric conversion efficiency of the chip is

calculated at 80%, the following formulas hold:

$$R_{Total} = R_{in} + R_{out} = R_1 + R_2 + R_3 + R_4 + R_5 \quad (1)$$

$$R_4 = \frac{1}{hA} \quad (2)$$

$$R_5 = \frac{T_w - T_\infty}{Q - Q_\theta} \quad (3)$$

$$Q_\theta = \varepsilon \delta A (T_w^4 - T_\infty^4) \quad (4)$$

$$R_{out} = R_4 + R_5 = \frac{T_w - T_\infty}{Q - Q_\theta} + \frac{1}{hA} \quad (5)$$

here, h is the average convection heat transfer coefficient on the surface of the microchannel radiator, A is the surface area of the microchannel radiator, T_w

is the surface temperature of the radiator, Q_θ is the radiation heat, ε is the surface emissivity of the microchannel radiator, δ is the blackbody surface emissivity. The range is generally between 0 and 1. The junction temperature of led chip can be obtained as follows:

$$T_c = T_\infty + QR_{Total} \cdot 80\% = T_\infty + R_{Total} \cdot V \cdot I \cdot 80\% \quad (6)$$

Here V is the voltage (V), I is the current (A), when the circuit led is working normally.

3. THE PATH OF LED HEAT TRANSFER

Thermal resistance is an obstacle to heat transfer, so it is necessary to reduce thermal resistance to improve heat dissipation [10,11]. The temperature difference between the two points in the heat transfer path is equivalent to the voltage, the heat generated by the heat transfer process is equivalent to the current, and the thermal resistance is equivalent to the resistance. In the state of thermal equilibrium, the thermal resistance is defined as the temperature difference between two points divided by the heat dissipation power between the two points [12-14]. The smaller the thermal resistance of the system, the better. In the design of led lamps, the general heat transfer path is PN junction, pin solder, PCB plate, radiator and external environment, and the specific heat transfer path is shown in Figure 1.

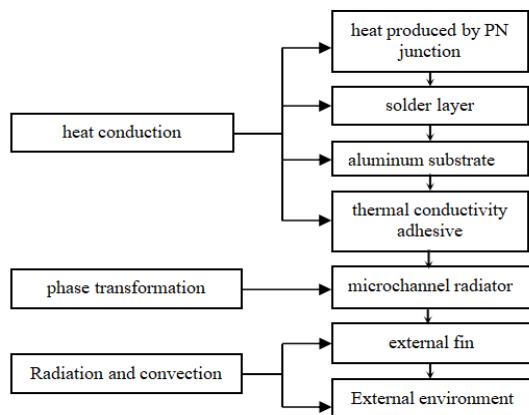


Figure 1. The path of LED heat transfer

4. DESIGN OF MICROCHANNEL RADIATOR

The high power led chip is made up of a number of led lamp beads array. The material with high thermal conductivity needs to be selected when the heat is dissipated by an external radiator. The materials commonly used in radiators are thermoplastic materials, ceramic materials and metal materials, most of which are metal materials. The thermal conductivity of silver in metallic materials is high, but the price is high. Copper also has high thermal conductivity, but difficult to process. Considering many factors such as cost and processing, aluminum alloy is used as radiator material, such as die casting aluminum, tensile extruded aluminum. The thermal conductivity of die-casting aluminum radiator is 70-90 W/mk, can be made into complex and beautiful shape, but the die cost is high. The thermal conductivity of extruded aluminum is about 200 W/mk, the fabrication form is relatively simple and the cost is relatively low, so it is suitable for making high power led radiator. Generally, the extruded aluminum is selected as the material of microchannel radiator.

Microchannel radiators are made by hot-rolling, blowing-up, and so on. The microchannel radiator consists of two plates, two aluminum plates of the same thickness, first in the two plates on one side of the hair, in the first piece of plate above etch the required groove; Then the first plate and the second plate are aligned and aligned, riveted along the edge, heated to a certain temperature for two plates riveted together, and maintained for a period of time. The two plates are welded together by diffusion welding process. The two aluminum plates are recrystallized to form a composite plate. A high pressure fluid is injected between the two plates and the first one to expand along the etched grooves. And then the necessary heat conduction circuit is formed.

5. CONCLUSION

In order to improve the lifetime of high power LED, it is generally required that the node temperature be below 110°C. If effective heat dissipation measures are not taken, the product life, brightness and stability will decrease. Therefore, in the design of high power LED lamp, heat dissipation technology has become the core problem that must be solved in the application of high power LED lighting products.

Led light source has become the future development trend. In this paper, a microchannel radiator is proposed to solve the problem of led heat dissipation. Compared with the current research situation and development trend of led heat dissipation at home and abroad, the analysis of different heat dissipation structures shows that air cooling and night cooling cannot satisfy the heat of high intensity heat flux. Injection cooling technology cannot be widely used for a long time because of the limitation of manufacturing process. The thermoelectric refrigeration and heat pipe cooling technology have

high manufacturing cost. Compared with the traditional heat pipe fin radiator, the method is simpler, lighter and easier to package. In this paper, the heat transfer and heat transfer path of microchannel radiator are analyzed in detail, which provides some basis for solving the heat dissipation of high power led.

REFERENCES

- [1] Yang Guiting, Liu Yibing. Design of Heat dissipation device for High Power led Lamps. *Journal of Lighting Engineering*, 2014, 25(6): 91-94.
- [2] Xiang Jianhua. Fabrication and performance of micro phase change heat sink for high power led. South China University of Technology, 2010.
- [3] Zhou Zhimin, Ji Aihua. Thermal design and engineering application of led. Electronic Industry Press, 2012.
- [4] Dong Shaojie. Optical Design and Thermal Analysis of led Lighting system. Zhejiang University, 2012.
- [5] Wang Huan, Wang Junyi. Application status of led Lighting Technology and Establishment of Future Development Standard system. China Standardization, 2017, (06).
- [6] Gu Haiting. Study on Illumination quality and Evaluation Index of led Light Source. Zhejiang University, 2017.
- [7] Zhang S., Qiu Y., Wang Y. A high-power-factor integrated-stage AC-DC LED driver based on flyback-class E converter. *IEEE Industry Applications Society Meeting*. IEEE, 2017.
- [8] Huang Jian, Luo Quanming, He Qingqing. Analysis and Design of a single stage isolated Constant-Current output led driver. *Chinese Journal of Electrical Engineering*, 2017, 37(16).
- [9] Gong Sansan, Qin Huibin. Thermal simulation of led filament based on ansys. *China Lighting Appliance*, 2015, (1).
- [10] Wang Helii, Xu Da, Wang Zhihui. Reliability Design of large size ltcc device in Aluminum Alloy package Module. *Modern Electronic Technology*, 2015, 38(5).
- [11] Tian Lixin, Wen Shangsheng, Huang Weiming. Study on the structure and heat transfer efficiency of high power led solution. *Journal of Optics*, 2015, 35(03).
- [12] Zhang Sen, Hua Chuxia, Lin Ze-kun. Optimization design of power led lamp radiator. *Optoelectronic technology*, 2014, (1).
- [13] Wang Zhibin, Kong Yanan, Liu Yongcheng, Zhang Qian. High power LED junction temperature prediction based on genetic algorithm optimized BP neural network. *Journal of Optoelectronics laser*, 2014, (7).
- [14] Li Jingzhao, Kan Zixiong, Chen Zhenqiang, Zhu Siqi. Study on the relationship between outdoor lighting characteristics and indoor simulation of LED street lamp. *Chinese Journal of Luminescence*, 2016, (11).

A Brief Discussion on the Development and Direction of AI Control Science in Automobile Industry

Zhiqiang Xu

Guangdong University of Science & Technology, Dongguan, 523083, China

E-mail: 450521404@qq.com

Abstract: With the rapid development of society, the scientific and technological level of society has also made great progress. Artificial intelligence is the advanced science and technology which has penetrated into various fields at present. It has a great impact on the whole automobile industry and even the society. Automobile is a necessary tool for people to travel. Therefore, the combination of AI and automobile industry is undoubtedly an epoch-making research. However, the automotive industry involves many aspects of content, if combined with artificial intelligence, there will inevitably be many problems. Now people should solve these problems as soon as possible, so that AI control science can better serve the automobile industry and bring more convenience to people's lives. In this paper, the author first gives a detailed introduction to AI control science, and then discusses the application of AI control science and technology in the automobile industry in the light of the current development situation of the automobile industry, hoping to play a certain role in the development of the automobile industry.

Keywords: automobile industry; artificial intelligence; control science; development status

1. INTRODUCTION

Automobile has gradually become a tool for people's daily travel. Intelligent development is also an inevitable trend. Artificial intelligence is an important part of the process of intelligent development. Artificial intelligence control science has now entered a new stage of development, each link is also slowly maturing. Whether it is personalized configuration, spare parts selection and production, intelligent communication system, intelligent brake pads, human-vehicle interaction, vehicle-vehicle interaction, vehicle-network interaction and so on, are developing, which makes the automotive industry make great progress. However, any scientific research is not easy, there are many details need to be taken into account. This paper makes a detailed analysis of the intelligent development of the automotive industry through the application of artificial intelligence control technology in the automotive industry.

2. INTRODUCTION TO ARTIFICIAL INTELLIGENCE

The so-called artificial intelligence is that people use

some method to make the unconscious intelligent machine have the ability to accomplish tasks that only human beings can accomplish. Artificial intelligence control science is essentially a branch of computer science, and its core content is the algorithm of controlling the running process of intelligent machines. AI control science usually consists of integration, decision-making, prediction and cognition. Artificial intelligence control science collects information from the outside world through cognition, collates and describes information, then uses prediction to infer possible event results, and finally uses decision-making to react to events. This whole process is integration. Nowadays, AI control science has been applied in many aspects, and I believe it will be developed more and more widely in the near future. Some scientists predict that repetitive mental work will be replaced by artificial intelligence one day. This is the inevitable development of the times and the power of science and technology.

As mentioned above, the core of AI control science is algorithm, in other words, knowledge and technology. Only science and technology can change the future. For the control science of artificial intelligence, it mainly involves three important technologies. Firstly, AI control science needs complete expert system technology. Like the name, expert system technology means that all expert system knowledge in a particular field is available in a computer program. It's like bringing together all the professionals in a field to work towards a common goal. Unlike traditional computer programs, AI control science should learn to solve many uncertain problems like human beings, rather than repeating the same problems according to specific steps. Therefore, AI control science needs to have a rapid response to incomplete, inaccurate, uncertain and no algorithm to solve the problem, which requires adding more models and creations to the rules of AI. Secondly, AI control science must have perfect pattern recognition technology. With the wide range of computer applications, artificial intelligence technology, which belongs to the computer field, has higher requirements for perception technology. For example, text, temperature, humidity, sound, image and other information can be recognized and many mature results have been achieved, but similar to keyboard, mouse, emotion and other

information, artificial intelligence is temporarily weak, and needs to be made a breakthrough. Therefore, if the future AI control science wants to make breakthroughs, pattern recognition technology needs to be developed and excavated. Only by improving the computer's external information perception ability can it develop more rapidly [1]. Thirdly, AI control science is inseparable from scene analysis technology. Scene analysis technology is an independent discipline from the field of computer vision perception. It can decompose and present the huge unprocessed input data which is difficult to process. It is an important process of communication between the field of computer science and the outside world. With the development of scene analysis technology to different stages, the quality of information presented will be quite different. The information quality presented is related to multi-spectral interpretation and processing technology, dynamic and time-varying vision, active qualitative vision, three-dimensional scene recognition and modeling technology. Nowadays, this technology is not only used in the automobile industry, but also developed in satellite, TV live broadcasting, industrial monitoring and other areas.

3. DEVELOPMENT STATUS OF AUTOMOBILE INDUSTRY

It has been a long time since the development of the automobile industry, which has a tremendous impact on human life. When we study the application of AI control science in automobile industry, it is necessary for us to understand the development process of automobile. In addition, we should understand and understand the basic design of automobile, so as to ensure that the words are persuasive.

3.1. Development of Automobile

From the development history of automobile, the development process of automobile has always been closely related to human life and work. Slow then fast, from simple manpower to animal power to mechanical vehicle. At first, the car had only two wheels, but later it slowly developed four wheels. Up to now, there are still two wheeled cars, besides bicycles, there are chicken buses from the Han Dynasty, military vehicles for war, and two-wheeled vehicles for carrying cement on construction sites [2]. In 1796, the invention of the world's first steam car brought mankind into a new era. The speed of the car can reach 4 kilometers from the original one kilometer, and it has increased several times. By 1860, the world's first gasoline-powered car came out. This car, built by German engineers, also marks the departure of mankind from the old backward era and ushered in a new form of transportation development. In China, mainly after the reform and opening up, our country's economic strength is growing, the living standard of every household is getting higher and higher, and automobiles are gradually becoming more and more important means of transportation.

3.2. Basic Design of Automobile

Because of the increasing popularity of automobiles in people's lives, people's design requirements for automobiles are also getting higher and higher. For people who want to buy cars, comfort, economy, basic performance, reliability and other aspects of the car are to be considered. The design of automobiles can largely determine the performance and quality of automobiles. For the design of a car, there are many aspects to be considered, such as accelerator, engine design, body design, material selection and so on. These are only internal details. There are also such external details as car aesthetics, economy and so on. The first thing people see about a car is its appearance. Poor appearance may affect its sales. In addition, economy is also very important. Every parent's economic affordability is different, and the configuration and requirements of the car will be different. Therefore, it is difficult to design a car that meets the expectations of the public. For the traditional automobile design, it is usually designed directly according to experience, but the modern automobile design is not so. The design of modern automobiles combines the links of modern society and economic development to ensure the design of automobiles with certain special functions. Figure 1 below shows some of the internal decomposition diagrams in the basic design process of the car.



Figure 1. Basic design of automobile

4. APPLICATION OF AI CONTROL SCIENCE IN AUTOMOBILE INDUSTRY

4.1. Comfort

Modern society is a fast-paced society. The pressure of life and work of modern people is relatively high. Therefore, as a means of transportation, automobiles must have appropriate comfort. This can not only lighten people's lives, but also improve the quality of life. Nowadays, AI control science can not only design intelligent massage seats in automobiles, but also detect the air in automobiles. Massage chairs can provide relaxation, reduce fatigue during driving, and can also be used as a place of rest for short-term work. Detecting the air in the car is because the car is a relatively closed space [3]. If the AI control science detects the air in real time, it can remind passengers or drivers of the air situation, so as to take timely treatment.

4.2. Technical Processing

AI control science plays an important role in automobile design, because AI control science can achieve many desired functions before. For example, intelligent communication, in-car control, intelligent braking. Intelligent communication means that in the process of driving, the car can automatically create an intelligent communication system. The road outside and other cars can interact with the driving car, and keep the signal stable and uninterrupted. This can help the driver to drive more accurately. In-car control is to establish a comprehensive intelligent control system in-car, which is convenient for drivers to observe the complex and changeable traffic environment and ensure driving safety. Intelligent brake is mainly aimed at the car with manual gear. If the car is parked in the uphill area, the intelligent brake function will play a great role. Because the car is equipped with sensors which can detect the inclination angle of the car and achieve intelligent braking.

4.3. Safe Driving

Safe driving is the primary requirement of automobiles, so it must be put in the first place in the process of automobile design. The application of AI control science can improve vehicle safety, which is mainly reflected in the following three aspects. The first is vehicle-vehicle interaction, which means that a moving car can capture the information of the neighboring car and react quickly to avoid danger. For example, some automobiles brake suddenly in the course of driving, which requires the rear vehicles to respond quickly, otherwise there will be rear-end collision. The second is human-vehicle interaction, which is to install an intelligent detection system inside the vehicle to observe the driver's behavior, head position, voice tone, physical and mental state, etc. According to the driver's response to external stimuli, an effective stimulus response model was established. Once the driver can not drive normally, the vehicle will start intelligent driving immediately to ensure the safety of driving and avoid the occurrence of safety accidents. Thirdly, the vehicle network interaction, the intelligent system in the vehicle can collect and analyze the external information, and assist the driver to drive. Figure 2 below shows a schematic diagram of vehicle-network interaction.



Figure 2. Interaction of vehicle network

4.4. New Product Manufacturing

In the process of automobile design and manufacture, there are still many processes that can not be separated from human operation. However, there are also some tasks that human beings can not complete, such as high temperature operation, complex data calculation, data storage and so on, which must rely on artificial intelligence control science to complete [4]. Artificial intelligence control science can efficiently and orderly accomplish what human beings can not do in a short time, improve the efficiency in the process of manufacturing new automobile products, and accelerate the development of industry. In the past, at the beginning of the design of a car, manual drawing was needed to determine the general design and basic structure of the car. Now, AI control science can use various software to carry out efficient drawing, and can make rapid modifications. It not only saves the drawing time greatly, but also improves the accuracy of drawing. Artificial intelligence control science can be used for drawing, and online simulation can also be carried out. That is to test the rationality of the graphics and modify the problems in time. At the new product production stage, AI control science can use automation technology to produce automotive parts. Mankind only needs to operate the machine simply, which greatly improves the production speed [5]. At present, the production tasks used in the automobile industry are only semi-automated robots. In the near future, there will be fully automated robots. The whole design process will also have identification and analysis, and the quality will be more closely monitored.

4.5. Supply Chain

For sales consultants in the automotive industry today, they rely more on feedback data from previous industries when they understand consumer demand. They have to analyze these data in detail in order to know the needs of customers and further targeted marketing. This kind of artificial analysis and judgment is likely to lose its authenticity, resulting in strong personal color in customer arrival service, sales data, and after-sales tracking, affecting the real sales situation of the whole market. And the whole process requires a lot of manpower and material resources, affecting the development speed of the entire industry. Nowadays, we can use artificial intelligence control science to intelligently analyze the transaction number, potential customers, customer groups, sales data, visits, customer feedback and other data of each automobile brand and store, so as to reduce the cost of data analysis and improve the performance of the whole sales industry. In addition, after-sales service can also use the technology of artificial intelligence control science to solve many customers' questions online synchronously, reduce the cost of after-sales service, and also enhance customer service satisfaction. Because when the number of customers reaches a certain number, it will be very difficult to solve the

customer's problems relying on manual customer service, and the result of solving the problem will also be a big problem. In a word, through the artificial intelligence control science, we can integrate the procurement, inventory, logistics data, post-service and other links in the supply chain, centralized analysis, industrial profits can naturally come up.

5. CONCLUDING REMARKS

At present, AI control science has been gradually popularized in the automotive industry, which provides great convenience for the design, production, assembly, testing, sales, statistics and so on, and brings earth-shaking changes to people's daily life. Although China's AI control science and technology started later than other European countries, it is in a very good state of development and will surely make greater achievements in the future. At present, the control science of artificial intelligence is only in the

preliminary stage of research. With the deepening of research, the future benefits are very considerable.

REFERENCE

- [1] Cai Zixing, Xu Guangyou. Artificial intelligence and its application. Beijing: Tsinghua University Press, 2004.
- [2] He Yusheng. Modern Method of Automobile Design. Academic Report of Chongqing University, 1991.
- [3] Shi Chunyi, Huang Changning. Principles of Artificial Intelligence. Beijing: Tsinghua University Press, 1993.
- [4] Wang Zhen. The Impact of Artificial Intelligence on Industrial Development. Modern Management Science, 2018.
- [5] Yan Xinwei, Zhu Zhengze, Zhou Kui. Application of artificial intelligence in autopilot system. Journal of Hubei Automotive Industrial Institute, 2018.

Overview of Moving Target Detection Algorithms

*Yongqiu Liu**, *Huarong Wang*

Guangdong University of Science & Technology, Dongguan, 523083, China

*E-mail: *banbianqiu@126.com*

Abstract: Science and technology are the primary productive forces. Therefore, with the continuous development of science and technology, China has made very gratifying achievements in the fields of science and technology such as computers. Especially in the aspects of computer equipment operation and control law-level programs, China has achieved many successful cases, laying a solid foundation for the subsequent development. In recent years, experts in the field of computer research in China have continued to conduct in-depth research on computer control technology and reporting technology, which has brought about great technological innovations in China's automated production. This paper begins with a brief description of the computer control technology, and then elaborates on the entire computer design process. Finally, it focuses on the details of the application of computer control technology to the automated production line. All in all, the development potential of computer control technology in automated production lines is unlimited, and the future production system must be gradually replaced.

Keywords: science and technology; computer control technology; automation; production

1. INTRODUCTION

Computer control technology is a product that will inevitably be formed in the development of science and technology. Computer control technology is simply a computer operation and control of a device [1]. Slowly replace the traditional manual records with computer system data, completely changing people's understanding of automated production. In this paper, not only the computer control system is elaborated, but also the process of computer control system and automated production is revealed. It is hoped that it will contribute to the popularization of computer control technology and promote the development of science and technology.

2. INTRODUCTION AND CHARACTERISTICS OF COMPUTER CONTROLTECHNOLGY

2.1. Introduction to Computer Control Technology

In a dynamic operating system, the use of a computer to implement a control process becomes a computer control technology. In a normal computer control system, conventional production equipment and the like are rare, and these devices have been basically replaced by digital computers. The problem of real system flow control or technical adjustment is realized by digital computer. In general, computer control technology is the replacement of conventional large-scale equipment or machines by digital computers, which not only reduces the time of the

entire operation process, but also achieves a low error rate. Computer control technology can be said to be a milestone in the field of control system technology, marking a huge technological innovation in China and even the entire light and heavy industry. Therefore, computer control technology not only achieves tremendous progress in the field of production, but also marks the advent of a new era of automatic control. Figure 1 below is a schematic diagram of the core operating system of computer control technology.

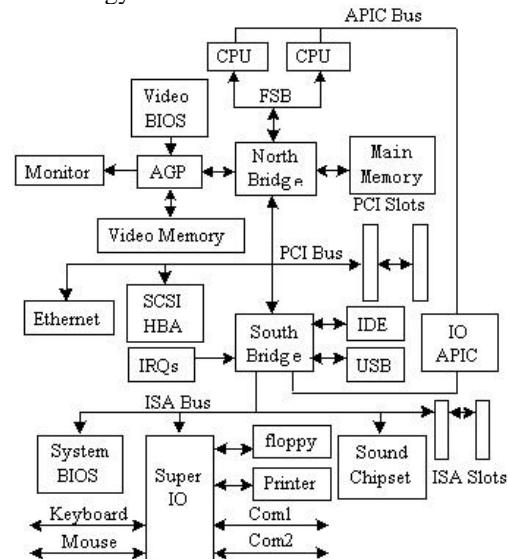


Figure 1. Computer Control Technology

2.2. Characteristics of Computer Control Technology

The computer control system combines the characteristics of computer technology and automatic control theory. The system is made up of analog hardware and is significantly different from previous automatic control theory. Through the analysis of the characteristics of computer control technology, the following three aspects are summarized. First, the core of computer control technology is the computer. Computer for multiple variables, multiple tools, multiple objects. Multiple circuits are comprehensively controlled to control the smooth operation of the entire production process, achieving safe production and further improving efficiency [2]. Secondly, during the operation of computer control technology, the main format of the output information is digital information. When the control object is running, the information is collected, maintained and quantified at the moment. All the information needs to

be presented at the end, and the form of the presentation is digital information. Finally, computer control technology will realize the control law programming in the production process, and all control processes are arranged and designed in advance. This kind of control regularization is not for which control law, but all processes are regularly controlled to ensure production.

3. DESIGN PROCESS OF COMPUTER CONTROL SYSTEM

Computer control system is mainly responsible for software design, control tasks, system design, the general structure and organization is the same. However, in the actual production process, due to the software and hardware structure of the organization has subtle differences, the whole control system will have a small adjustment.

3.1. Control System of Computer

The whole control system of the computer should be composed of software and hardware. It is divided into the following parts: fully automatic instrument, fully automatic software system, manipulated object, important parts of object and peripheral equipment of figure.

3.2. System Scheme Design

System design is based on the system involved in the task book to complete, and the composition of the new system is based on the construction of hardware and software requirements. If the time is limited and the design is not in place in the actual production process, the staff can complete the basic scheme design by combining the accessories on site with their own involved modes. However, the whole process must pay attention to the software and hardware price and time. In addition, the sensor, memory, hardware design and debugging, microprocessors, wiring port selection and other basic content cannot be ignored.

3.3. Software Design

The software design of computer control technology must follow the general guidance of system planning, and the reasoning and time difference of various functions and system performance must be arranged in strict accordance with the requirements of the table. Divide different systems according to the contents presented in the table, and then make detailed plans for these control systems. In fact, each table can be debugged separately. After the completion of the combined debugging of various parts, they will be correctly combined, interconnected, tested and debugged according to certain time and reasoning.

3.4. Control Tasks

The control task is actually to the entire computer control system's task instruction, is each part should follow the criterion. Only by understanding the requirements of the computer control system, can the final goal be achieved through the design, the time control of the scene, data flow and so on will be orderly. Only by strictly following the whole plan can the design process of the system go smoothly.

3.5. On-Site Installation and Debugging

The field installation and debugging of the computer control system is based on the rational design of the system. Only reasonable computer control system design, software and hardware debugging can get accurate structural data. At the same time, in the whole process of installation and debugging, the parts to carry out unified experiments and reasoning [3]. The simulated object is the most basic and reasonable requirement of the computer control system in the verification process, which has great reference value.

4. APPLICATION AND ANALYSIS ON AUTOMATIC PRODUCTION LINE

Computer control system used in the automatic production line can be simple to understand for industrial machinery automation of the arm, this process is divided into the following several specific aspects: the overall transfer of a steel plate material, thread, sheet metal cleaning oil, steel plate material position correction, the first stamping press, blanking machine arm extraction material, press stamping again, according to the design process to the next working procedure, robot charging material and tailoring, convey it to the next table press, a robot then extracting materials, their material on the conveyor, workers began to model pile sheet according to the rules.

The above mentioned operation process is the process of almost all automated production lines, which is closer to the technological innovation and sustainable economic development advocated by the contemporary society. At present, the automation of industrial robot arm can be applied to all kinds of mass production industries. It only needs to change the setting of software to be applicable to the production of a variety of models. Moreover, the industrial robot arm automation stability is extremely high, does not appear the technical breakdown for the long time use. The automation system of industrial robot arm consists of the following three aspects: upper and lower material structure, cleaning and oiling machine system for various types of punch and upper and lower material system, material conveying system. These systems are connected with each other, which strictly follow the principle of reduction control and unified operation control. No matter what level, it is the product of elaborate design and implementation of science and technology, with relatively independent software and hardware control system and Internet engineering, all aiming to achieve automatic production. The connection system of the automated production line is based on the touch technology of HMI SIEMENS, and each production link is equipped with a separate display screen [4]. These displays use Proflbus's data connection so that workers can find problems in the first place and make timely response to reduce losses. In addition, emergency switches and information lights are installed at all operating locations, and besides

showing where problems occur, the monitors also use red and yellow lights to check the I/O signals associated with the equipment. A red light indicates a problem, and a yellow light indicates normal. In addition, if the system found a problem, the alarm will be sounded, maintenance personnel can pay attention to the problem as soon as possible, reduce the maintenance time. The system also has the ability to rehearse digital scenes. During the simulation exercise, the system can adjust the pressure and rotation speed in advance, so as to reduce the time of rest period and put into production as soon as possible.

In general, the computer control system in the automated production line does effectively reduce the intensity of labor, improve the labor conditions of workers, ensure the safety of the production process, improve the workshop production rate. Robot automated production is more and more popular in the manufacturing market, and has gradually become the mainstream of automated production lines.

5. APPLICATION ADVANTAGE OF COMPUTER CONTROL TECHNOLOGY IN AUTOMATIC PRODUCTION LINE

Because the computer control system has many advantages that the operating system does not have before, it is applied more and more widely in the automatic production line. It has to be said that the computer control system can indeed increase the production output, subverting the conventional production mode of the manufacturing industry. Below, the computer control system in the application of automated production lines in detail.

First of all, computer control technology can control the cost, improve the safety factor, reduce environmental pollution. In the past conventional production lines, the form of labor is basically used, the safety problems in the production process cannot be guaranteed, and the workers work long hours, the pressure is very big. Computer control technology is to solve these problems, not only improve the production efficiency, greatly reduce the demand for labor, but also from the source control of pollution, very efficient.

Secondly, computer control technology can effectively reduce the loss in the production process, improve the effectiveness of production. On the other hand, computer control technology is to simplify the complicated operations of the process, rapid production. For example, due to the fast pace of modern society and the rapid development of transportation, the car ownership of every family is on the rise. For the past automobile assembly process, it needs to rely on a variety of different equipment, and then pay attention to the installation and debugging according to the different assembly process. The whole assembly process should pay close attention to the pressure, displacement and other parameters. Once these data problems occur, they should be

solved immediately to ensure the smooth implementation of the installation and debugging process. Now, the application of computer control technology in a very short time can achieve the above functions, and all kinds of data and work status can be real-time monitoring, truly accurate, safe, fast production.

Furthermore, computer control technology can effectively improve the degree of standardization of automated production. For example, the relatively common computer controlled play technology, computer controlled play technology is the automatic production model of canned drinks. All the workers need to do is to set the filling time and dwell time for each empty bottle in the automatic production line, and the rest of the work line will be completed automatically. When the conveyor belt of the production line starts up, it will stop as soon as the sensor detects empty bottles. The canning process starts immediately with the filling of the empty bottles, and when they are filled, they are moved on to the next process, with no human intervention at all [5]. It can be said that computer control technology is the standard configuration of mass standardized production, greatly reducing the error rate.

Finally, computer control technology can be more comprehensive, direct and effective detection of automated production lines. In the past production line, the detection of the production line basically needs to rely on manpower to complete, the staff should arrange reasonably, record and analyze the data of each part in detail, and solve and deal with the problems as soon as they are found. With the computer control technology, these monitoring is only programmed things, the use of programmable controller to collect signals, and then the corresponding operation on the production line can be effectively implemented detection. In the common electric automatic production line, the computer control technology can use the programming controller to control the motor and the fan on the production line, and carry on the intelligent switch and speed regulation [6]. The PLC can also display the detected information directly on the monitor, which is convenient for the operator to know in time. In addition, the programming controller shows the problem, will also give the corresponding solution, improve the efficiency of the staff to solve the problem.

In a word, computer control technology can play a very important role in automatic production line. Not only improve the production efficiency, but also reduce the risk, improve the market competitiveness of enterprises, promote the development of enterprises.

6. CONCLUSION

According to the current trend of social development level, computer control technology will be deeply into the various production fields, automatic production

line is just the implementation of the early field under the general trend. Therefore, we must innovate unceasingly, creates the more perfect control system, makes the bigger contribution for our country's production profession. At present, the computer control system hardware, software and control algorithm has developed relatively mature, anti-interference performance is to ensure the long-term effective operation of the necessary function of the system. Therefore, we should pay attention to these aspects and lay a more solid foundation for the development and application of computer control system.

REFERENCES

[1] Liu Zhaoyan, Yue Shusheng. PID control research and application. Journal of Hebei institute of technology, 2017, (3).

- [2] Zhang Hao. Discussion on the application of computer control technology in automatic production line. Science and technology, 2013, (2): 107.
- [3] Zhao Wenbin. Application of computer control technology in industrial automation production line. Computer CD-Rom software and application, 2011, (6): 98.
- [4] Lyman. Computer control technology in automatic production. Digital technology and application, 2013, (3): 16.
- [5] Xiao Xiangbing. Automation technology, computer technology T000213 computer control engineering. Gui xiaofeng, Wang jianhui. Hubei people's publishing house.
- [6] Liu Jiuping. Application of computer controlled drama technology in automatic production line. Software development and design. 2011, (20): 45-416.

The Difference and Connection between Traditional Electrical Control and PLC Control

Libo Yang

*Guangdong University of Science & Technology, Dongguan, 523083, China
E-mail: 654337610@qq.com*

Abstract: With the continuous development and updating of power science and technology, more and more control methods have emerged in electrical control, such as computer control technology, PLC control technology, etc. These control technologies have advantages compared with traditional electrical control technologies. There are also deficiencies. At present, PLC control technology has been widely praised in the industrial field, but the traditional electrical control method is not yet completely out of the market. As a successor to the new era, mastering the differences and connections between traditional electrical control technology and new PLC control technology is the premise for mastering the operational specifications of various electrical equipment, and is also an essential skill for future development. This paper mainly discusses the difference and connection between traditional electrical control and PLC control. In order to make the article persuasive, this paper first introduces and analyzes the traditional electrical control and PLC control technology in detail, and then combines the actual production and points out the difference and connection between the traditional electrical control and the PLC control.

Keywords: electrical control; PLC control; industrial field; electrical equipment

1. INTRODUCTION

Traditional electrical control and PLC control are essentially the same, mainly to deal with various types of logic calculations. However, the traditional electrical control is more suitable for logic and simple control circuits. The wiring looks very complicated and economical. PLC control seems to be relatively high-end atmosphere, can handle larger capacity calculations at the same time, and the cost of this kind of control circuit is also relatively high. In the actual production process, it is still necessary to choose which control method to use according to the situation.

2. INTRODUCTION TO TRADITIONAL ELECTRICAL CONTROL SYSTEM

Electrical control is the secondary control loop of electrical equipment, and different control loops can be selected depending on the equipment. Even the voltage level will affect the choice of electrical

control system. The following is a detailed description of the system components and functions of traditional electrical control to help form an understanding of traditional electrical control.

2.1. Composition of Traditional Electrical Control Systems

2.1.1. Power supply circuit

The design method and principle of the power supply loop of the electrical control system are certain, but the voltage of the power supply can be selected according to the situation, mainly AC380 V and 220 V.

2.1.2. Protection circuit

When the electrical control system experiences voltage loss, overload and short circuit, the electrical control system needs to protect the circuit from damage. The protection circuit is mainly composed of a voltage regulator component, a rectifier component, a voltage loss coil, a thermal relay, a fuse, etc. The working power source has a single phase 220, 36 V or DC 220, 24 V and the like.

2.1.3. Signal loop

The signal loop is to pass different information through the set signal display rules. The normal and abnormal signal loop directly marks the working state of the line, giving the staff the most intuitive reflection. Common signals are displayed with lights, sounds, and so on.

2.1.4. Combination of manual and automatic links

Traditional electrical control systems generally use a combination of manual and automatic management. The transition between manual and automatic management is mainly achieved through transfer switches and combination switches. In some systems such as installation, commissioning, emergency handling, and control lines, manual control is required because manual control can improve the efficiency at this time. In summary, manual and automatic selection is mainly based on actual needs.

2.1.5. Brake parking circuit

The brake opening circuit mainly uses regenerative power braking, reverse pulling reverse braking, electric source reverse braking, energy braking and other braking and stopping modes to cut off the power supply of the circuit in some emergency situations, so that the motor Stop quickly in a short period of time to avoid certain dangerous situations and avoid losses.

2.1.6. Locking the same way

The so-called blocking the same way, that is, when there are two or more machines at the same time, only one machine is powered on, and the protection circuit that other machines are not powered is called the same way. At this time, the breaking contacts of the two contact points are respectively connected in series in the circuit of the other party [1]. Figure 1 below is a circuit diagram of the same circuit.

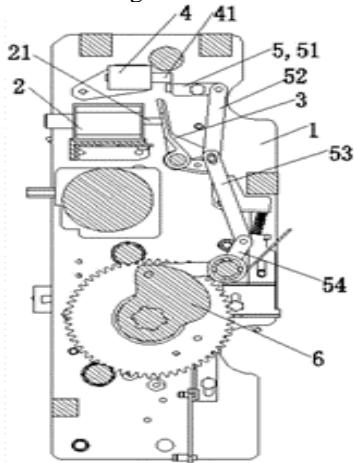


Figure 1. A circuit diagram of the same circuit

2.2. Functions of Traditional Electrical Control System

The most important feature of traditional electrical equipment is the function of secondary circuit or time control circuit. The secondary circuit is mainly designed to ensure the safety of the whole circuit, which is operated by many electrical equipment with auxiliary functions. Specific functions are divided into the following aspects.

2.2.1. Quantitative function

The so-called quantitative function is to use various instruments and instruments to measure the power, frequency, current or voltage of the line, and to quantitatively know the working conditions of each part of the electrical equipment. Accurately speaking, the most obvious feature of quantification is to use data to speak, not simply to judge whether the circuit is faulty according to whether the display light is on or not. In order to achieve quantitative function, many components, instruments and control devices of traditional electrical equipment have been controlled by computers and related electronic components, and achieved good results, which is very helpful to production.

2.2.2. Protection function

In the safe production process, there will inevitably be some faults or faults. Once the current passed exceeds the protection range of the line or equipment, the equipment will automatically switch or disconnect the line [2]. This process is somewhat similar to the circuit protection measures of voltage instability automatic tripping, which has a good protection effect on the equipment.

2.2.3. Automatic control function

Many traditional electrical equipment in the operation process of the current is very large, the control of current equipment volume is also very large. At this time, many electrical equipment will be equipped with automatic control of electrical operation equipment. Once the fault occurs, the power supply equipment will be tightly controlled, and the switch will automatically cut off the circuit, thus realizing the automatic control function of the equipment.

2.2.4. Monitoring function

For humans, currents and voltages are invisible to the naked eye. When a machine or device is placed there, we can't tell if it's live. Therefore, we need all kinds of electrical monitoring equipment with monitoring function very much. The equipment has the function of accurately capturing audio-visual signals such as lighting and sound, so as to realize the monitoring function of the equipment.

3. INTRODUCTION OF PLC CONTROL SYSTEM

3.1. Characteristics of PLC Control System

The PLC control system grew up under the background of the development of automation technology. The development of PLC control system is mainly due to the needs of the times and technology. PLC control system mainly uses programmed memory to carry out the operation process, and the data interface of input and output are all digital control. It can be said that the PLC control system perfectly integrates automation technology and computer technology, which not only improves the working level of mechanical devices, but also improves the working efficiency of mechanical and electrical devices. Conventional PLC control system is mainly composed of data transmission interface, central processing unit, external device programmer and memory. Figure 2 below is a schematic diagram of the PLC control system.

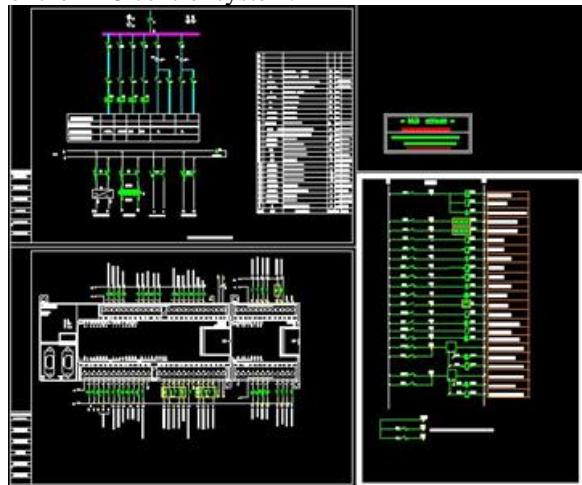


Figure 2. PLC control system

For the technical characteristics of PLC control system, there are three main points. First of all, the PLC control system has a very good ability of self-detection. The data of the whole system are connected. As long as one fault occurs, the PLC

control system will automatically process according to the size of the fault. If it is a self-recoverable fault, the system will simplify the processing. If it is a large-scale fault information, the system will issue a fault alarm, so that maintenance personnel can rush to the scene in the first time to reduce losses. Secondly, the PLC control system has strong anti-interference ability. For the traditional electrical control system, its anti-interference ability is relatively weak, and it is easy to play its due control effect in the interference environment. However, the integrated circuit technology is added to the PLC control system, which greatly improves the anti-interference ability, so it can effectively ensure the smooth progress of the mechanical production process. Finally, PLC control system can improve the degree of mechatronics. Because the PLC control system is the integration of automation and computer technology, so the quality is excellent. In the process of operation, the PLC control system is easy to install, simple to use and low power, which effectively improves the degree of mechatronics.

3.2. Advantages of PLC Control System

3.2.1. More practical

The PLC control system not only has the same logic processing function as the traditional electrical system, but also has the basic logic processing ability. In addition, the PLC control system can be used not only in the analog electrical control system, but also in the digital control system. It has great innovation in technology and compatibility has been greatly improved. With the attention paid to the PLC control system in the industry, the functions of the PLC control system are more and more complete [3]. Nowadays, the PLC control system can realize the control of CNC and other fields, as well as the precise control of position and temperature.

3.2.2. More portable

Compared with the traditional electrical control system, the PLC control system has changed greatly in volume and weight. In the past, the volume and weight of the control system were huge, so the portability of the system was very low. Nowadays, the volume of PLC control system is very small, the weight is less than 150 g, the size of the floor is only 100 mm, easy to carry. Because of the small volume and weight, the calorific value of the PLC control system is very low, and the power consumption is only several watts.

3.2.3. Strong anti-jamming ability

Compared with the previous electric control system, the anti-interference ability of the PLC control system has been greatly enhanced. This is mainly because the anti-interference processing with very strong stability is adopted in the PLC control system. In addition, the PLC control system can detect itself before the failure occurs, and warn in time to prevent accidents.

4. THE DIFFERENCE BETWEEN TRADITIONAL ELECTRIC CONTROL AND PLC CONTROL

SYSTEM

4.1. Working Mode

The traditional electrical control mainly adopts the parallel working mode, that is, when the power is connected, all the devices in the circuit are in a restricted state. This means that every device in the circuit is sucking or not sucking as required. But the PLC control system mainly adopts the serial mode of work, that is, every program in the PLC system is circulated in a fixed order [4]. Each individual device works according to the sequence of the program, which is quite different from the traditional electrical mode of work.

4.2. Control Speed

Traditional electrical control is mainly through the action of mechanical contacts to complete each control. The working frequency of mechanical contacts is relatively low, but also prone to some faults, such as contact jitter, frequency fine-tuning and so on. The time between two mechanical contacts is usually about tens of milliseconds, occasionally floating. However, the control speed of PLC control system mainly depends on program instructions, and the terminal is the semiconductor circuit. The time between program instructions is usually in microsecond level, which is much faster than traditional mechanical contacts, and the frequency is stable, and there will be no jitter leading to time imbalance.

4.3. Control Method

The traditional electrical control method mainly uses hardware wiring, because the number of mechanical contacts is limited, so this wiring method will make the control process less flexible, too many wiring connections, scalability is very low. For the PLC control system, the wiring form is seldom used, but the function to be realized by logic control is put in the memory in the form of program, and the function to be realized by programming is achieved. Because there is no actual circuit, this form of function realized by program is also called "soft wiring". Because the PLC control system does not need to be connected, so it will not be limited by the number of contacts, so the expansion and flexibility are very high.

4.4. Maintainability

The traditional electrical system mainly adopts the form of hardware connection, so there are many connections and frequent use of contacts, which results in low maintenance of the traditional electrical control system, short service life of the system, mechanical wear and arc damage are very serious [5]. For the PLC control system, all the contact switches are replaced by semiconductor circuit, so the service life is long and there will be no frequent failure. In addition, the self-detection function of the PLC control system can be self-checked at any time, and the fault can be displayed to the operator, which facilitates the maintenance of the system and greatly

improves the production efficiency.

4.5. Counting Control and Timing Function

Traditional electrical control is mainly accomplished by time relay in counting and timing functions, but because relay is very vulnerable to humidity and temperature, relay precision of traditional electrical control is very low, and timing function is very difficult to achieve. The PLC control system mainly uses semiconductor integrated circuit as timer. The timing range is very wide and the accuracy is not high. Users can modify it at any time according to their needs, and set the required timing range by themselves. For counting function, PLC control system can also be easily realized.

5. CONCLUDING REMARKS

Traditional electrical control and PLC control systems are control technologies developed in their respective times and technological backgrounds, which have their own characteristics and functions. According to the description and introduction above, it can be simply understood that the PLC control system is actually an improvement of the traditional electrical control. Whether it is working mode, control speed, control method, maintainability or counting control and timing function, the PLC control system has great advantages. Therefore, the traditional methods are becoming more and more inappropriate for the increasingly accurate, refined, highly standardized and miniaturized electrical equipment. In order to maximize the efficiency of electrical control, reduce

the occurrence of system failures in electrical control, and improve the development level of science and technology in related fields, the electrical industry should gradually move towards high-tech fields such as PLC control system. It is believed that in the near future, the PLC control system will replace the traditional electrical control in an all-round way, and the electric control field of our country will make greater breakthroughs.

REFERENCE

- [1] Gu Weidong, Chen Yuguang. Brief discussion on common fault phenomena and fault analysis and solution of electrical control system. Scientific and technological information (scientific teaching and research), 2008, (19).
- [2] Yuan Shuping. Brief description of electrical control system and design automation. Scientific and technological innovation and application, 2013, (20).
- [3] Shen Bo. Analysis and Research of Electrical Control Based on PLC Application Technology. Electronic Testing, 2017, (11): 93-94.
- [4] Xing Jinli. Construction Technology of Electrical Control System Renovation; Papers Collection of the 24th Annual Conference of the National Technical Cooperation Conference of 200MW Thermal Power Units, 2006.
- [5] Zhong Luyang. Application of PLC in Electrical Control. Technology and Market, 2016, 23(10): 155.

Development of Campus Resource Sharing Software Based on Android Platform

Jihong Chen, Peng Min, Yachen Wang, Yang Li, Ting Han, Guangjian Chen*, Xiaofang Liu

School of Computer Science, Sichuan University of Light Chemical Industry, Zigong, 643000, China

*E-mail: 455379194@qq.com

Abstract: In order to solve the problem of the waste of all kinds of resources in the campus, this paper designs a campus resource sharing software based on the Android platform for the disadvantages of the idle resource information and the untimely sharing. In this paper, the design and implementation of the software are described in detail. The client of the software mainly realizes the functions of resource sharing, instant chat, user personal center and user goods service center. The software, with the characteristics of beautiful interface, safe, easy to operate, has a certain application prospect.

Keywords: android platform; resource sharing; campus; java; python

1. INTRODUCTION

In this era of the Internet plus, we need to use the ideas of Internet to explore resources or find the answers we want. In order to respond to the “the idea of sharing” and the “shared development” that the government put forward in the Fifth Plenary Session of 2016 and the end-to-end and goal of social development, in recent years, colleges and universities have a great degree in the development of sharing software, so as to devote strength to the high-level form of the communist class [1].

As a matter of fact, we have always been sorry that all kinds of resources on campus cannot be maximized and wasted, so we have been concerned about campus sharing for a long time. We all know that sharing bicycles is the first and largest share in China, which brings a lot of convenience to people at the same time. Therefore, we will utilize IT technology to develop a common campus sharing software in colleges and universities in China to minimize the waste of resources. This system uses Android and Python as the development tool, adopts the B/S mode design, studies the technical route of the shared resource design and realization based on the campus environment, mainly including the system requirement analysis, the system function design and the database design [2].

2. ANALYSIS OF ANDROID SYSTEM AND APPLICATION ARCHITECTURE

The architecture of Android is mainly composed of two parts, namely, system and application. The system architecture of Android is the bottom frame of Android system, which contains the basic operation principle of Android system, and the main

development work of the system is also completed on this basis. Android application framework mainly has the development default support MVC architecture and the current more popular MVP architecture [3]. In the course of the development of Android application, we should first design the application framework to keep the program modular, achieve high cohesion and low coupling, which is beneficial to the development of large-scale Android applications, and the modules can work together to improve the development efficiency. Android applications are usually developed using MVC framework and MVP architecture. In this paper, MVP architecture is mainly studied. In MVP architecture, M: (Model) mainly includes local cache access component and network data access component; V: (View) is mainly composed of three components: Activity, Fragment, Adapter, the main function is to complete the application of the page layout settings; P: (Presenter), this layer uses a customized Presenter showcase as the base component [4].

3. DEMAND ANALYSIS

As a mobile campus client, which is committed to accelerating the information construction of campus resource sharing and improving the convenience of students' acquisition of campus information, a lot of preparation is carried out in the early stage of the software development, in which the requirement analysis includes the feasibility analysis of the software realization, function module demand analysis, user experience demand analysis, software stability demand analysis, and security requirement analysis. This paper focuses on the function module demand analysis. After the campus mobile client is installed and enters the software main interface, the user can see the basic function module, mainly including resource sharing, instant chat, user's personal center, user's article service center [5].

4. SYSTEM OUTLINE DESIGN

4.1. System Structure Design

The purpose of this paper is to design a smart campus Android mobile client to provide students with shared information on campus, its primary task is to collect existing shared resources on campus, organize and centralized release. In the course of development, it is necessary to consider the urgent need of the students, and the most important part needs to be displayed on the mobile client; secondly, the master of the mobile development technology is also very important,

which plays an important role in the development of the client. The overall structure design of the client in

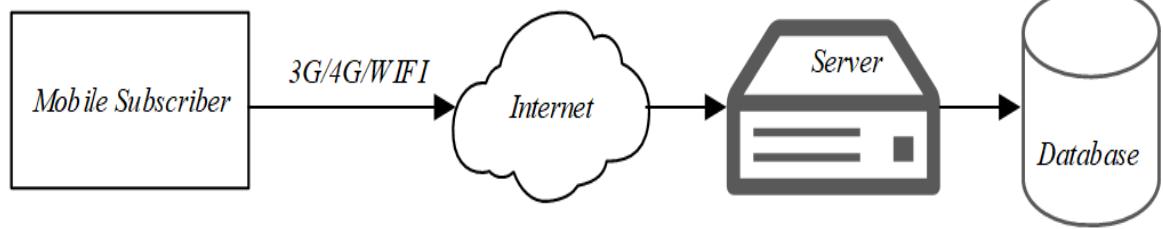


Figure 1. System Structure Design

4.2. Client System Architecture Design

With the rapid development of mobile technology and the popularization of intelligent devices, user experience has become one of the most important factors affecting the effectiveness of application. Therefore, on the basis that the application can provide the campus resource sharing information

this paper is shown in Figure 1.

service, it is particularly important to run the client's imagination smoothly and stably. Based on the pre-demand analysis, the client of campus resource sharing software mainly includes four categories: resource sharing, instant chat, user personal center and user goods service center. The details are shown in Figure 2.

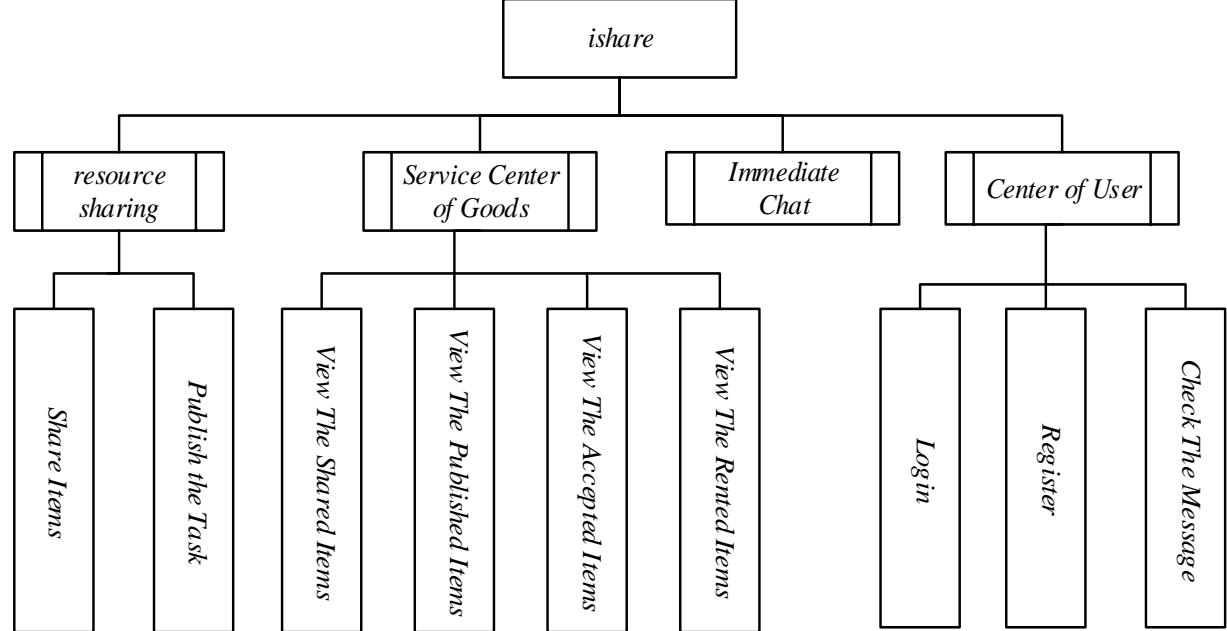


Figure 2. Client System Architecture Design

Resource sharing and user goods service center are the basis and conditions of campus sharing. Instant chat and user personal center are the important functions of dividing two sides and recording and sharing in the process of sharing. Resource sharing is a very important function in the whole system, because the functions of other versions are derived around how to make better use of resources, and its main function is to provide convenience for users to publish and share resources. Instant chat is a communication tool in Ishare, the main purpose of which is to make users who share shared resources more convenient to contact with shared users. The user's personal center contains functions such as login, registration and message viewing, among which the registration function requires the user to hold the real identity to register. This way not only

provides convenience for users to manage themselves and the communication between users, but also eliminates many unnecessary troubles for Ishare background management. User goods Service Center can be said to be the background management of Ishare, which includes classification, query and integration of resources and other functions. Efficient service enables users to use Ishare is more lightweight and convenient [6].

4.3. Database Design

The database of campus sharing software based on Android system designed in this paper is jointly established by Java and MySQL. The database design includes users, administrators, sharing information and so on. The local ER diagram of the background database of the system is shown in Figure 3.

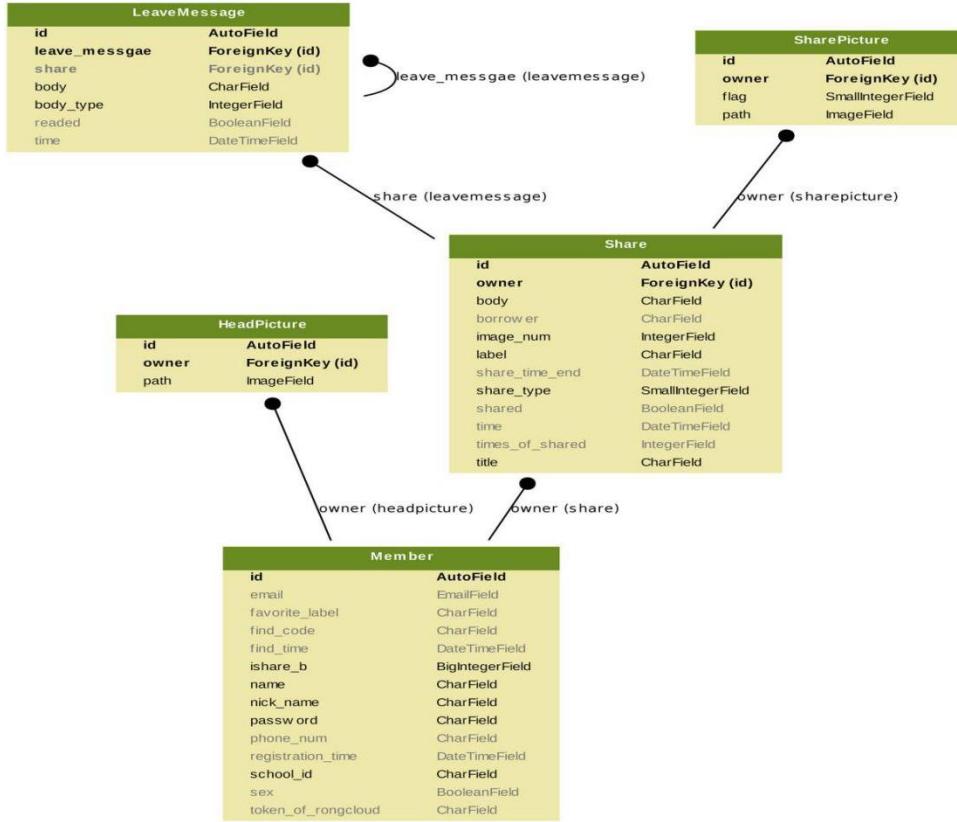


Figure 3. E-R Diagram

5. DETAILED DESIGN AND IMPLEMENTATION OF CLIENT

5.1. Client Work-Flow Design

We design and develop the software architecture, module composition, interface display, network communication and data acquisition of the client, and finally complete the design of the Android version of the campus client. The software flow chart is shown in Figure 4.

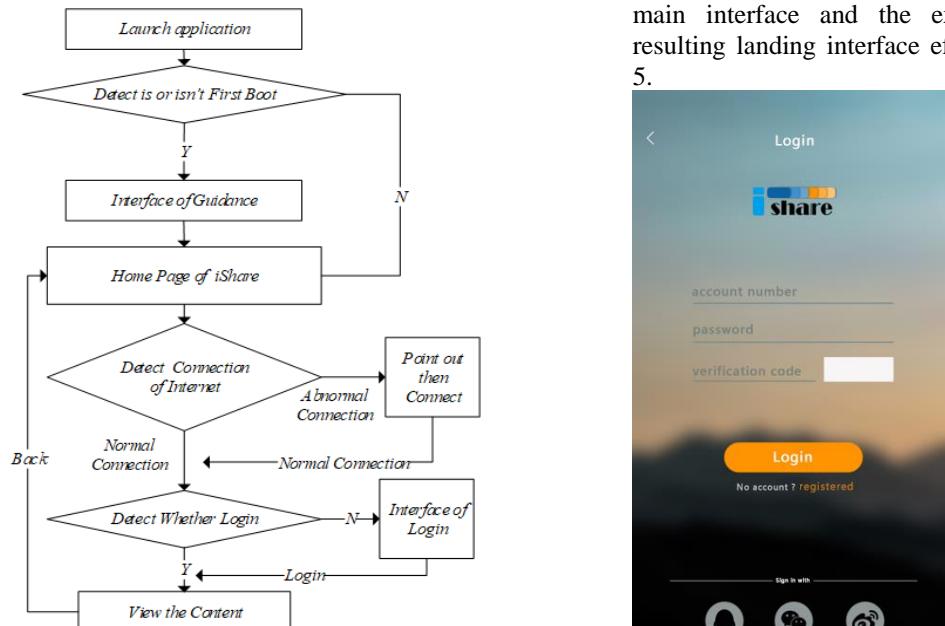


Figure 4. Client Work-flow

5.2. Design and Implementation of Main Interface

When the user installs the campus resource sharing client and starts it, the software automatically detects whether this start-up is the first time, and if the test result is the first time, the boot interface will be displayed. The boot interface includes a basic introduction to the software to facilitate the user's use of the software. When the user enters the client, each module of the client can be accessed through the main interface and the extended interface. The resulting landing interface effect is shown in Figure 5.

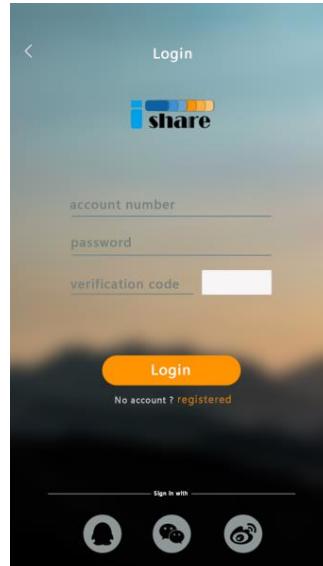


Figure 5. Effect of Landing Module

The main code to implement the login module is as follows:

```

class UserLogin(APIView):
    def post(self, request):
        return self.login_post_do(request)
    def login_post_do(self, request):
        username = request.data.get('username', '')
        username = str(username)
        pwd = request.data.get('password', '')
        pwd = str(pwd)
        validate_code_custom =
request.data.get('validate_code', '').upper()
        validate_code_server =
request.session.get('validate_code_s', '').upper()
        if validate_code_custom != validate_code_server:
            return
        Response(status=status.HTTP_200_OK,
data=response_code.VALIDATE_CODE_ERROR)
        del request.session['validate_code_s']
        if pwd == '':
            return
        Response(status=status.HTTP_200_OK,
data=response_code.NEED_RIGHT_USERNAME_
AND_PASSWORD)
        if match(r'^(\d){11}$', username) is not None:
            return self.pass_phone_login(request,
phone=username, pwd=md5(pwd))
        elif is_email(username):
            return self.pass_email_login(request,
email=username, pwd=md5(pwd))
        else:
            return
        Response(status=status.HTTP_200_OK,
data=response_code.NEED_RIGHT_USERNAME_
AND_PASSWORD)
        def pass_email_login(self, request, email, pwd):
            try:
                member = Member.objects.get(email=email,
password=pwd)
                request.session['user'] = member.id
                return
            Response(status=status.HTTP_200_OK,
data=response_code.LOGIN_OK)
            except Member.DoesNotExist:
                return
            Response(status=status.HTTP_200_OK,
data=response_code.NEED_RIGHT_USERNAME_
AND_PASSWORD)
            def pass_phone_login(self, request, phone, pwd):
                try:
                    member =
Member.objects.get(phone_num=phone,
password=pwd)

```

```

request.session['user'] = member.id
                return
            Response(status=status.HTTP_200_OK,
data=response_code.LOGIN_OK)
            except Member.DoesNotExist:
                return
            Response(status=status.HTTP_200_OK,
data=response_code.NEED_RIGHT_USERNAME_
AND_PASSWORD)
6. CONCLUSION

```

This paper introduces in detail the design and implementation of a campus sharing software based on Android platform. The software in debugging and running stage has basically realized resource sharing and instant chat, user personal center and user goods service center and other major functions. Moreover, thanks to the beautiful interface, safe and convenient operation, so the software has a certain application prospect.

ACKNOWLEDGMENT

This work was supported by College students' Innovation and Entrepreneurship Project (No. 20170622026), Science and technology plan projects of Sichuan province (No. 2017GZ0303), the research project of Sichuan Provincial Key Lab of Enterprise Information and Control Technology for Internet of Things (No. 2017WYJ01).

REFERENCE

- [1] Wu Shan. The system and Application frame of Android. *Electronic Technology & Software Engineering*, 2019, 2.
- [2] Peng Xu. Research and Implementation of Intelligent Campus System Based on Android Platform. Jiangsu University of Science and Technology, 2016, 3.
- [3] Sun Bo, Fan Xinhui, Xin Dixin. The Design and Implementation of the Information Platform for the Sharing of Teaching Resources in Colleges and Universities, 2012, 7.
- [4] Wu Daiwen. Design and Implementation of Resource Sharing Website Based on Web. *Journal of Weinan Normal University*, 2013.
- [5] Zhong, J., Weber, C., Wermter, S. Robot trajectory prediction and recognition based on a computational mirror neurons model. In *International Conference on Artificial Neural Networks*, Springer, Berlin, Heidelberg, 2011, pp. 333-340.
- [6] Zhong, J., Cangelosi, A., Ogata, T. Toward abstraction from multi-modal data: empirical studies on multiple time-scale recurrent models. In *2017 International Joint Conference on Neural Networks (IJCNN)*, IEEE, 2017, pp. 3625-3632.

Innovation of Enterprise Management Model in the Background of Big Data

Zhuolin Xiao^{1,*}, Peter Watson²

¹Department of Food and Pharmaceutical, Qingyuan Polytechnic, Qingyuan, Guangdong, China

²Leeds University Bussiness School, University of Leeds, Leeds, UK

*E-mail: xiaozhuolin@yeah.net

Abstract: With the gradual improvement of economic level, the rapid advancement of scientific and technological strength and the vigorous development of many emerging industries, the industry competition is becoming increasingly fierce. Nowadays, our country has gradually entered the information age, in other words, the era of data explosion. In today's big data background, how to better manage enterprises is the focus of this analysis. In addition, this paper will also give some suggestions on the establishment of a new business management model, hoping to help business leaders, in order to maintain the vitality and development of enterprises.

Keywords: big data; enterprise; management mode; innovation

1. INTRODUCTION

When enterprises are founded, they must face the cruel competition of the industry. At the same time, how to manage the enterprises and seek better development is the problem that every enterprise should think about. The development of enterprises is not unchanged, and stagnant enterprises will eventually collapse. Under the background of big data, enterprises have suffered a certain impact because of the popularization of automation, but at the same time, they have also obtained opportunities. Enterprises can use the network to restructure the supervision system, replace the old management mode, implement new, convenient and efficient management mode, and constantly innovate, so that enterprises will always be full of vitality and get better development [1].

2. BIG DATA AND BIG DATA AGE

2.1. The Concept of Big Data

As the name implies, “big data” is used to describe data obtained from various sources. These data are often updated in a timely manner. They come from a wide range of sources. They do not simply refer to one-way consumption records, but include social media, e-commerce, negotiation and other channels. Big data is the final product of the high development of science and technology and the development of information technology [2].

2.2. Definition of Big Data Age

The era of big data is full of huge information and huge amount of information today. McKinsey was the

first person to put forward this concept, and the New York Times also pointed out that under the background of “big data”, enterprise management and decision-making are no longer limited to personal vision and experience, and the addition of information data makes enterprise management and operation more scientific and efficient”.

2.3. Characteristics of Big Data

The characteristics of large data can be summarized as “4 V”, which includes the following four points:

(1) Huge amount of information

Huge information data is the cornerstone of “big data”. The basic units of big data are P (1000 T), E (1 million T) or Z (1 billion T). And the huge data provide more professional suggestions for the enterprise management, make the enterprise look more long-term, and benefit the management and operation of the enterprise [3].

(2) Various species

Big data includes many kinds of information, including chat, telephone, articles, videos, short messages, pictures, etc. Various kinds of information data are gathered together, which puts forward high requirements for the information data processing ability of enterprises. Therefore, some enterprises with lower informationization will be greatly impacted, but on the other hand, enterprises can use these information actively, establish a relationship network, use the network to manage the internal operation of enterprises, convert information into data feedback to the top of enterprises, and make decisions and deployments [4].

(3) Uncertainty of data value

Nowadays, information and data are generated all the time in our life, but it is difficult to know whether the data is valuable or not. This is also a loophole that needs to be focused on and solved. This feature is not a good thing for enterprises. If there are a lot of meaningless information data in enterprise management, it will have a great impact on enterprise management [5].

(4) Efficiency of data transfer and processing

With the popularity of the Internet and computers, the speed of information processing has been improved qualitatively. In the past, it took ten days and a half months to work on the computer. It took only about ten minutes to operate on the computer, which brought a lot of convenience to the operation of enterprises.

Make enterprise management more convenient [6].

3. THE DEFECTS OF ENTERPRISE MANAGEMENT UNDER THE BACKGROUND OF BIG DATA

3.1. Information Data Analysis and Processing Level Difference

Nowadays, under the background of big data, enterprise management is gradually moving towards informationization, which requires enterprises to have a certain ability to deal with huge data information. Nowadays, with the explosion of data, the ways for enterprises to obtain information have become various. Therefore, how to analyze and process the information is a top priority. However, most companies have not yet formed a mature system to deal with information, which has hindered the establishment of information management system for companies, and is not conducive to the development of enterprises [7].

3.2. Information Data Update Speed is too Slow

Economic globalization has closely linked global enterprises, enabling them to cooperate and benefit each other better. At the same time, it is easier for them to get information about the trends of the industry market. However, after obtaining information, it is still unknown whether they can make correct judgments according to the information in time, seize the market opportunities, lead the development of Companies and manage them better. However, if the information is not updated in time, the enterprise will make a judgment based on the wrong information, which will cause great losses to the company [8].

3.3. Data Processing Control Company Management

Now, the results of information analysis and processing often influence the decision of the company's top management. Scientific and rigorous data analysis results can help managers make correct decisions and better manage the company. But a wrong data processing results will confuse the judgement of management and cause irreparable losses. Therefore, companies should not rely too much on information integration, but targeted selection of useful data, in order to better manage the company.

3.4. Information Data Security needs to be Improved

Information leakage is one of the common problems in the world. When confidential data or information of a company is leaked, the lighter one will cause economic losses of the company, and the heavier one will lead to stock decline, public instability and even bankruptcy. Nowadays, most companies pay no attention to protecting company information data.

4. INNOVATION OF CORPORATE SUPERVISION SYSTEM UNDER THE BACKGROUND OF BIG DATA

4.1. Strengthen the Ability of Data Acquisition and Processing Based on Informatization

Information acquisition is the most important means

for a company to communicate with the outside world and determine the development of the company. To establish the database of the enterprise, it needs the support of enterprise informatization. Only by realizing the informatization of the company, can we actively collect and screen useful information and input it into the database for staff to consult. To achieve this, we need to emphasize the awareness of research and sharing. Only by sharing the acquired information can others receive information, thus promoting the supervision of enterprises.

4.2. Understanding the Economic Significance of Data and Establishing a Systematic Supervision System as early as possible

Nowadays, there is no system or mode for company operation and management. How to improve the inherent system is a problem many companies are facing now. Big data can be used as a breakthrough to help companies establish a regulatory system through data, jump out of the original rigid regulatory model, and implement information-based and automated supervision. To build an automated regulatory system, the first thing is to pay attention to the value of data. By interpreting the data, we can know the internal situation and external trends of the company, grasp the overall situation, and make more reasonable decisions.

4.3. Pay Attention to the Validity Period of Information Data

With the popularity of the network, the interpretation of data has become easier. Enterprises need to establish an information network system as early as possible to obtain and process data, and give suggestions for enterprise development and supervision. The company should build a network information analysis and processing center according to the actual situation of the company, provide data support and suggestions for the company's decision-making, establish a digital supervision system based on data as support, update and process data information in real time, in order to realize the innovation of the inherent management mode, and rely on first-hand information to retain customers in conversation with customers, and improve the company's profits. Benefit, to achieve better development of the company.

4.4. Establish a Special Data Analysis Center

Nowadays, few companies specialize in information processing and analysis. Most of them are submitted directly to their superiors, and managers make decisions based on their own judgments. Establish a special data analysis center to screen, analyze and process the huge data, and select the most valuable information to be submitted to the superiors. In this way, it can not only lighten the burden of senior management, but also add a chip for decision-making, and better manage and operate the company. In addition, the establishment of a special data analysis department is a reform of the original company management model. Under the original hierarchical

system, the employees in the system are linked through network information, so that they can grasp the company's agility without any effort and achieve more convenient and efficient management.

4.5. Strengthen the Training of Employees' Information Network Ability

Under the current big data background, the computer ability of employees is particularly prominent, which requires the company to update the original management model and improve the ability of network information analysis and processing of employees. Nowadays, there are few senior managers who know data analysis, and there is a great shortage of talents in this field in China. Therefore, the company should strengthen the training of employees, cultivate their professional competence and professional accomplishment, and improve the competitiveness of the company. In addition, the company can also employ professional technicians to manage the huge data system, know the market trends, make timely decisions, so that the company is invincible.

5. CONCLUDING REMARKS

In summary, companies in the context of big data will not only be impacted, but also harvest opportunities. How to make use of big data, seize opportunities, go up to a higher level, and achieve the innovation of corporate regulatory system, we need to depend on the actual situation of each enterprise. In short, only by training more relevant professionals and reforming the old disjointed system in the system, can enterprises stand out in the fiercely competitive market and realize the long-term development of the company.

REFERENCE

- [1] Zhang Shouhong. Explore the influence and strategy of big data technology on enterprise management accounting. *Market Modernization*, 2018, (20): 162-163.
- [2] Chen Lei. Research on Business Management Innovation in Big Data Era. *China Management Informatization*, 2018, 21(19): 55-56.
- [3] Li Wanxuan. Improving Measures of Enterprise Management Accounting in the Background of Big Data. *Accounting Learning*, 2018, (13): 131-133.
- [4] Duan Lihua. Challenges and changes of enterprise financial management in the context of big data. *China International Finance and Economics (Chinese and English)*, 2018, (09): 162-163.
- [5] Zhong, J., Cangelosi, A., Ogata, T., Zhang, X., Encoding Longer-Term Contextual Information with Predictive Coding and Ego-Motion. *Complexity*, 2018.
- [6] Zhong, J., Cangelosi, A., Zhang, X., Ogata, T. AFA-Pred Net: The action modulation within predictive coding. In 2018 International Joint Conference on Neural Networks (IJCNN) IEEE, 2018, pp. 1-8.
- [7] Zhong, J., Cangelosi, A., Ogata, T. Toward abstraction from multi-modal data: empirical studies on multiple time-scale recurrent models. In 2017 International Joint Conference on Neural Networks (IJCNN) IEEE, 2017, pp. 3625-3632.
- [8] Zhong, J., Cangelosi, A., Wermter, S. Toward a self-organizing pre-symbolic neural model representing sensorimotor primitives. *Frontiers in behavioral neuroscience*, 2014, 8: 22.

Innovation of Supply Chain Finance Model Based on Blockchain Technology

Zunli Zhang*, Xinyi Li

School of Management, Shanghai University, Shanghai, 201800, China

*E-mail: 379343039@qq.com

Abstract: The phenomenon of ‘information island’ is prevalent in the current supply chain operation, the information is distributed in different enterprises in the supply chain the information authenticity and reliability is poor, which leads to the financing difficulty and high expense of small and medium-sized enterprises; correspondingly the endogenous characteristics of blockchain: decentralization, unified data storage, cannot be tampered with, traceability and so on, can promote the recording and tracing of information transmission process, so that realize the penetration of core enterprise credit to the end of the long tail of small and medium-sized enterprises, and form innovative solutions to supply chain finance financing problems. This paper firstly analyzes the current pain points of supply chain finance, and then puts forward the application of block chain technology to promote supply chain finance to achieve multi-level credit penetration. Combining three typical financing modes of supply chain finance with blockchain technology, hoping to further promote supply chain finance into the era of digital visualization.

Keywords: supply chain finance; information

asymmetry; blockchain; application scenarios

1. INTRODUCTION

Block chain is a disruptive technology to create credit. It is driving a new round of global industrial and technological change in the new era. It will undoubtedly become the “source” of global technological innovation and mode innovation, and realize the effective transformation of information to value. In the 13th Five-Year Plan for National Informatization, it is clearly pointed out that the block chain technology will be the key frontier technology in the development of the new era in China, and it will continue to develop, innovate and apply, and occupy a strategic advantage in the fierce global information competition.

At present, the application of block chain technology in China is still in the process of active exploration and attempt. The focus of block chain technology is gradually focusing on the combination of block chain and other fields. The potential in the application scenarios of product traceability, credit information, supply chain finance and other fields is constantly being tapped. The application scenario of block chain in supply chain finance is shown in Figure 1.

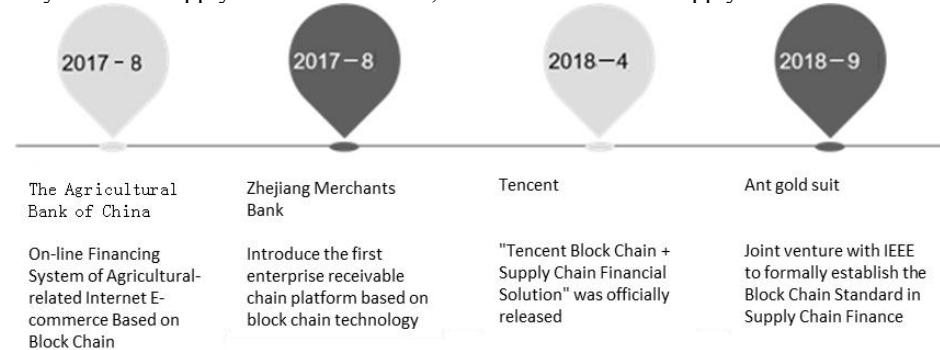


Figure 1. Application scenario of block chain in Supply Chain Finance

According to Critical Future’s market report, the market size of global block chains is expected to grow at a compound annual growth rate of 62.61%, reaching 101 billion by 2024, up from 548.2 million in 2018. Because of its huge market potential and multi-agent participation in cooperation, supply chain finance has gradually derived a large number of application scenarios combining with block chain technology. Block chain technology will become one of the important factors leading the development direction of supply chain finance in the future.

2. LITERATURE REVIEW

In Bitcoin: A Peer-to-Peer Electronic Cash System

(2008), Bencong Nakamoto, the creator of Bitcoin, first introduced the bottom technology block chain of Bitcoin, a point-to-point, decentralized trading technology. Jon Berkeley (2015) published a cover article entitled “The Promise of the Block-chain: The Trust Machine” in The Economist, arguing that the block chain is a trust-creating machine and technology, which will bring about tremendous changes and impacts on the mode of social cooperation in the future [1]. In the White Paper on Technology and Application Development of China’s Block Chain published in 2016, Block Chain is defined as an innovative application mode of new

complex computer technology in the Internet age, and the application of this mode extends to various fields of social development, which mainly involves the fields of Finance and supply chain. Yuan Yong and Wang Feiyue (2016) systematically sorted out the basic principles, basic models, core technologies and applicable scenarios of block chain, and proposed that block chain technology, with its characteristics of decentralized credit, cannot be tampered with at will, can not only be successfully applied in the field of digital encryption, but also can be widely used in financial transactions, data storage and other fields [2].

There is no doubt that the characteristics of block chains can be widely used in various fields now and in the future. Many scholars have studied the specific application of block chains in various fields. Zhang Xiuguang and Li Zhengdao (2016) have analyzed the opportunities and challenges that block chains meet in the application of China's financial field, and introduced the operation mode of block chains [3]. Li Zhengdao, Ren Xiaocong (2016) changed the credit reporting system of Internet finance by establishing block chain blacklist and white list on the basis of the former, and analyzed the positive role of block chain technology in risk control of Internet finance [4]. The characteristics of decentralization and traceability of block chains provide a new way to solve the problems of medical information sharing and drug traceability anti-counterfeiting in the medical field. Xue Tengfei et al. (2017) proposed a medical data sharing model based on block chain technology. The method of comparative analysis proves that the model can better realize the safe storage and sharing of medical data [5]. In addition, in other application areas, Pudong Ping et al. build the circulation system, payment system and credit system of e-commerce platform with the corresponding characteristics of block chain, and analyze the various risks faced by the combination of block chain and e-commerce in the future development [6].

This paper mainly discusses the application of block chain technology in the field of supply chain finance. Before that, Lin Hong introduced the model of online supply chain finance and the existing risks. He proposed that the use of block chain technology can enhance the credibility of supply chain, reduce credit costs, open up the communication channels of supply chain and create new opportunities for supply chain finance, and summarized the results. The future development direction of block chain technology in the field of online supply chain finance [7]. Lu Li et al. proposed that block chain technology has a positive effect on risk prevention in supply chain finance: improving the efficiency and flexibility of bill transfer, reducing the difficulty of financing and reducing the cost of risk control, and summarized the positive role of block chain technology in solving trust problems, realizing transnational value transfer, practical

application significance and promoting global value circulation [8].

At present, few scholars have studied the mode of combining block chain technology with supply chain finance, and have not put forward the mode innovation based on block chain technology for the specific business of supply chain finance. So this paper takes the pain point of supply chain finance as the breakthrough point, and puts forward three different application scenarios of supply chain finance, which are order financing, warehouse receivable financing and warehouse receivable financing using block chain technology.

3. APPLICATION OF BLOCK CHAIN TECHNOLOGY IN SUPPLY CHAIN FINANCE

3.1. Pain Points of Supply Chain Finance Business

Up to now, nearly 80% of the business of supply chain finance still concentrates on advance payment financing and inventory financing [9]. For the sake of business risk, financial institutions represented by banks have the performance of reluctance and prudence in lending to SMEs, even though these SMEs have real trade data, which is extremely true for SMEs with strong financial needs. The development of supply chain finance has been greatly affected, and the application scenarios and coverage targets of supply chain finance have been limited.

3.1.1. Chain information cannot penetrate barriers to financing

The position of core enterprises in supply chain finance is extremely critical. Small and medium-sized enterprises in the chain usually form a bundle with core enterprises, and increase credit through core enterprise credit. Essentially, they obtain financing services by pledging the cargo rights or bonds derived from core enterprises. However, for the sake of controlling the wind, financial institutions are only willing to provide financing for enterprises with direct transactions with core enterprises, while there are still a large number of secondary and tertiary levels in the same supply chain N-level suppliers/distributors cannot get the required financing, resulting in a large amount of capital demand in the supply chain.

3.1.2. Business security affects business implementation

Financial institutions in supply chain finance need to pay attention not only to the willingness and ability of enterprises to repay in the future, but also to other factors affecting the security of financing business before making decisions on whether to provide financing services to enterprises. Among them, the core enterprises collude with the upstream and downstream enterprises to defraud financing. In addition, there are many phenomena in the supply chain financial business, such as self-theft, false warehouse receipt pledge fraud, false trade contract fraud and false chattel pledge warning line.

3.2. Core Technology of Block Chain

Block chain is essentially an application mode of

computer technology based on modern database technology, Internet technology and modern cryptography technology, which integrates distributed data storage, point-to-point transmission, consensus mechanism, encryption algorithm, etc., [10,11]. Its core still returns to the technical dimension, covering a wide range of areas. Here, only a brief description of common representative technologies is given.

3.2.1. Distributed accounts

That is, the coinless block chain, in short, is accounting, but the difference is that this account is not recorded by one person (node), but by multiple nodes distributed in different places, it records the data generated by public space.

3.2.2. Asymmetric encryption and authorization

On the platform of block chain technology, each user has its own pair of public key and private key. These two keys correspond to the steps of encryption and decryption, that is, public key is used for encryption and private key is used for decryption. Asymmetric encryption has higher security than symmetric encryption. If a party's key receives security risks, it will not lead to the whole communication process being invaded.

3.2.3. Consensus mechanism

Consensus mechanism is a set of criteria to reach agreement on the block chain platform, that is, how to judge the effective records and malicious invalid records. The existence of consensus mechanism not only maintains the normal operation of the block

chain platform, but also guarantees the fairness of different users.

3.2.4. Intelligent contracts

Intelligent contract is an automation contract made by multiple users. It can automatically implement the terms and regulations set in the contract in subsequent transactions based on the real and untouchable contract content made by users.

3.3. Block Chain Innovation Drives Supply Chain Finance Development

3.3.1. Analysis of Participants' Interests

For core enterprises, the supply chain financial model based on block chain alleviates the current situation of capital shortage of upstream and downstream enterprises, optimizes the overall effect of supply chain, and enhances the overall competitiveness of supply chain; for upstream and downstream enterprises which carry out business around core enterprises, it solves the problem of capital shortage with lower cost, optimizes the cash flow of enterprises, and improves the capital of enterprises. Gold turnover efficiency; for financial institutions, access to more transparent information, risk-controllable high-quality assets, improve capital efficiency.

3.3.2. Business framework

The supply chain financial system based on block chain consists of bottom-up data layer, network layer, consensus layer, incentive layer, contract layer and application layer, as shown in Figure 2.

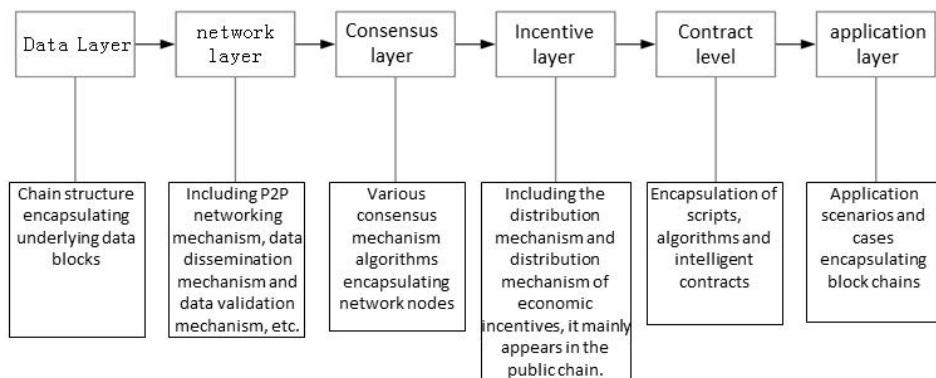


Figure 2. Business Framework

3.3.3. Financial credit transfer in supply chain based on block chain

In the traditional supply chain financial system, trade process and financing process exist in the supply chain as independent and different links. For example, when enterprise C and core enterprise A sign trade contracts, core enterprise A has absolute voice in terms of pricing and accounts receivable. However, because of the long account period, enterprise C will face financial constraints and liquidity difficulties. In order to meet the needs of production and operation of enterprises, enterprise C applies to bank B for financing on account receivable. For the consideration of business risk control, bank B will evaluate and judge the credit grade, the authenticity of transaction

data and the authenticity of accounts receivable of enterprise C, which consumes a lot of time cost, labor cost and transaction cost.

Under the block chain technology system, this transaction is still the same. When enterprise C and core enterprise A sign the trade contract, the contract information is entered into the block. All the information involved in the trade process, such as warehouse delivery, transportation vehicle driving, buyer's signature and account receivable, can be recorded in the block chain completely. Bank B can provide suppliers at any level. The trade information and documents are checked to realize the multi-level transmission of core enterprise credit in the supply chain.

As a “trust machine”, the block chain can realize the credit penetration of the supply chain financial system, guarantee the authenticity and validity of the entire bill and the transfer of creditor’s rights in the process of confirming the rights of the core enterprises, and realize the credit penetration. In this trust ecosystem, the credit of core enterprises (bills, credit lines, right of payment) can be converted into digital vouchers to improve efficiency and reduce cooperation costs.

4. SUPPLY CHAIN FINANCIAL BUSINESS MODEL BASED ON BLOCK CHAIN

The application of block chain technology in supply chain finance is to build a block chain platform, relying on which to achieve the goal of supply chain digitalization. The main manifestations of the feasibility of block chain technology are data visualization, i.e., data recording and visualization of node information, contract information, transaction details, etc. and background management, i.e. system management of transaction statistics, transaction query, contract invocation, contract management, business monitoring, business early warning, etc.

4.1. Financing of Accounts Receivable

Accounts receivable financing is the main business of supply chain finance. The balance of accounts

receivable of non-financial enterprises in China has reached 16 trillion yuan. In the financing mode of accounts receivable based on block chain, the main function of block chain technology is to record, walk and reconcile accounts receivable financing transactions through its characteristics of distributed books and intelligent contracts. Depending on the block chain platform, the receivable vouchers concluded by core enterprises and small and medium-sized enterprises upstream and downstream form an electronic contract A after examination and approval, which is sent to financial institutions and applied for financing. After the financial institutions check the information (including the authenticity of the transaction, the credit quota of both parties, especially the core enterprises (reflected in tokens), such as confirming that they have met the financing requirements, gold Financial institutions form new electronic contracts for financing business B (including repayment period and amount) and carry out lending operations. Block chain platform automatically stores electronic contracts A and B, and sends out early warning notice to core enterprises before the expiration of the contract, referring specifically to Figure 3.

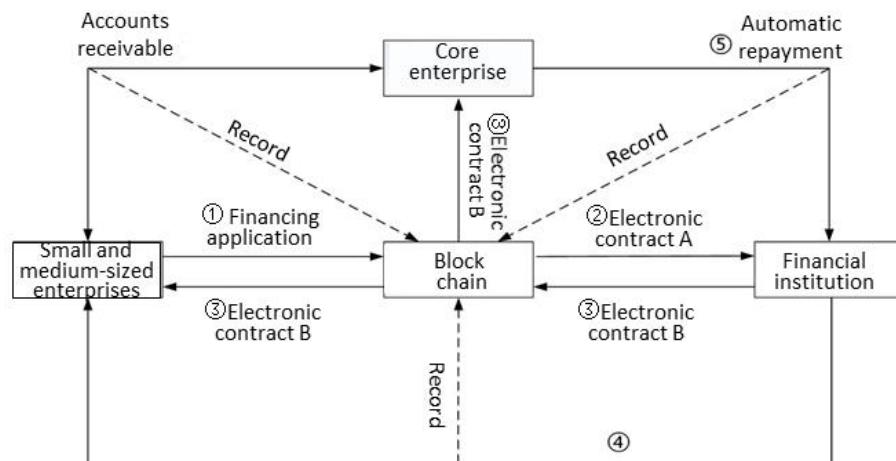


Figure 3. Accounts Receivable Financing Based on Block Chain Technology

4.2. Order Financing

In order financing mode based on block chain, financial institutions send financing funds to purchasing enterprises and then pay to the account of raw material suppliers relying on block chain platform. These processes can be completed by one-time intelligent contract of block chain platform. Upstream enterprises (small and medium-sized enterprises) conclude trade contracts with core enterprises to form electronic contracts A, and send them to financial institutions to apply for order financing. Financial institutions confirm the creditworthiness background (reflected in tokens) of both sides of the trade in electronic contracts and specific trade information, and then issue new electronic contracts B (including repayment period and amount) formed by financing business. Send it to

the upstream enterprise, and lend it to the raw material supplier account. SMEs will pay back automatically when they are due.

4.3. Warehouse Receipt Pledge Financing

Relying on the block chain platform, SMEs (cargo owners) apply for financing to the block chain platform. After the warehouse receipts have been examined and verified, an electronic contract A containing warehouse receipts is formed on the block chain platform. Financial institutions examine and verify the credit quota (expressed in tokens) and contract contents of the enterprises provided by the platform, and a new electronic warehouse receipt pledge financing contract B meets the financing requirements. Send them to financing enterprises and warehousing service companies respectively, and pledge the goods, lend money to SMEs, and repay

automatically when the SMEs are due. Refer to Figure 4.

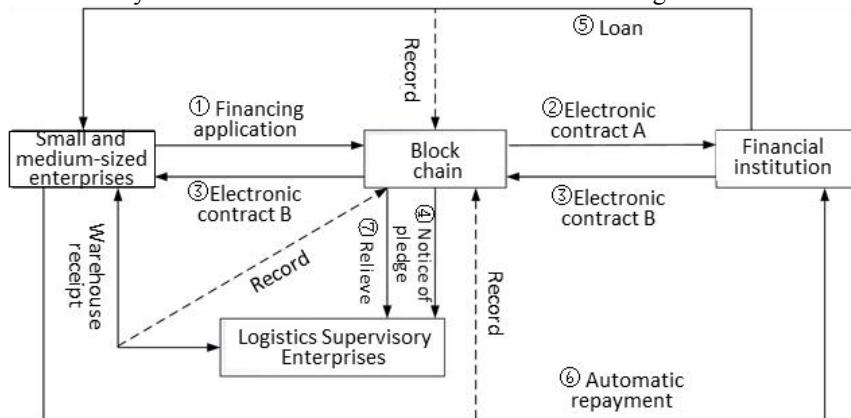


Figure 4. Warehouse receipt pledge financing based on block chain technology

5. SUMMARY AND PROSPECT

Based on technological advantages, the application of block chains in all walks of life has been gradually promoted. In the field of supply chain finance, due to its endogenous characteristics such as decentralization, unified data storage, no random tampering and traceability, it greatly reduces the risk of supply chain financial business, such as repeated pledge, empty bill pledge, misappropriation of funds, etc. In addition, it can achieve supply by using block chain technology. The real and effective transmission of information on the supply chain enlarges the scope of credit radiation of core enterprises, improves the operational efficiency of financing business, helps small and medium-sized enterprises to reduce financing costs, and finally realizes the construction of supply chain financial ecological system that credit transmission ultimately transforms into value sharing. Based on the combination of block chain technology and supply chain finance, this paper proposes three common application scenarios. However, more application scenarios and potential of block chain technology still need to be further explored in the future.

At present, block chain technology is still in the stage of continuous trial and optimization, its data storage capacity and the construction of a unified global standardized identification system need to be improved; the landing application in the field of supply chain finance still needs further construction and improvement, because the participants in the supply chain still do not have a good ability to share data resources, and the credit information sharing mechanism has not yet been established. This cannot make full use of the advantages of block chain technology. In addition, problems such as high cost of technology development and unknown risk of new technology lead to long landing period of block chain application still hinder the application development of the combination of block chain and supply chain finance.

REFERENCES

- [1] The Economist. The promise of the blockchain: the trust machine. <http://www.economist.com/news/leaders/21677198-technology-behind-bitcoin-could-transform-how-economy-works-trust-machine>. 2017, 43(10): 1703-1712.
- [2] Yuan Yong, Wang Feiyue. Parallel Block Chain: Concept, Method and Connotation Analysis. Journal of Automation, 2017, 43(10): 1703-1712.
- [3] Zhang Xiuguang, Li Zhengdao. "Block Chain + Internet" Prospect Analysis and Challenge in Financial Field. Management Modernization, 2016, 6: 4-6.
- [4] Li Zhengdao, Ren Xiaocong. Impact of Block Chain on Internet Finance and Future Prospects. Research on Technology, Economy and Management, 2016, 10: 75-78.
- [5] Xue Tengfei, Fu Qunchao, Wang Zong, et al. Medical data sharing model based on block chain. Journal of Automation, 2017, 43(09): 1555-1562.
- [6] Pudong Ping, Fan Chongjun, Liang Hejun. Construction and application of e-commerce platform system based on block chain perspective. China's circulation economy, 2018, 32(03): 44-51.
- [7] Lin Hong. The Impact of Block Chain on Online Supply Chain Finance. Journal of Inner Mongolia University of Finance and Economics, 2017, 5: 11-14.
- [8] Lu Li, Sun Wei and Li Huiling. Research on Financial Risk Prevention of Supply Chain Based on Block Chain Technology. 2018, 2: 22-23.
- [9] Snow Storage and Gaobo Frugality. Research on Supply Chain Financial Innovation Driven by Block Chain. Financial Development Research, 2018, 8(8): 68-71.
- [10] Shao Qifeng, Jin Chengqing, Zhang Zhao, et al. Block Chain Technology: Architecture and Progress. Journal of Computer Science, 2017, 4(11): 1-21.
- [11] He Pu, Yu Ge, Zhang Yanfeng, et al. A review of block chain technology and application prospects. Computer Science, 2017, 44(4): 1-7.

Monitoring and Tracking Technology of Sensitive Information in Microblog

Jiaqi Li^{1,*}, Zihao Bai², Yin Huang³

¹New Media College, Communication University of Zhejiang, Hangzhou, China

²College of International Cultures & Communications, Communication University of Zhejiang, Hangzhou, China

³College of Journalism & Communication, Communication University of Zhejiang, Hangzhou, China

*E-mail: jiaqi.li0409@foxmail.com

Abstract: At present, the collecting microblog information in China are network crawling and Application Programming Interface (API) based on Sina Microblog open platform. However, normal web crawlers do not have the login function and cannot grasp the full contents of JavaScript, while the API Open Platform also has certain limits of authority, so the collection efficiency is not high. This work develops a system on MyEclipse platform using MySQL database for data storage. After simulating the login of Sina Microblog, according to the keywords presented, it can search the relevant Microblog text information, and grab the information content and author information. The collected information is transformed into structured data and stored in a designated database for public opinion analysis and system analysis.

Keywords: online public opinion; information collection; topic monitoring; crawler

1. INTRODUCTION

With the emergence of microblog and the continued popularity of the Internet, more and more netizens choose to express their opinions and emotions through the network, and network public opinion is also playing an increasingly important role in reflecting public opinion and reality. Therefore, it will play an important role in the healthy development of network culture to analyze the coping strategies of network public opinion and establish a monitoring and early warning mechanism. Collecting sensitive content of microblog is an important prerequisite for the establishment of a monitoring mechanism of public opinion [1]. At present, the structure of the Microblog website is different from that of ordinary websites. The front-end and back-end mobilization of a large number of instant data and the use of a membership system make it hard for traditional web crawlers to crawl the data. In view of this, this paper proposes a new web crawling method which can crawl a large amount of Microblog information. It can update the Microblog information effectively and regularly while monitoring the Microblog information so that the Microblog information can keep fresh. The experimental results show that compared with traditional methods, this project can judge whether a

blog contains sensitive information based on keyword retrieval, and then track the location of that sensitive information according to the forwarding by other authors, which can effectively improve the accuracy of content monitoring [1].

2. RELATED RESEARCH

Matthew Gray invented Wanderer, the earliest web collector in 1993. Mario Cataldi studied it in depth and found the first way to extract Twitter topics. K. F. Bharati studied deep web crawlers and proposed a hidden web page collection model for secure web pages [2]. Taking China as an example, most of the data mining methods for social platforms such as Microblog are based on API and web page.

Sina Microblog provides more than 20 kinds of APIs for users to call in any development environment. However, the API provided by the open platform has quota limitation, such as API access times (hours, users) [3], which leads to low collection efficiency. The web crawler gets URL address according to the sequential URL queue, retrieve the contents and then parses the page using DOM tree. A web crawler is one of the key technologies of search engine [4]. Web crawler based information collection can break through API open interface restrictions and continuously crawl information. In Sina Microblog, however, the content a user can access without login is very limited. Only logged users can get the information, while the traditional web crawler does not have the function of logging in to Sina Microblog. In this system, HttpClient is used to implement the simulated Login Function of Sina Microblog, Fastjson is used to generate the microblog information into JSON format for subsequent information extraction, and Jsoup is used to extract the required microblog information. Experimental results show that the system has greatly improved efficiency and accuracy of information extraction [5,6].

3. DESIGN AND IMPLEMENTATION

This project takes Sina Microblog as the research object, using Eclipse development platform, JAVA language and SQL SERVER 2008 database, designs an information acquisition system that can capture the results of microblog search. Users can get relevant microblog information by setting keywords and grab the content of a single microblog and the information

of a single user. The collected information is transformed into structured data and stored in a designated database for the use of public opinion analysis system. At the same time, the system can judge whether the content of microblog contains sensitive information based on keyword retrieval, and track the source and location of sensitive information through the transmission of this microblog by other microblog users. The system is divided into two parts, which can capture Microblog information and user information respectively. The main modules of the two parts are similar [7]. They are divided into the following six modules: system configuration module, interface module, keyword search module, URL extracting module, content analysis module, and content update module. The implementation process is shown in Figure 1.

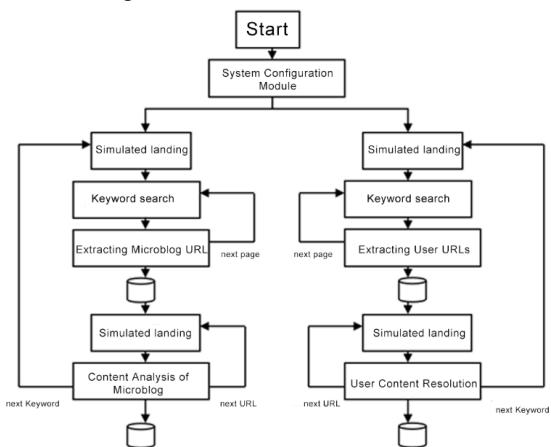


Figure 1. Flow chart of Sina Microblog Information Acquisition System

3.1. System Configuration Module

This module includes the functions of setting crawling, managing keywords, managing test accounts and setting the number of pages to be crawled. Through the system configuration module, we can configure tasks, keywords and test accounts before the system runs, which is convenient for users to manage the system.

3.2. Interface Module

Login module accesses HTTP protocol through HttpClient, builds a virtual browser to access Sina Microblog website, and simulates login to Sina Microblog through the test account in the database.

3.3. Keyword Search Module

By adding keywords to the URL, the keywords loaded into the database are coded and processed to form a microblog search results page. Finally, a directional search is carried out according to the results. The system obtains the results of microblog by directing the given keywords, eliminating the layer-by-layer crawling mode of common crawler programs, and carrying out simple and efficient, which is helpful for subsequent collection of public opinion sensitive content.

3.4. Extracting URL Module

Take on the directional search results page of the previous module, parse the Microblog collection page, extract the URL address of each Microblog, and store it in the ungrabbed URL queue for the next content parsing module to use. If there is another page, the same process is executed.

3.5. Content Analysis Module

Extract the URL information from the queue to be grabbed, get the source code of the URL page, and according to the pre-set rules, use JSOUP to intelligently parse and denoise the pre-processed content of Sina Microblog, so that the source code can be converted into the required structured data, and obtain the required content through regular expressions and store it in the corresponding data table of the database. If you have the next URL, you do the same process.

3.6. Content Update Module

The collected content can be updated through the content update module to deal with the keywords or sensitive content that update faster, so as to achieve the purpose of timely collection. The captured URLs in the database are imported into the Bloom filter as the original comparative data. The original data in the database are backed up first, then the contents of the Microblog information table and the user information table are deleted and loaded into the keyword queue for re-capturing.

4. EXPERIMENT

The hardware environment of the application server is as follows: CPU: Pentium (R) Dual-Core CPU 3.20 GHz, Memory: 2.00 GB, HD: WDC WD5000AAKX-753CA1 (500GB), and the OS is Windows 10 (64x), JDK: 1.7.079, Tomcat: 7.0.8, MyEclipse, SQL Server Enterprise Edition. The network is 10M LAN. After setting up the test environment, open Eclipse and run the system program and interface program. The management platform of the microblog information acquisition system includes task management, keyword management, and test account management. The Basic test steps are: start the background management platform and add microblog users to the platform and check the updated microblog user information on the management platform after starting the acquisition system.

The database collects information as shown in Figure 2, user information as shown in Figure 3.

5. CONCLUSION

In view of the unique of Sina Microblog, this paper aims to capture a large amount of microblog information into the database by keywords, update and manage the data, and provide automatic monitoring function for sensitive content of microblog. According to the test results, the system can monitor sensitive information of Microblog accurately, but because the monitoring and analysis of information events still need a certain time window, real-time monitoring needs further improvement [7].

In addition, the system only implements the static description of information events, not the actual evolution process of events. The focus and emotional distribution of events will also change accordingly. Therefore, it is still of great practical significance to

describe the development and change of information events through multi-knowledge in further research for understanding the law of event development and in-depth study of sensitive information.

	id	weibourl	userid	topic	weibocontent	source	nickname	forwarduser	forwarduser_nic.
223	230	http://weibo.com/	2783...	Dad, where are you going?	#Watching the show# to get free telephone..Micro-activities_Watc...	YiLianDong_hjx	weibo.com.. Sky video		
224	231	http://weibo.com/	3478...	null	#Dad, where are you going?#COMMING SOON!	Microactivity [Dad,wh...	XingXingabby7	weibo.com.. Sunflower cla	
225	232	http://weibo.com/	2846...	Dad, where are you going?	#Dad, where are you going?#will be stronger.Microactivity[seeing ...	Zunayuan	weibo.com.. Sunflower cla		
226	233	http://weibo.com/	3796...	null	Dad,where are you going?# is so great..Micro-activities_Watc...	Tiredenough	weibo.com.. Guangdong Xin		
227	234	http://weibo.com/	2581...	2018 Micro_blog night	#Dad,where are you going?#finally wins!con..2018 Micro_blog night	Joan_Linbin	weibo.com.. Sky video		
228	235	http://weibo.com/	3815...	Dad, where are you going?	#Watching the show# hope good luck will co..Microactivity[seeing ...	KaB	null	null	
229	236	http://weibo.com/	3279...	null	#Watching the show# to get free telephone..Micro-activities_Watc...	Xiaoyuaisehgnuo	weibo.com.. Sky video		
230	237	http://weibo.com/	3699...	Dad, where are you going?	#Dad, where are you going?#will be stronger.Microactivity [Dad,whe...	Wuzhongguyan	weibo.com.. Guangdong Xin		
231	238	http://weibo.com/	2581...	Dad, where are you going?	#Watching the show# hope good luck will co..Microactivity [Dad,whe...	Buweiju	weibo.com.. Sunflower cla		
232	239	http://weibo.com/	3802...	Dad, where are you going?	#Dad,where are you going?#fymam!my favori..Microactivity [Dad,whe...	Benshan	weibo.com.. Sunflower cla		
233	240	http://weibo.com/	3248...	null	#Watching the show# I really love it!	Microactivity [Dad,whe...	Xiaoyiguzhou	weibo.com.. Sunflower cla	
234	241	http://weibo.com/	3793...	null	#Dad,where are you going?#will be stronger.Micro-activities_Watc...	ComputerGears	weibo.com.. Sky video		
235	242	http://weibo.com/	3905...	Dad, where are you going?	#Watching the show# to get free teleph..	Microactivity[seeing...	Artman	weibo.com.. Guangdong Xin	
236	243	http://weibo.com/	3816...	Dad, where are you going?	#Friday night#Iam going to watch the show!	Microactivity[seeing...	nancy98	weibo.com.. Guangdong Xin	
237	244	http://weibo.com/	2671...	null	#Friday night# I can not wait!	Sina Microblog	Joy_Yuan	weibo.com.. Sunflower cla	
238	245	http://weibo.com/	3314...	null	/European and American fashion front line..Microactivity [Dad,whe...	DJM store	weibo.com.. Sunflower cla		
239	246	http://weibo.com/	3833...	Dad, where are you going?	#Watching the show# hope good luck will co..Microactivity[seeing...	HeRo_blue	weibo.com.. Guangdong Xin		
240	247	http://weibo.com/	3471...	Dad, where are you going?	Dad,where are you going?# is a nice Tvprog..Microactivity [Dad,whe...	Happy_Lucky	weibo.com.. Sunflower cla		
241	248	http://weibo.com/	3371...	null	#Watching the show#strongly support!	Micro-activities_Watc...	Lanka	weibo.com.. Sunflower cla	
242	249	http://weibo.com/	3817...	Dad, where are you going?	#Watching the show# to get free telephone..Microactivity[seeing...	Weihuodong	weibo.com.. Sky video		
243	250	http://weibo.com/	3926...	Dad, where are you going?	#Dad,where are you going?#what a wonderful..Microactivity[seeing...	Yishuxi	weibo.com.. Guangdong Xin		
244	251	http://weibo.com/	3815...	Dad, where are you going?	#Friday night#calling calling calling	Microactivity[seeing ...	Yamaha	weibo.com.. Guangdong Xin	
245	252	http://weibo.com/	3881...	null	#Watching the show# to get free telephone..Microactivity[seeing ...	Twindri	weibo.com.. Guangdong Xin		

Figure 2. Microblog information collection

	id	userurl	nickname	place	sex	birth	blog	personalurl	describe	u..	i..	f..	f..	follo..	fa..	weibo..
71	71	http://weibo.com/p/..	leven_shiyou	Wuhan	F	1969..	null	null	finally finished!	L..	0	right	8	762	60	47
72	72	http://weibo.com/p/..	xiaoxairenwu	Huai Fang, Shandong	F	1999..	null	http://..	Let the world know	L..	0	right	8	75	110	1694
73	73	http://weibo.com/p/..	wangqian	Yulin, Guangxi	F	null	null	null		L..	0	right	8	77	11	667
74	74	http://weibo.com/p/..	jinbeiqixing	Xi'an, Shaanxi	M	2000..	null	null		L..	0	right	8	235	257	831
75	75	http://weibo.com/p/..	xuejianFANCE	Other	M	2001..	http://..	http://..	BRAAAAAAAAVO	L..	0	right	8	47	283	54
76	76	http://weibo.com/p/..	Zhaozhadaman	Shantou, Guangdong	F	1990..	http://..	http://..	From East to West..	L..	0	right	8	262	90	638
77	77	http://weibo.com/p/..	dayexiaoshijie	Zhangzhou, Fujian	F	null	null	null	PKUer,Life is unlim...	L..	0	right	8	21	134	140
78	78	http://weibo.com/p/..	Vixinran	Kunming, Yunnan	F	null	null	null		L..	0	right	8	27	28	52
79	79	http://weibo.com/p/..	liangqihieiyu	Shunyi District, Beijing	F	null	null	http://..	null	L..	0	right	8	116	8	121
80	80	http://weibo.com/p/..	yatouzhenfan	Guangzhou, Guangdong	F	null	null	null	SoooooooYAUNOMY!	L..	0	right	8	336	559	326
81	81	http://weibo.com/p/..	jiushixihuann	Chaoyang District, Beijing	F	1998..	null	http://..	Seeking in the jour...	L..	0	right	8	172	95	743
82	82	http://weibo.com/p/..	fangyingyingbuquia	Changsha, Hunan	F	1992..	null	null		L..	0	right	8	93	48	30
83	83	http://weibo.com/p/..	suizheshijian	Zhangzhou, Fujian	M	null	http://..	http://..	FAZHA fans&DEZHA Fa...	L..	0	right	8	31	9	272
84	84	http://weibo.com/p/..	qianqian	Shantou, Guangdong	M	1972..	null	null	Never too late to ll...	L..	0	right	8	175	66	8
85	85	http://weibo.com/p/..	xushidaifa	Zhanjiang, Guangdong	F	null	null	null	WHUer,renshegnrunil...	L..	0	right	8	84	14	1806
86	86	http://weibo.com/p/..	kamu	Changsha, Hunan	F	null	http://..	http://..	woyisixingren,rensh...	L..	0	right	8	14	91	97
87	87	http://weibo.com/p/..	dairose8	Other	F	null	http://..	http://..	null	L..	0	right	8	219	15	821
88	88	http://weibo.com/p/..	xixiAmi	Kunming, Yunnan	M	2004..	http://..	http://..	To practice alone..	L..	1	right	8	56	609	1464
89	89	http://weibo.com/p/..	gaoxiaohuanziuri	Wuhan, Hubei	M	2002..	http://..	http://..	Keep up with the scl...	L..	0	right	8	257	15	3851
90	90	http://weibo.com/p/..	zhaozhadaman	Yulin, Guangxi	M	null	http://..	http://..	It's a little diffi...	L..	0	right	8	24	609	117
91	91	http://weibo.com/p/..	yiwagnV5	Other	M	1991	http://..	http://..	null	L..	0	right	8	65	32	47
92	92	http://weibo.com/p/..	viannanlianla	Kunming, Yunnan	F	1977	http://..	http://..	miss11	L..	0	right	8	2543	124	245

Figure 3. Collected user information

ACKNOWLEDGEMENT

Supported by “College Students Innovation and Entrepreneurship Training Program” (Grant No.201811647001).

REFERENCES

- [1] L.M. Aiello, G. Petkos, C. Martin, et al. Sensing Trending Topics in Twitter. IEEE Transactions on Multimedia, 2013, 15(6): 1268-1282.
- [2] K.F. Bharati, P. Premchand, A. Govardhan. Hidden Page Web Crawler Model for Secure Web Pages. International Journal of Electronic Communication and Computer Engineering, 2013, 4(2): 427-431.
- [3] Sina Microblog Open Platform.
- http://open.microblog.com/.
- [4] J. Cho. Crawling the web: discovery and maintenance of large-scale web data. L.A.: Stanford University, 2001.
- [5] Wang Yan. Research and implementation of Microblog sentiment analysis technology based on co-occurrence chain. Beijing: University of Defense Science and Technology, 2011.
- [6] Han Guofeng. Research and Implementation of Distributed Performance Testing Tool for Web System. Tianjin: Nankai University, 2007.
- [7] Ma Zhekun, Tu Yan. Research on content monitoring of network public opinion bursts based on the knowledge map. Information Science, 2019 (2): 33-39.

Research and Application of Heuristic Algorithms for Nurse Scheduling

Aijv Lei¹, Cui Ying^{1,*}, Sifeng Zhu², Yu Zhao², Chunqing Liu²

¹Zhoukou Central Hospital, Henan, 466000, China

²Zhoukou Normal University, Henan, 466001, China

*E-mail: 2049@qq.com

Abstract: Scheduling of nurses in hospitals belongs to the problem of working order, which has many characteristics. Therefore, the correct algorithm and related optimization are needed to carry out typesetting and related work effectively. In this paper, the problems related to nurse shift scheduling, the comparison of scheduling algorithm systems, the application of heuristic algorithm, the shortcomings of practical application and solutions are analyzed, and the relevant experience is summarized.

Keywords: nurse; shift scheduling; heuristic algorithm; research; application

1. ANALYSIS OF NURSE SCHEDULING RELATED PROBLEMS

Nurse scheduling problem is actually a fixed period of time, and based on a set of constraints, and then for all nurses in the hospital to arrange work shifts. The constraints are divided into hard constraints and soft constraints. The specific assignment of shifts should be based on the level and level of nurses, so as to ensure that nurses can be competent and solve the basic issues and problems in their work [1].

Among them, the hard constraints are the conditions that nurses must meet. The first point is that the coverage rate of nurses should meet the needs of the number of posts. The second point is that each nurse should arrange 0 or 1 shifts in a day's schedule, that is, one shift a day [2].

Among them, soft constraints are the conditions that nurses must not meet, and more soft constraints can improve the scientificity and rationality of scheduling. The first point is that within a relatively fixed period, the working days of nurses should be considered. The minimum and maximum two extremes should be reasonably formulated. The second point is that the continuous working days and rest days of nurses should be taken into account. A reasonable continuous cycle will ensure the utilization of human resources, and provide nurses with a relatively stable and reasonable working and rest law, thus ensuring a full working state and efficiency. The upper and lower thresholds should be set in advance. The

third point is that the rest time of night nurses should be considered. Usually, it is more reasonable to take two days off in one night shift. The fourth point is that the number of weekend work should be taken into account. Unit nurses cannot be on duty for many weekends in a row. Reasonable thresholds for continuous weekend work of nurses should be established in advance. The fifth point is to follow the rule of full weekend restriction, to ensure that nurses work overtime or rest all day during the weekend, and to ensure the same shift. The sixth point is that we should fully consider the needs of nurses on special dates and try to avoid special dates for scheduling and so on. In view of the importance of soft constraints and the sorting of their proportion, it is necessary to consider specific situations. In different data sets, the weights of soft constraints are likely to change [3].

2. THE COMPARISONS OF SCHEDULING ALGORITHMS SYSTEMS

Nurse scheduling heuristic algorithm system has many advantages compared with traditional manual scheduling system. The efficiency of a heuristic algorithm nurse scheduling system is much higher than that of an artificial algorithm nurse scheduling system. Secondly, the human cost of the heuristic algorithm nurse scheduling system is much lower than that of the manual algorithm nurse scheduling system [4]. The three heuristic algorithm nurses scheduling system has more scientific content and technical content than the manual algorithm nurses scheduling system. Four heuristic algorithm nurses scheduling system has lower error rate than manual algorithm nurses scheduling system. Five heuristic algorithm nurses scheduling system can cover more constraints than manual algorithm nurses scheduling system, which is more standardized. Six heuristic algorithms have better scalability than manual algorithms. When the number of nurses in hospital changes, heuristic algorithms will not be greatly affected and can continue to be used [5]. The manual method needs to be changed. If the number of people changes too much, the manual scheduling algorithm will probably need to be recalculated and scheduled, which will consume

more manpower and time costs. Therefore, on the whole, the application of heuristic algorithm in nurse scheduling has many advantages, which brings a lot of convenience and rapidity to nurse scheduling, and can effectively improve the quality and level of nurse scheduling [6].

3. SPECIFIC APPLICATION OF HEURISTIC ALGORITHMS

At present, heuristic algorithm is widely used. Heuristic algorithm is an algorithm composed of intuitive experience. With the increasing number of nurses, the results obtained by the heuristic algorithm are more stable, and will not be affected by the number of nurses. In the computable three-dimensional space, the optimal feasible solution will be obtained. Heuristic algorithms include genetic algorithm, variable neighborhood

search and particle swarm optimization [7]. Firstly, the initialization stage of calculation is carried out. According to the actual work schedule of the hospital, the multi-level level, hard constraints and soft constraints of nurses are fully considered. Then, according to the highest level of nurses, the group shift is divided. Finally, the order from high to low, corresponding to the level and level of nurses, shifts were arranged, and the number of shifts of nurses in different shifts was marked. The minimum number of shifts can be calculated and scheduled from the beginning of a certain date. An appropriate heuristic algorithm is adopted to generate an initial solution of feasibility. Thus, the scheme of the initial solution obtained has strong adaptability and expansibility [8]. The Figure 1 is a flowchart showing the initial solution:

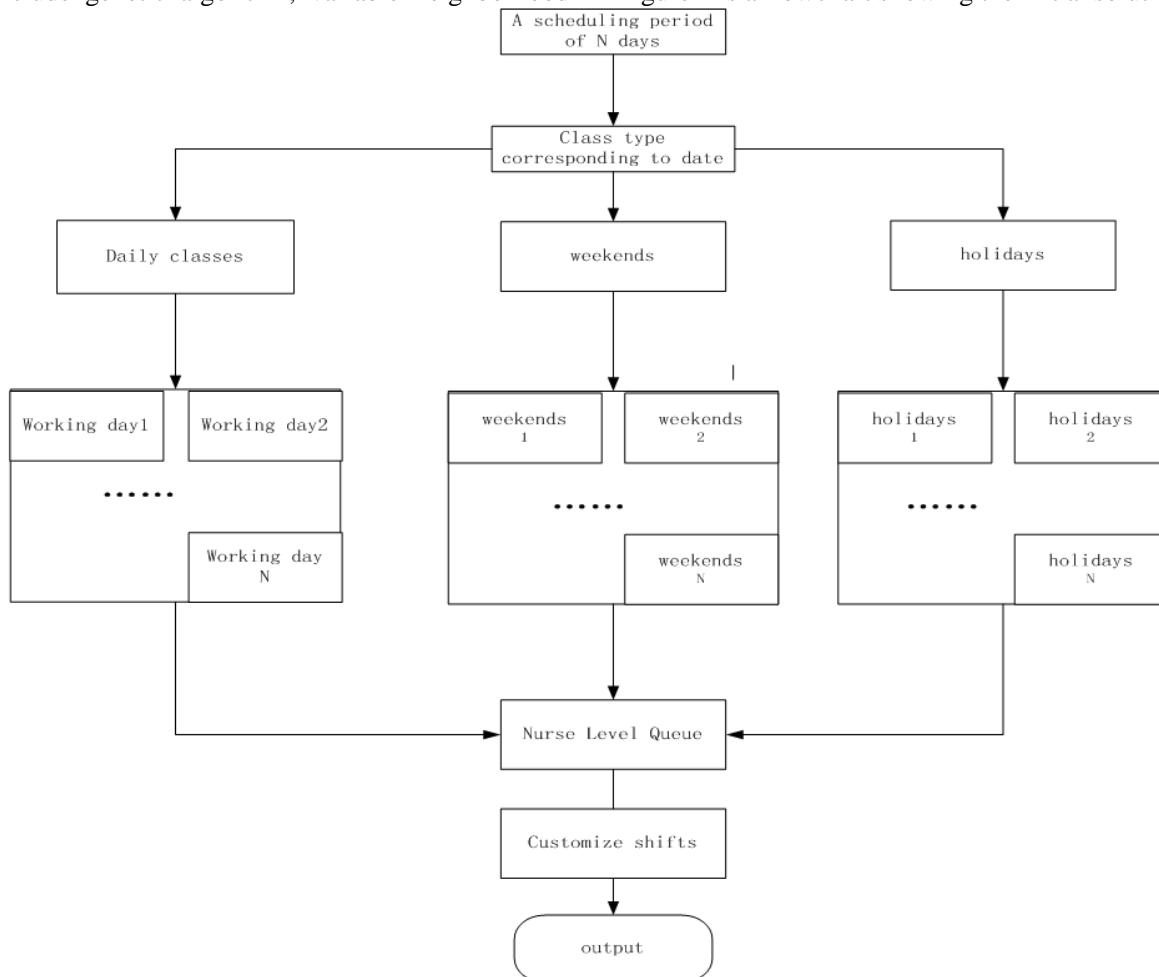


Figure 1. Flow chart of initial solution

Secondly, appropriate neighborhood structure should be constructed, and stopping criteria should be formulated, and then the optimal solution of the region can be obtained based on variable neighborhood search. Usually, the method of variable neighborhood search follows the way of gradient descent or greedy.

When the neighborhood of the region obtains a

better solution than the initial solution, the method of updating and replacing the initial solution is chosen to obtain and maintain the optimal solution in the first neighborhood, and on the basis of the new initial solution, the search of neighborhood is restarted and continued [9].

Finally, it continues until all neighborhood searches are completed and the optimal solution cannot be

changed or replaced.

When the preset termination condition is reached, it marks the end of the algorithm and finally gets the optimal solution. The following Figure 2 is the flow chart of the variable neighborhood search algorithm:

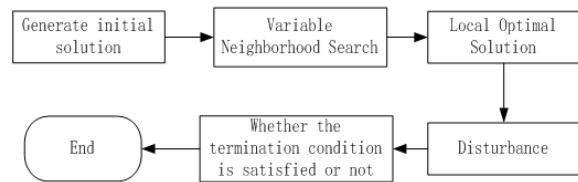


Figure 2. Flow chart of variable neighborhood search algorithm

4. DEFICIENCIES IN PRACTICAL APPLICATION AND SOLUTIONS

4.1. The Insufficiency of Heuristic Algorithm in Nurse Scheduling

On the one hand, in the process of applying heuristic algorithm to actual nurse scheduling, many difficulties and problems will be encountered, which affect the stability of heuristic algorithm. This is a problem that we need to consider and solve at present.

On the other hand, there are many models and constraints for nurse scheduling problem. If the constraints change greatly, it will directly affect the application effect and adaptability of heuristic algorithm, and may affect the solution to achieve the optimal effect.

4.2. Solutions to the Shortcomings of Heuristic Algorithm in Nurse Scheduling

Aiming at the instability of heuristic algorithm in the application of nurse scheduling, the instability of heuristic algorithm can be effectively reduced by designing a matching nurse scheduling system. The heuristic algorithm is incorporated into the design of nurse scheduling system. Nurse scheduling system can include four subsystems for nurses to use in different situations and working nature. The first part is the personal center system, which records the schedule forms and personal data of each nurse. It can realize the marking of the special work needs of nurses, and the declaration and approval of nurses' leave and going out. Real-time record of each nurse's status during work and office content, and also can achieve mail exchanges between superiors and subordinates or ratings. The second part is the scheduling management system, which can realize the work of management personnel, head nurses and nurses such as scheduling browsing, recording, supervision and management. At the same time, it also provides the scheduling rules viewing module. The third part is the system management system, which covers the

management modules of departments, employees, competencies and class models. The fourth part is the statistical report system, which can realize the functions of making and submitting reports for individuals and departments.

At the same time, with the help of modern science and technology and platform, gradually improve the information level of nurses' shift work. More soft constraints can be incorporated to continuously improve the quality and efficiency of nurses' shift scheduling.

5. CONCLUSION

In conclusion, heuristic algorithm is very popular in the application of nurses' shift scheduling, which can optimize the calculation results of nurses' shift scheduling, thus improving the quality and effect of nurses' work order. On the one hand, it can ensure and improve the utilization rate of human resources in hospital units. On the other hand, it can reasonably regulate and guarantee the work and rest rules, work efficiency and work status of all nurses. By establishing the combination of scheduling information automation system and heuristic algorithm, one can better apply heuristic algorithm. Second, it can effectively reduce the cost of manpower and time. Third, it can improve the level of hospital information management and office work. Fourthly, it can effectively meet the requirements of constraints, embody the humanized management concept of nursing shift work, and improve the happiness index and health index of nursing work. Fifth, it can improve the order of nurses' shift arrangement and promote the sustainable development of hospital units.

ACKNOWLEDGMENT

This work is supported by the Key Scientific Research Projects of Henan Province, China (No. 17A110038).

REFERENCES

- [1] Wang Zhuo. Heuristic Algorithms for Machine Redistribution and Multi-Stage Nurse Scheduling. Huazhong University of Science and Technology, 2017.
- [2] Zhou Shuorange. Research on heuristic algorithm for nurse scheduling and design and implementation of scheduling management system. Beijing: Jiaotong University, 2016.
- [3] Feng Kairui, Wang Naiyu, Li Quanwang, Lin Peihui. Measuring and enhancing resilience of building portfolios considering the functional interdependence among community sectors. Structural Safety, 2017, (66): 118-126.
- [4] Feng K., Hou G., Li Q. Evaluating the role of transportation system in community resilience assessment. 12th international conference on applications of statistics and probability in civil

- engineering (ICASP12), Vienna, Austria, 2017, 6-10.
- [5] Zhong Junpei, Lola Canamero. From continuous affective space to continuous expression space: Non-verbal behaviour recognition and generation.4th International Conference on Development and Learning and on Epigenetic Robotics. IEEE, 2014.
- [6] Jiang Y., Yang C., Na J., Li G., Li Y., Zhong J. A brief review of neural networks based learning and control and their applications for robots. Complexity, 2017.
- [7] Zhong J., Weber C., Wermter S. Robot trajectory prediction and recognition based on a computational mirror neurons model. In International Conference on Artificial Neural Networks, Springer, Berlin, Heidelberg 2011, pp. 333-340.
- [8] Zhong J., Cangelosi A., Wermter S. Toward a self-organizing pre-symbolic neural model representing sensorimotor primitives. Frontiers in behavioral neuroscience, 2014 (8): 22.
- [9] Zhong J., Cangelosi A., Ogata T. Toward abstraction from multi-modal data: empirical studies on multiple time-scale recurrent models. In 2017 International Joint Conference on Neural Networks (IJCNN), IEEE, 2017, 3625-3632.

Research on Landscape Design Method Based on Big Data Mining

YuGuo

Xinyang Agriculture and Forestry University, Xinyang, 464000, China

E-mail:Guoyu20004@163.com

Abstract: In this age of continuous expansion and huge data, big data has penetrated into every corner of our lives. There are already many sensors and cameras in the entire city. At the same time, people's demand for intelligent and information-based life is growing. However, the landscape development of China's creative parks is still at an exploratory stage. The performance of landscapes is mostly simple and intelligent. Therefore, the landscape development of the creative park must be closer to people's lives in the context of the big data era, so as to better meet people's new needs.

Keywords: big data analysis; landscape design; design method

1. INTRODUCTION

Landscape is a complex of land and space and objects on land. It is to make a scientific and rational analysis of all human outdoor space problems related to land and seek solutions. With the progress of society and economic development, how to coordinate the relationship between man and nature has become the primary task of gardeners and environmental protection workers [1]. The construction and development of garden green space is an extremely important part of protecting and improving the urban environment. Garden green space plays an irreplaceable ecological service function for other urban landscape elements in maintaining urban ecological balance, purifying and beautifying the urban environment, and maintaining the public's physical and mental health [2]. In the design analysis, the smallest unit can be counted to the individual, and each person's ideological change to treat different issues can be provided through big data. In this way, the content of the landscape analysis can be greatly expanded, and the problem can be analyzed from the perspective of human beings, not just a one-sided one-sided analysis of regional spatial functions [3]. Therefore, the content of its analysis is more diversified, which has a transformative impact on the content of the design analysis. The designer's design needs to accept public opinion, and then design the contents of the landscape design according to the design content most concerned by the public. Big data can help us to understand the situation at that time and use big data analysis to guide the design of landscape architecture with specificity, diversity and timeliness [4].

2. FEATURES OF THE BIG DATA ERA

The amount of data in the era of big data is huge. The amount of data in the world has jumped from TB level to PB, EB and even ZB. According to IBM's research results, 90% of all data obtained in the entire human civilization was generated in the past two years. As new technologies such as social networks, mobile computing, and sensors continue to emerge, big data applications extend to web logs, social media, and sensory data. These big data covers audio, pictures, video, audio, geographic information, analog signals, and so on, truly interpreting the diversity of data. Big data can break through existing technology architectures and routes, efficiently process huge amounts of data, and collect vast information collected through real-time processing and feedback to users.

3. THE APPLICATION OF BIG DATA IN LANDSCAPE DESIGN

3.1. Topographic and Topographic Analysis

Topographic analysis is an important link in landscape planning. Only by grasping the topographic characteristics of the terrain can we make a reasonable layout of different land use in the planning, so as to make the planning more meet the actual situation. The analysis of terrain and terrain requires data acquisition in the planned area. In the analysis of topography in GIS, the planar topographic map of the planned area can be established according to the collected data. On the basis of the planar map, the digital elevation model (DEM) can be established. Through three-dimensional perspective, the terrain can be observed intuitively, and then the corresponding arrangement can be made for different topography. As shown in Figure 1.

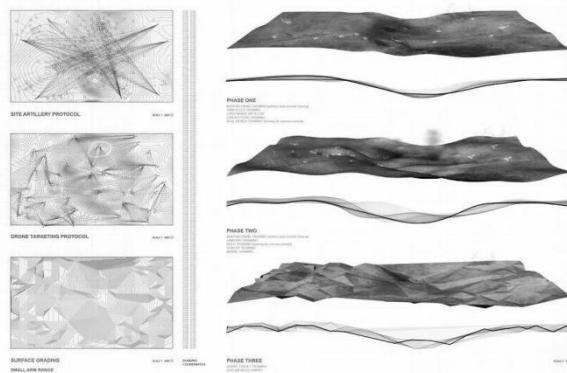


Figure 1. Acquisition of terrain big data

3.2. Planting Analysis

The extensive use of native plants embodies the authenticity of the site, and shows the intention of returning to nature and eco-system completion. Additionally, the site is implanted with new optimized planting system, which helps improve the ecological cycle. Meanwhile, the site specificity is achieved. Wetland planting landscape: eco wetland herbal flora, pieces of kans, reed, Hemarthria compressa, Gramineae Paspalum distichum, water willow and other water plants, adorned in between by drooping willow and poplars which help solidify dam, purify water and beautify

3.3. Slope and Aspect Analysis

Slope and aspect analysis is an important aspect in topographic analysis of planned areas. The gradient of the area directly affects its utilization mode in landscape planning and the consideration of engineering quantity in construction, while the gradient affects the ventilation and lighting of the buildings and the selection and arrangement of plants. Therefore, slope aspect analysis is also an important work in landscape planning. The extension module of 3D analysis in GIS has the function of slope and aspect analysis. Combining it with DEM, the slope and aspect analysis map can be generated, which can provide direct reference for planners in site layout and plant selection.

4. ANALYSIS OF INTELLIGENT LANDSCAPE CONSTRUCTION PROJECT UNDER THE BACKGROUND OF BIG DATA BIG DATA INTEGRATION ANALYSIS CONTENT VISUALIZATION METHOD

The collected big data visualization analysis is a new expression for the landscape analysis problem. Such analysis results will completely break the simple analysis of the traditional regional spatial functions. But for the first time, the analysis results are viewed from the perspective of people. For example, the analysis of people's interest in landscape elements in the region through big data, the extent of road conditions in the region through Google Maps in recent years, and the increase in the area of urban expansion in the region are significant. The analysis of the impact of villages or people's attention on built sites through social comment platforms is a breakthrough in the analysis of the original tradition. To apply the new analysis results based on big data to the landscaped garden analysis, it is necessary to break through the original concept of integrating data and adapt to the concept of analyzing and integrating big data. Traditional data analysis ideas should make three major changes. One is to change the sampling idea. In the era of big data, the sample of data we face is the sum of past data. The sample is the whole. By analyzing all the data related to things, it is not only helpful to understand the whole, but also helps to understand the parts. The second is to change the idea of data measurement, to be willing to accept the data

is noisy, no longer pursuing accurate data. We should accept all sorts of data that are noisy and complicated, and we should not only pursue the accuracy of the data, so as to avoid losing the big ones. For example, for an analysis of the road conditions of a city, it is not possible to simply investigate the recent road conditions, but to look at the road conditions in the past 10 years. Third, it is no longer exploring the elusive causality and instead focuses on the correlation of things. Due to the large scale of data, complex data structures, and intricate data variables, presupposition of causality and analysis of causality are relatively complex. Therefore, when we analyze data in the age of big data, we no longer seek out the difficult-to-follow causality, and instead pay attention to the relationship between things.

4.1. Digital Construction of Green Resources

Use GIS spatial database to manage the spatial information of garden facilities, landscaping data, attribute information and urban topographic maps, and digitize the city's green resources. Therefore, to achieve information at any time, search, query, output, etc., digital management of information, not only can fully reflect the overall situation of urban landscape greening, but also to find out every detail. Conservation patrol grid construction: Make an inspection grid system. Management personnel of various departments of the Garden Management Center can perform user management, metadata management, and rights management through the wood system. Implement GIS graphic browsing, statistics, positioning, query, custom thematic maps, and output of results. Based on garden big data and using advanced technologies such as cloud computing, internet of things, mobile applications, and space geography GIS, we have introduced smart garden related applications and built urban gardens as a modern platform for information sharing and interconnection. Reasonable garden planning and construction can not only create an environment-friendly and ecological natural environment, promote the development of related industries such as tourism and leisure entertainment, but also improve the management and service level of the garden in an all-round way, and establish an important way to establish a famous brand in a city.

4.2. Beijing Bus Credit Card Big Data and Greenway Planning and Design

For example, Beijing bus swiping big data can be combined with greenway planning and design. Bus swiping data is particularly important due to its wide coverage and strong availability. According to the "Beijing Traffic Development Annual Report 2016", in 2017, the proportion of bus trip sharing continued to increase for the 11th consecutive year, and it increased again by 2 percentage points to 44%." Bus passes account for the proportion of bus trips. Above 80%, it can be seen that in big cities such as Beijing, where public transportation is well developed, bus

swiping big data can meet the law of people's travel activities, reflect the spatial distribution of the population, and identify areas where citizens use high frequencies.

Bus vectoring data can be vectorized and visualized in the GIS to obtain the starting point of each bus card. A decision tree can be established based on information such as the time interval, travel time, period, and frequency of two bus rides and card swipes to identify people's travel behavior and the type of travel location. In this way, it is possible to determine the frequency of public use of green spaces such as places of residence, places of employment, business districts, parks, and scenic spots. That is, with the support of big data in public transportation card swipes, it identifies and identifies high-frequency destinations from the perspective of citizens' use. The greenway connecting patches are no longer limited to patches of green space. Instead, the multiple types of land used by the public are uniformly identified. Public facilities sites, employment sites, etc. are also included in the green line selection process, and linear or patchy shapes can be selected.

The mining and analysis of bus card swiping data in Beijing Central City can establish the coupling analysis of the spatial distribution characteristics of the people's travel and potential connection areas of the greenway. We dig these data and use it as the basis for Beijing's greenway route planning, with a view to linking high-use frequency urban space through greenway planning to facilitate citizens to travel through greenways. This will enable the green travel mode to quickly and easily reach a variety of destinations such as business districts, employment sites, public service facilities, and green areas, thereby facilitating the tight layout of urban land. To make use of the advantages of large data volume, rapidity, and high value, it is possible to innovatively use the distribution pattern of urban population travel as the basis for green line selection.

5. RESULT ANALYSIS AND DISCUSSION

5.1. Establishing a Sustainable Appropriate Landscape Evaluation System

In the urban garden green space system planning, the effective way to exert the ecological service function of the garden green space can only rely on the scientific green space structure and layout. There are complex and diverse types of landscape in urban green spaces, and there are significant differences in the environmental adaptability and landscape functions of different landscape types of green space. The constraints of green land landscape types on the land unit include not only the adaptability of the growth and development of garden plants to various environments, but also the coordination and ecological functions of the landscape around the land.

5.2. Degree of Landscape Evaluation System

In the urban green space system planning, the effective way to play the ecological service function

of the green space can only depend on the scientific green space structure and layout. Research has confirmed that there are complex and diverse landscape types in urban green space, and there are significant differences in environmental adaptability and landscape function between different landscape types of green space. There are many constraints on the landscape type of green land on certain land unit, which not only includes the adaptability of landscape plant growth and development to various environmental factors, but also its coordination with the landscape around the site and the requirements of aesthetics and ecological functions of different green landscape types in specific locations. And soil is an important part of the urban ecological environment and one of the basic conditions for urban trees to survive. Soil thickness is a comprehensive reflection of soil development and soil nutrient status, which also has a very important impact to the growth of plant, thus in the study of soil factors are given a high degree of weight. The traditional urban greening quality evaluation index represented by the per capita public green area and urban green space has great limitations. And considering the stability, dominance and operability of evaluation index, in this paper, the evaluation index system of landscape suitability of urban garden greenbelt is constructed.

5.3. Land Suitability Analysis and Evaluation

Land suitability analysis is a widely used theoretical method in landscape planning and site analysis and design. The core of land suitability analysis theory proposed by McHagg is quantitative analysis of natural, political, economic and cultural factors, so as to understand the local situation, existing policies, economic status quo and environmental science. On the basis of appropriate development practices, this paper evaluates the ability of land to be suitable for different development and utilization. Vector layer and raster layer in GIS have the function of overlay analysis, which can satisfy the realization of evaluation.

5.4. Topographic Analysis

Topographic and topographic analysis is an important link in landscape planning. Only by grasping the characteristics of topographic and topographic features can we make a reasonable layout of different sites in the planning, so that the planning can meet the actual situation more. The analysis of terrain and terrain requires data acquisition in the planned area. GIS can be used to analyze the topography of the area to be planned. According to the collected data, the planar topographic map of the planned area can be established. On the basis of the planar map, the digital elevation model (DEM) can be established. Through three-dimensional perspective, the terrain can be observed intuitively, and then the corresponding landscape design arrangement can be made for different terrain.

5.5. Landscape Horizon Analysis

Landscape horizon is very important for planning and design, different visual areas will bring different landscape feelings. The analysis of line-of-sight horizon by using GIS technology can be accomplished through three-dimensional expansion module. The irregular triangular network model can be combined with this function. The surface can be observed from different viewpoints, from one observation point to another, and the raster and vector data can be pasted on the surface to create a real perspective.

5.6. The Analysis of Service Radius and Accessibility of Urban Green Space

Uses the Buffer function of GIS to draw equidistant lines around the analysis objects. Within the range enveloped by the equidistant lines, the straight-line traffic distance from or to the analysis objects is less than the service radius, while outside the envelope area of the equidistant lines, it is larger than the service radius. If this vector-based analysis method is changed to grid-based analysis method, the result of analysis is that the value of each grid is the distance away from the analysis object, which is incremental and continuous from the analysis object at a certain distance. In the city, traffic is generally generated along the road, which is restricted by the direction and speed of the road. Therefore, the network analysis technology based on GIS can be used to generate the isochron limited by the road direction, speed and traffic management. This method considers the calculation of the grid distance of walking speed. The residents' walking speed along the road, walking speed across residential areas, green space and open space are given different weights, and their effects are similar to those of the equal-time service scope.

6. CONCLUSION

The arrival of the era of big data has provided large-scale and high-quality individual space-time distribution data for planning and design, and has become an important basis for early analysis. In this study, big data is applied to the greenway planning, and the accurate travel data of time and space information is used to guide greenway planning and achieve scientific green line selection. At the same time, the greenways are no longer limited to the use of greenbelts in tandem and ecological functions. Green Road has become a carrier based on urban

linear or patchy patches. It has ecological, landscape and cultural functions. At the same time, the green space and the landscape connect the important areas of the city's business districts, residential communities, public service facilities and green spaces, and provide citizens with a green and open space for convenient access. With the support of big data, high-frequency urban space has been incorporated into the patch of greenways, making the greenway meet the daily needs of residents in various aspects and maximizing the green space for residents to travel conveniently. The study found that traditional landscape planning and design mainly rely on subjective rational experience and perceptual creation. Big data can make landscape architecture rely on objective and rational analysis to solve problems. Analyze the huge amount of data in a professional manner and find the right way to deal with intricate problems.

ACKNOWLEDGEMENT

This research has been financed by the Science and Technology Innovation Service Project of Xinyang Agricultural and Forestry College in 2018, "Research on Rural Landscape Planning in Southern Henan of Dabie Mountains" (CXTD-201807).

REFERENCE

- [1] Erdogan S.Z., Bilgin T.T. A data mining approach for fall detection by using k-nearest neighbour algorithm on wireless sensor network data. *IET Communications*, 2013, 6(18):3281-3287.
- [2] Othman M.L., Aris I., Othman M.R., et al. Rough-Set-and-Genetic-Algorithm based data mining and Rule Quality Measure to hypothesize distance protective relay operation characteristics from relay event report. *International Journal of Electrical Power & Energy Systems*, 2011, 33(8):1437-1456.
- [3] Nakayama N., Oketani M., Kawamura Y., et al. Algorithm to determine the outcome of patients with acute liver failure: A data-mining analysis using decision trees. *Journal of Gastroenterology*, 2012, 47(6):664-677.
- [4] Chen C. A Study on Sustainable Riverfront Landscape Design on Design Strategy Based on Ecological Recovery and Context Protection. *Menopause-the Journal of the North American Menopause Society*, 2011, 2(4).

Risks and Control Measures of International Procurement for Process Packages in Engineering, Procurement and Construction of Liquefied Natural Gas Project

Guanjun Xiao, Huishan Cui*

China Petroleum Engineering & Construction Corp. North China Company, Renqiu, Hebei, 062552, China

*E-mail: cuihuishan@cpeccnc.com

Abstract: In the EPC of LNG project, the risk control of international procurement for LNG process package has direct influence to the quality, schedule and cost of the whole project. Taking the international procurement for LNG process package of one LNG project for example, this paper has carried out the case-study for the risk factors existing in the procurement contract, put forward the efficient measures for precaution, and illustrated the emergency and solutions in the implementation phase, aiming to provide objective risk decision basis and solutions for the international procurement projects in oil and gas industry.

Keywords: Liquefied Natural Gas (LNG); Procurement; Engineering Procurement Construction (EPC); risk analysis; control measures; solution

1. INTRODUCTION

The equipment of LNG process package mainly include spiral wounded heat exchanger, MRC compressor package, cryogenic valves, analyzer house, low temperature rebar, resilient felt and others, among which the spiral wounded heat exchanger is the product with core technology. In consideration of the complexity of the process package, and dozens of international suppliers with different technical level, the international procurement of LNG process package [1] has been defined into selection of international bidding agency, procurement of engineering and main equipment in the package by international bidding and international procurement contract signing by foreign trade agency.

In the process of procurement, the selection of bidding agency and foreign trade agency, the confirmation of data and production quality inspection, customs clearance and local commodity inspection have become the key point and the challenge of the whole procurement process. Any problem that occurs in any step will affect the whole procurement process, even affect the normal operation of LNG plant. Thus, it is necessary to carry out the risk analysis of these key procedures and take appropriate measures to guarantee the smooth development of the project.

2. GENERAL RISK ANALYSIS AND CONTROL

MEASURES

2.1. Selection of Bidding Agency

The introduction of process package is within the range of international bidding management of national mechanical and electrical products. If the tenderer is not qualified for independent bidding, it shall entrust one professional international bidding agency to take charge of the bidding. In the selection of bidding agency, the attention shall be paid to the review of qualification and experience of the international bidding agency [2], the control of bidding time and the endeavor for the one-time bidding success.

2.2. Selection of Foreign Trade Agency

In the international procurement of equipment, if the purchaser is not entitled with import and export qualification, it shall entrust one foreign trade agency to sign the contract and take charge of the issues agreed in the contract. The business scope of foreign trade agency is wide, including but not limited to signing the contract, issuing L/C, payment, customs clearance, local commodity inspection and others [3]. The appropriate foreign trade agency will highly promote the efficiency, reduce the procurement cost, and avoid the risk of extra charges arisen due to the agency's unfamiliarity with the import steps of the goods and materials. The contract shall be signed by three parties and with clear prescription of the responsibilities of each party, in convenience of purchaser's management, payment and contact with the supplier of process package [4].

2.3. Risks in Preparation of ITB Documents

The ITB documents are important basis of the bidder's preparation of bidding documents. All the requirements and conditions of procurements shall be embodied in the ITB documents. If the ITB documents are not elaborate and reasonable enough, the bidder's documents may not completely respond the ITB documents, to cause the major deviation in the bidding results [5].

The risks in preparation of ITB documents can be avoided from the following aspects.

- a. Definition of the scope of contract. The contract for equipment and materials and the contract of technical services shall be signed individually, so as to avoid

the collection of customs and added-value-tax to the technical service charges and the extra project cost [6].

b. Confirmation of field services. The field services shall include the inspection of the equipment arrived, installation guidance, commissioning of single equipment, joint commissioning, training, and others, as well as the supplier's presence at site when equipment failure (not caused by the supplier). The ITB documents shall make clear the quantities of field services, time, charges for service exceeding the time limit, the validity of the service charge, accounting method of field services, the unit price of the service exceeding the time limit and the related default clauses of field services [7].

c. Determination of guarantee period. The guarantee period of process package introduced shall be same to the one of EPC contract. If there are any requirements, the guarantee period of process package shall be later than the time of mechanical completion [8].

2.4. Data Confirmation and Quality Inspection

The purchaser shall confirm the drawings and specifications issued for construction. The large deviation in the data confirmation will not only cause the increase of project cost but also delay the project schedule. Based on the contract and ITB documents, the data shall be submitted as per the agreed plan, and its contents shall be confirmed that there is no substantial technical deviation from the ITB documents, and that no charges will be caused [9].

The purchaser shall dispatch profession engineer or third party inspection agency to carry out the supervision and inspection in the foreign factory. Due to the large quantities of goods and materials, the risks shall be avoided which are brought to the supervision and inspection by limited time, lack of preparation before inspection and sampling. The inspection shall be carried out to the key and core equipment and materials having larger influence to the project and goods & materials with complicated structure & process and more quality control points [10,11].

2.5. Schedule Control of Customs Clearance

To ensure the smooth and efficient operation of customs clearance, the purchaser shall enhance the schedule control of the customs clearance from the following aspects [4].

a. Specialist shall be assigned by the purchaser to be responsible for the expediting, reception, handling, reply of the documents for customs clearance submitted by the foreign trade agency;

b. The foreign trade agency shall complete the preparation of documents required by customs clearance in advance, and submit the documents to the purchaser before the arrival of the goods, within the agreed time in the Agency Service Contract;

c. After the arrival of the goods at the seaport, the specialist shall supervise the schedule of customs clearance submitted by the agency, fill in the schedule

management logbook of goods customs clearance.

d. The specialist shall timely check the schedule and make spot check at the seaport to ensure the schedule of customs clearance.

e. The specialist shall pay more attention to the payment of customs duties, added-value tax and port surcharges. The purchaser shall finish the approval of internal finance and the payment to the customs clearance company within 2 days of the payment application.

2.6. Local Commodity Inspection

The local commodity inspection has some regionalism, so more attention shall be paid to some special requirements. The commodity inspection shall be carried out with advance contact with the inspectors according to the goods transportation status to ensure the timely arrival of the inspectors at the arrival of the goods.

The foreign trade agency shall be responsible for submitting the project construction report to the local commodity inspection authorities within 30 days after the signing of the process package contract, informing the project status and the estimated arrival plan of the goods at the seaport, appointing the estimated arrival date with the local commodity inspection authorities two days before the planned finish time of customs clearance, and carrying out the commodity inspection at the arrival date of the goods. The foreign trade agency contract shall make clear the agency's responsibility of coordination and organization of the commodity inspection, the payment for the commodity inspection services, and the settlement of the service charges.

3. TEMPORARY EVENTS AND SOLUTIONS IN THE PROCUREMENT IMPLEMENTATION

3.1. Unmatched Information of Airway Bill for Goods

The goods by air shipment has included various loosely miscellaneous accessories (O shaped seal ring, gas seal ring, gas relay, pressure relay and others). There are various types of good and materials transported, but the invoice of the supplier has only shown the generic terms of these accessories. However, the customs requires that the invoice and the B/L shall show the details and description of all the commodities, and some of them shall be certified by CCC, or these commodities will be deemed to be smuggled.

The purchaser shall require the suppliers to revise the invoice, details of the airway bill and their description in schedule time, select the experienced foreign trade agency and customs clearance company, control the detail of transportation and customs clearance in the contract, and avoid the risk brought by the delay of the clearance time caused by the incomplete.

3.2. Larger Size of the Actual Commodity than in the Contract

The actual weight, size and quantities of some commodities are quite different from the ones in the contract, some of which may have deviation over

15% as shown in Table 1. There are no clauses in the commercial contract that explicitly stipulated the duties for oversize of the commodities, which will cause the increase of the transportation cost. (Please refer to Table 1 on the next page for the further details)

Table 1. Details of commodities transported with larger size

Batch NO.	Category	Package NO.	Weight in Contract (t)	Actual Weight (t)	Package Size in Contract (m ³)	Actual Package Size (m ³)
NO.9	Motor	K77-k80	36.1	45.43	36.287	83.591
	Frequency Converter	K104-110, 134	16.5	19.283	82	107.087
	Transformer	K81-k103	65	77.269	155.232	152.968
	23E01 pre-condenser	K131	70.5	69.4	211.33	409.978
	23E03 subcooler	K133	15.5	15.02	42.549	120.633
In Total			203.6	226.402	527.398	874.257
Actual Increase on the Contract				22.802		346.859
NO.10	Compressor	K111-130	40	144.424	41	497.031

When signing the contract with the supplier, the purchaser shall explicitly stipulate the duties for oversize of the commodities in the contract, in order to reduce the extra transportation cost brought by the oversize of the commodities.

In the shipment contract of the import commodities, the commodities shipped in containers shall be charged by containers with fixed unit price for the shipment of the container, while for LCL and bulk cargo, the unit price shall be determined by the weight and size provided by the supplier, in order to avoid the risks of transportation cost increase brought by the oversize of the actual commodities.

3.3. Maintenance and Storage of Commodities Kept at Site for Long Time

Due to the problem of upstream gas source, schedule of the project construction has been delayed, thus the compressors, motors, spiral wounded heat exchangers and related instrumentation and electrical equipment has arrived at site one year before the construction schedule as per the procurement schedule and contract. This has influenced the maintenance, storage and commissioning after installation.

The purchaser shall require the supplier to provide the maintenance and storage requirements of the equipment in one to years and quote the related cost increased. Meanwhile, the contract with the Owner shall clearly shown that the Owner shall bear the cost caused by the maintenance and storage of equipment kept at site for long time due to the Owner's fault, in order to avoid the risks of cost increase brought by long-time stay of the equipment at site.

4. CONCLUSION

Based on the previous procurement experience, this paper has carried out the analysis of risks of the selection of bidding agency, selection of foreign trade agency, data confirmation, quality inspection, customs clearance, local commodity inspection and other key steps, made up the control measures, to provide references for the procurement of LNG process package and other similar goods and materials.

REFERENCES

[1] China Petroleum Engineering & Construction

Corp. North China Company. Core technology of project management in LNG project, 2017, pp. 1-2.

[2] Supervision and management rules for international bidding agency of mechanical and electrical products (trial), 2017, (18): 48-52.

[3] Zhong J., Cangelosi A., Zhang X. and Ogata T. AFA-PredNet: The action modulation within predictive coding. In 2018 International Joint Conference on Neural Networks (IJCNN), IEEE, 2018, pp. 1-8.

[4] Zhong J., Cangelosi A., Ogata T. and Zhang X. Encoding Longer-Term Contextual Information with Predictive Coding and Ego-Motion. Complexity, 2018.

[5] Zhong J., Cangelosi A. and Ogata T. Toward abstraction from multi-modal data: empirical studies on multiple time-scale recurrent models. In 2017 International Joint Conference on Neural Networks (IJCNN), IEEE, 2017, pp. 3625-3632.

[6] Zhong J., Cangelosi A. and Wermter S. Toward a self-organizing pre-symbolic neural model representing sensorimotor primitives. Frontiers in behavioral neuroscience, 2014, 8: 22.

[7] Zhong J., Weber C. and Wermter S. Robot trajectory prediction and recognition based on a computational mirror neurons model. In International Conference on Artificial Neural Networks. Springer: Berlin, Heidelberg, 2011, pp. 333-340.

[8] Chen X.S. Research on the transition of Chinese foreign trade agency, 2016.

[9] Wang Y.G. Discussion of basic procedures of custom clearance for imported equipment. Golden Hill, 2011, 3: 132-133.

[10] Feng K., Hou G., and Li Q. Evaluating the role of transportation system in community resilience assessment. In 12th international conference on applications of statistics and probability in civil engineering (ICASP12), Vienna, Austria. 2017, pp. 6-10.

[11] Feng Kairui, Wang Naiyu, Li Quanwang, and Lin Peihui. Measuring and enhancing resilience of building portfolios considering the functional interdependence among community sectors. Structural Safety, 2017, 66: 118-126.

Style Learning Algorithm Based on Deep Learning

Xinpeng Luo*, Yi Yang, Chenjun Du

New Media College, Communication University of Zhejiang, Hangzhou, China

*E-mail: 337834783@qq.com

Abstract: Aiming at the problem that traditional style transfer algorithm cannot recognize all style images and low efficiency, this paper introduces a style transfer algorithm based on deep learning. The algorithm uses VGG model to extract the high-level abstract feature representation of content image and style image, and then generates the composite image with original content and new style through iterative optimization from the random noise image. Finally, this paper uses python to implement and experiment the algorithm, and the results show that it has a good portability, breaking the previous style migration which can only be applied to a specific picture, and greatly improve the efficiency of the whole process.

Keywords: style transfer; deep learning; VGG

1. INTRODUCTION

With the continuous upsurge of artificial intelligence, style transfer has quickly become one of the hot topics in the field of artificial intelligence research. Image style transfer is a technique for converting picture styles, using this technology, which can easily make ordinary photos have a strong sense of art and artistic effect. In simple terms, style transfer is to input a set of photos and extract its content features but not its texture features. Then select the image you want to achieve the artistic effect (such as the work of art) and extract the texture features without content features. Image style transfer technology can be used to combine the content of one photo with the style of the other to produce the desired style. Nowadays, there is great enthusiasm and concern for image style transfer at home and abroad.

Aiming at traditional style transfer can only identify a single image content as well as the limitations of extremely complicated manual modeling, the style migration algorithm is proposed based on convolutional neural network, which achieves through iterative optimization scheme to generate with a specified content and image. This method can be applied to any one group of pictures which implements the traditional style migration can only be applied to a specific image.

2. RELATED WORK

Style transfer is not a new concept and has been studied for decades. The most important idea of traditional image style transfer is to use the statistical model of local features to describe the overall image style [1]. Therefore, most of them first analyze the

images of a certain style, and then build a mathematical or statistical model for the images of this style, and finally change the image to be migrated to make it more consistent with the model to be built. So the traditional image style migration technique can only simple processing of image texture and color, and the migration of this style is for a particular style, that is, a program can only handle a scene or a style which has a bad application portability. At the same time, the traditional style migration modeling method adopts manual modeling, which is inefficient, and it is unimaginable for the program to imitate a picture arbitrarily. With the development of neural network, a new deep convolutional network structure VGG-Net [2] was developed in 2014 by the computer vision group of Oxford University and researchers from Google Deep Mind. This kind of convolutional network has more concise structure, deeper layers and lower error rate. How to separate the object image features and realize the fusion with the target image structure is the technical difficulty and emphasis. Gatys and his colleagues first proposed the concept of style transfer algorithm based on neural network in 2015, and published a paper on CVPR in 2016. They found that the convolutional neural network could be used to separate the image content from the image style, and then the style transfer could be realized by processing these high-level abstract feature representations. Compared with the traditional style transfer, this method has more ideal artistic effect, but it solidifies the transfer style and content and is not flexible enough.

3. STYLE LEARNING ALGORITHM BASED ON DEEP LEARNING

In this paper, the style migration algorithm is based on the VGG-19 network. The VGG model is used to extract the high-level abstract feature representations of the content image and the style image respectively. Then, starting from the random noise image, the composite image with the original content and the new style is generated by iterative optimization. The algorithm can be applied to any set of images, breaking the limitations of previous style migrations that can only be applied to a particular image.

It can be seen from Figure 1 that the VGG19 network includes five convolution groups, each convolution group is composed of multiple convolution layers and pooling layers. After the picture passes through the 5 convolution groups of VGG19, the height and width

of the obtained feature map gradually become smaller, but the feature depth of the acquired picture gradually becomes deeper [3].

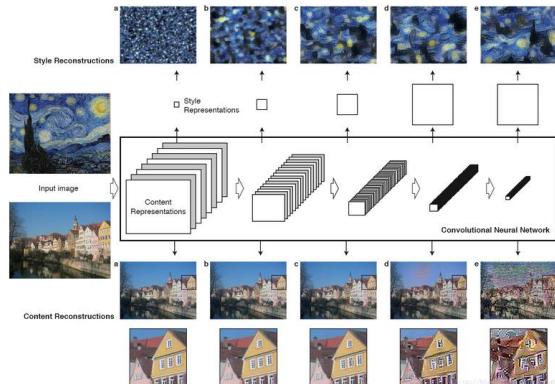


Figure 1. Reconstructing the convolutional network layer of the picture

The convolutional graphics network separates the image into a content abstract feature representation and a style abstract feature representation. At the time of crawling, the high-level neural network captures the style distribution of the image, collects colors and textures, and the underlying neural network captures the content portion of the image to grasp the details. In the process of style migration, you need to enter two images respectively. A style picture, recorded as \vec{a} ; a picture of the content is recorded as \vec{p} ; a white noise picture. The VGG19 network extracts the content and style in the content image and the style image, and builds a convolutional neural network that can generate a composite image. It is necessary to iterate continuously on the noise picture until a composite picture that combines style and content is obtained [4].

The content picture \vec{p} passes through the five convolutional layers of the VGG19 network, and the feature map is obtained at each layer, which is recorded as \vec{p}^l , the feature obtained by the 1st convolutional layer. The feature of the noise picture \vec{x} obtained through the 1st convolutional layer is recorded as \vec{F}^l . Define the loss function as follows:

$$Locntent(\vec{P}, \vec{a}, l) = \frac{1}{2} \sum_{i,j} (F_{ij}^l - P_{ij}^l)^2 \quad (1)$$

\vec{F}^l The Gram matrix is recorded as \vec{G}^l , the color and texture features of the style image stored in the Gram matrix to establish the style loss function. The Gram

matrix of the style picture \vec{x} is recorded as

\vec{A}^l . Calculate the Euclidean distance between \vec{G}^l and \vec{A}^l , the Gram matrix is $G_{ij}^l = \sum_k F_{ik}^l F_{jk}^l$. The layer style loss function is:

$$E_l = \frac{1}{4N_L^2 M_L^2} \sum_{i,j} (G_{ij}^l - A_{ij}^l)^2 \quad (2)$$

The total loss function of the style is:

$$L_{style} = \sum_{l=0}^L w_l E_l \quad (3)$$

The total loss is the linear sum of content loss and style loss. α and β are the weight coefficients of the content picture and the style picture. Changing the proportion of α and β can adjust the proportion of content and style:

$$L_{total}(\vec{p}, \vec{a}, \vec{x}) = \alpha L_{content}(\vec{p}, \vec{x}) + \beta L_{style}(\vec{a}, \vec{x}) \quad (4)$$

This paper mainly uses the Python scripting language and its rich class library and deep learning-based style migration under the deep learning Tensorflow framework. You can combine different content images and different style images to make the original image have a new style without destroying the content.

4. METHOD AND EXPERIMENT

This experiment is built under the framework of deep learning Tensorflow. The style migration algorithm based on VGG-19 network is realized by Python language. The entire algorithm principle is divided into three Python files: neural_style.py, stylize.py and vgg.py.

Neural_style.py: mainly used to store external interface functions, defines the main parameters of the function and the default values of some parameters, including reading and storing the image, resizing the input image, assigning weights, etc. And the resize image is passed to stylize.py. Some parameters related to the experiment are defined in this file, such as the number of iterations of the training model, the file path, etc., as shown in Figures 2 and 3:

```
# default arguments
CONTENT_WEIGHT = 5e0
CONTENT_WEIGHT_BLEND = 1
STYLE_WEIGHT = 5e2
TV_WEIGHT = 1e2
STYLE_LAYER_WEIGHT_EXP = 1
LEARNING_RATE = 1e1
BETA1 = 0.9
BETA2 = 0.999
EPSILON = 1e-08
STYLE_SCALE = 1.0
ITERATIONS = 100
VGG_PATH = 'imagenet-vgg-verydeep-19.mat'
POOLING = 'max'
```

Figure 2. Neural_style.py

```

def build_parser():
    parser = ArgumentParser()
    parser.add_argument('--content',
                        dest='content', help='content image',
                        metavar='CONTENT', required=True)
    parser.add_argument('--styles',
                        dest='styles',
                        nargs='+', help='one or more style images',
                        metavar='STYLE', required=True)
    parser.add_argument('--output',
                        dest='output', help='output path',
                        metavar='OUTPUT', required=True)
    parser.add_argument('--iterations', type=int,
                        dest='iterations', help='iterations (default=%(default)s)',
                        metavar='ITERATIONS', default=ITERATIONS)
    parser.add_argument('--print-iterations', type=int,
                        dest='print_iterations', help='statistics printing frequency',
                        metavar='PRINT_ITERATIONS')
    parser.add_argument('--checkpoint-output',
                        dest='checkpoint_output',
                        help='checkpoint output format, e.g. --output_{:05}.jpg or --output_{:05d}.jpg',
                        metavar='OUTPUT', default=None)
    parser.add_argument('--checkpoint-iterations', type=int,
                        dest='checkpoint_iterations', help='checkpoint frequency',
                        metavar='CHECKPOINT_ITERATIONS', default=None)
    parser.add_argument('--progress-write', default=False, action='store_true',
                        help='write iteration progress data to OUTPUT's dir',
                        required=False)
    parser.add_argument('--progress-plot', default=False, action='store_true',
                        help='plot iteration progress data to OUTPUT's dir',
                        required=False)
    parser.add_argument('--width', type=int,
                        dest='width', help='output width',
                        metavar='WIDTH')

```

Figure 3. Neural_style.py

```

def stylize(network, initial, initial_noiseblend, content, styles, preserve_colors, iterations,
           content_weight, content_weight_blend, style_weight, style_layer_weight_exp, style_blend_weights, tv_weight,
           learning_rate, beta1, beta2, epsilon, pooling,
           print_iterations=None, checkpoint_iterations=None):
    shape = (1,) + content.shape
    style_shapes = [(1,) + style.shape for style in styles]
    content_features = {}
    style_features = [{}, {} for _ in styles]

    vgg_weights, vgg_mean_pixel = vgg.load_net(network)

    layer_weight = 1.0
    style_layers_weights = {}
    for style_layer in STYLE_LAYERS:
        style_layers_weights[style_layer] = layer_weight
        layer_weight *= style_layer_weight_exp

    # normalize style layer weights
    layer_weights_sum = 0
    for style_layer in STYLE_LAYERS:
        layer_weights_sum += style_layers_weights[style_layer]
    for style_layer in STYLE_LAYERS:
        style_layers_weights[style_layer] /= layer_weights_sum

    # compute content features in feedforward mode
    g = tf.Graph()
    with g.as_default(), g.device('/cpu:0'), tf.Session() as sess:
        image = tf.placeholder('float', shape=shape)
        net = vgg.net_preloaded(vgg_weights, image, pooling)
        content_pre = np.array([vgg.preprocess(content, vgg_mean_pixel)])
        for layer in CONTENT_LAYERS:
            content_features[layer] = net[layer].eval(feed_dict={image: content_pre})

```

Figure 4. Stylize.py

```

VGG19_LAYERS = (
    'conv1_1', 'relu1_1', 'conv1_2', 'relu1_2', 'pool1',
    'conv2_1', 'relu2_1', 'conv2_2', 'relu2_2', 'pool2',
    'conv3_1', 'relu3_1', 'conv3_2', 'relu3_2', 'conv3_3',
    'relu3_3', 'conv3_4', 'relu3_4', 'pool3',
    'conv4_1', 'relu4_1', 'conv4_2', 'relu4_2', 'conv4_3',
    'relu4_3', 'conv4_4', 'relu4_4', 'pool4',
    'conv5_1', 'relu5_1', 'conv5_2', 'relu5_2', 'conv5_3',
    'relu5_3', 'conv5_4', 'relu5_4'
)

def load_net(data_path):
    data = scipy.io.loadmat(data_path)
    if 'normalization' in data:
        # old format, for data where
        # MDS(imagenet-vgg-verydeep-19.mat) = 8ee3263992981a1d26e73b3ca028a123
        mean_pixel = np.mean(data['normalization'][0][0][0], axis=(0, 1))
    else:
        # new format, for data where
        # MDS(imagenet-vgg-verydeep-19.mat) = 106118b7cf60435e6d8e04f6a6dc3657
        mean_pixel = data['meta']['normalization'][0][0][0][2][0][0]
    weights = data['layers'][0]
    return weights, mean_pixel

```

Figure 5. Vgg.py

Stylize.py: Read the style image, and input the image conversion network to calculate the converted image, input the original image, the style image, and the converted image into vgg.py to calculate the loss function, and include some training, optimization and other processes. As shown in Figure 4:

Vgg.py: Defines the network model and related operations for extracting the style features of the image to be extracted. After using the code below, vgg.py reads the VGG-19 neural network for constructing the Neural Style model. This model has been trained on a very large image dataset, so the network has been able to identify many low-level and high-level image features. The content picture is input to the network, and the output value of the content picture on the network designation layer (such as ['conv4_2', 'conv5_2']) is calculated. As shown in Figure 5:

Figure 6a is the work of Picasso, the content of the picture of Figure 6b is extracted and merged to obtain Figure 6c.

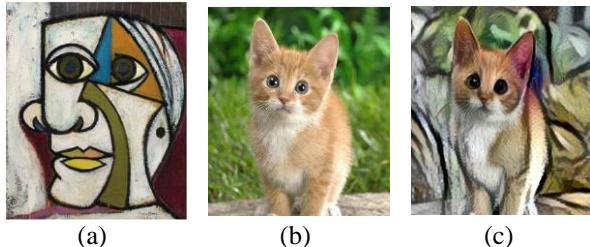


Figure 6. The effect of the style migration algorithm based on VGG-19 network. (a) The work of Picasso
(b) Pictures of the content being extracted
(c) Synthetic picture

5. CONCLUSION

This paper first begins with the development of artificial intelligence and painting art, introduces the limitations of traditional style migration, and leads to style migration based on deep learning. From the algorithm principle to the system implementation, a complete reference is given. At present, style migration based on deep learning not only has potential to be underestimated in many fields, but also its own algorithms are constantly breaking through and optimizing. For example, a quick style migration can quickly generate images with different effects, which can be applied later in the design direction of the video. At the same time, the style migration

algorithm can reduce the amount of manpower and time compared to the traditional way of artistic creation, which brings convenience to all parties and helps to inspire new ideas. It is believed that with the improvement of GPU computing power and the rapid development of deep learning, coupled with people's pursuit of aesthetics and efficiency, style migration based on deep learning will have a longer-term development [4].

ACKNOWLEDGEMENT

Supported by “College Students Innovation and Entrepreneurship Training Program” (Grant No. 201811647001).

REFERENCES

- [1] Jianmao Huang. Application of Style Migration Algorithm of Convolutional Neural Networks in Scene Processing. *Journal of Yibin University*, 2018, (12).
- [2] Simonyan K., Zisserman A. Very Deep Convolutional Networks for Large-Scale Image Recognition. *Computer Science*, 2014.
- [3] Jie Pan, Xuesong Wang, Yuhu Chen. Multi-source color migration based on active contour exploration. *Journal of Automation*, 2014, 40(4): 713-720.
- [4] Gatys L.A., Ecker A.S., Bethge M.A. Neural Algorithm of Artistic Style. *Computer Science*, 2015.

Carbon Temperature Dynamic Prediction Model Based on Macquarie Algorithm

Wei Yuan^{1,2}, Jinhong Chen^{1,3}, Daimo Wang⁴, Xiaoqiang Guo^{5,*}

¹North China University of Technology Mathematical Modeling Innovation Laboratory, North China University of Technology, Tangshan, 063210, China

²Yisheng College, North China University of Technology, Tangshan, 063210, China

³College of Metallurgy and Energy, North China University of Technology, Tangshan, 063210, China

⁴College of Architecture and Engineering, North China University of Technology, Tangshan, 063210, China

⁵College of Mechanical Engineering, North China University of Science and Technology, Tangshan 063210, China

*E-mail: 525427149@qq.com

Abstract: In order to break through the technical bottleneck of small and medium-sized converter steelmaking, and realize the de-capacity and green manufacturing, this paper focuses on the control error of the accurate hit of the intelligent steelmaking end point of small and medium-sized converters, and uses the Macquarie algorithm to study it. First, the collected data is processed, and the duplicate data is deleted to ensure the reliability of the data. Secondly, the linear model is used to curve the data, and the relationship between PQ, Q, [CO], [CO₂] and [C] & [T] is explored. Finally, the Macquarie algorithm is used to fit the function parameters and utilize The 1stOpt software solves the problem to minimize the sum of squared residuals and achieve the best fitting effect, so as to solve the values of the respective variables, and obtain the prediction model expressions of carbon content and temperature respectively, which provides theoretical support of high hit rate for the intelligent steelmaking end point of small and medium-sized converters.

Keywords: the accurate hit of the steelmaking end point; curve fitting; Macquarie algorithm; carbon content; temperature

1. INTRODUCTION

At present, there are more than 500 small and medium-sized converters under 100 tons in China, accounting for about 50% of the national steelmaking capacity. These converters play an important role in local steel enterprises. Because the sub-gun system cannot be installed in small and medium-sized converters, the end-point control hit rate is low, and it faces the coupling pressure of “de-capacity, green manufacturing and market competition”.

The key to realize the intelligent steelmaking of small and medium-sized converters lies in the accurate hit of the steelmaking end point. The key parameters of the end point hit are the carbon content in the molten steel and the temperature of the molten steel. The traditional medium and small converter steelmaking end point prediction is based on the static mechanism of physical chemical reaction. The control model

causes control errors due to the long distance between the control start and end points. The control main body of the large-scale converter dynamic control system is also a static control model. The dynamic control process is to dynamically detect the carbon content and temperature value in the later stage of steelmaking by the sub-gun system, input the detected value into the static control model, and correct the calibration static in real time. The control curve ultimately achieves a high hit rate at the steelmaking end point.

The dynamic control of converter flue gas analysis is to calculate the instantaneous decarburization rate and decarburization amount of the molten pool by continuously detecting the flue gas components (CO, CO₂, N₂, O₂, Ar, H₂) and flue gas flow generated in the converter blowing. According to the instantaneous oxygen supply amount and the amount of slag added, the distribution ratio of oxygen in C, Si, Mn, P, S and other elements is calculated, and the content of each element in the molten pool and the slag composition are derived. Whether it is possible to use the data processing methods such as statistics and machine learning to deeply mine the steelmaking process data collected by the flue gas analysis system, and obtain a robust carbon temperature dynamic prediction model is a key issue, and it is also a key technology in practice. This paper collects data sample sets that can be collected by the flue gas analysis system, explores the relationship between PQ, Q, [CO], [CO₂] and [C] & [T], and builds [C] & [T] forecast model based on smoke components.

2. MODEL ESTABLISHMENT AND SOLUTION

2.1. Data Preprocessing

There are a lot of duplicate data in the dataset, but because in the actual steelmaking process, it is impossible to have exactly the same data due to temperature and the like, which may be the data duplication caused by the experimental verification error, so the duplicated data in Annex I is deleted. Finally, 203 sets of data were obtained. According to the actual situation, the [CO] and [CO₂] index values in the data table and the other few index values are

synchronously corresponding in time, but there is a certain delay in the actual reflection. That is to say, the two indicators [CO] and [CO2] currently collected reflect the molten pool information at the previous time or the first few moments, and the delay phenomenon of such index values exists and is difficult to avoid. Therefore, when we build a predictive model, we do not consider the delay and allow it to exist as long as it does not have a significant impact on the final outcome of each forecast.

2.2. Model Establishment and Solution

The key to realize the intelligent steelmaking of small and medium-sized converters lies in the accurate hit of the steelmaking end point. The key parameters of the end point hit are the carbon content and the molten steel temperature value in the molten steel [1]. The prediction model is to solve the carbon content and the molten steel temperature value in the molten steel during the intelligent steel making process. Predict the basis of the problem, in order to break through the technical bottleneck of small and medium-sized converter steelmaking, and open up small and medium-sized converter intelligent steelmaking. The data was analyzed and a linear model was established for curve fitting to predict the carbon content and molten steel temperature in the molten steel. The mathematical expression of the model is:

$$y_1 = a_1x_1 + b_1x_2 + c_1x_3 + d_1x_4 \quad (1)$$

$$y_2 = a_2x_1 + b_2x_2 + c_2x_3 + d_2x_4 \quad (2)$$

The dependent variable y_1 is the carbon content [C] in the molten steel, y_2 is the molten steel temperature value [T]; the independent variables x_1 , x_2 , x_3 , x_4 are the oxygen consumption ratio - PQ and the total oxygen consumption - Q, The CO content in the flue gas - [CO]. The CO2 content in the flue gas - [CO2], respectively. where the unknowns are the coefficients of the respective variables.

2.3. Model Solution

Solve the values of the respective variables, mainly using the Macquarie method of function parameter fitting. The following is a brief introduction to this algorithm:

(1) Macquarie algorithm

The Macquarie algorithm, also known as the *LM* algorithm, is mainly used to solve the least squares problem [2], and is mostly used for curve fitting. The main principle is to use the iterative procedure [3] to estimate whether the best fitting effect is achieved by calculating the sum of the squares of the residuals. When the sum of the squares of the residuals is the smallest, the iteration ends and the optimal fitting result is obtained.

Objective function

$$X^2(a) = \frac{1}{N-P} \sum_i \sum_j [y - f_{ij}(x_{li}x_{2i}, \dots, a_1, a_2, \dots)]^2 \quad (3)$$

Where X^2 is the sum of squared residuals; N is the total number of experimental points; P is the number of parameters.

According to the least squares method, the objective function should satisfy the smallest sum of squared errors, that is,

$$y = \min X^2(a) \quad (4)$$

Expand X^2 into a second-order Taylor series and omit high-order terms:

$$X^2(a) = \gamma + \frac{\partial X^2}{\partial a_k} + \frac{1}{2} a \cdot D \cdot a \quad (5)$$

Where D is a Hessian matrix and a is a parameter, $k=1,2,\dots,m$. The LM algorithm makes the parameter a_{cur} of this iteration infinitely close to the optimal parameter a_{min} through multiple iterations, namely:

$$a_{min} = a_{cur} + D^{-1}[-\nabla X^2(a_{cur})] \quad (6)$$

Model solving

For this problem, using the Macquarie algorithm is to require the minimum of the following formula

$$X^2(a,b,c,d) = \frac{1}{203-4} \sum_i [y'_i - y_i(a,b,c,d,x)]^2 \quad (7)$$

Get the optimization problem

$$\min X^2(a,b,c,d) \quad (8)$$

Solve the above problem with 1stopt software:

Table 1. Data collected by the flue gas analysis system

PQ	Q	[CO]	[CO2]	[C]	[T]
0.7013	2254.3100	64.3400	9.7500	1.1578	1433.9090
0.7028	2259.0700	63.7600	9.8200	1.1523	1434.7196
0.7043	2263.8300	63.4300	9.9900	1.1467	1435.5302
0.7058	2268.6000	63.4300	10.0100	1.1410	1436.3426
0.7073	2273.3600	63.0400	10.1100	1.1352	1437.1532
0.7087	2278.1000	63.0500	10.1100	1.1295	1437.9604
0.7102	2282.8100	62.3400	10.2300	1.1237	1438.7625
.....
0.9959	3201.2300	40.2300	14.5500	0.0675	1595.1695
0.9973	3205.6200	39.7100	14.5400	0.0655	1595.9171
0.9987	3209.9600	39.3100	14.5500	0.0635	1596.6562
1.0000	3214.2800	39.2800	14.5500	0.0616	1597.3919

The data of the four independent variables x are as shown in Table 1, and the above known quantities and the formulas (1)-(3) are implemented in the 1stOpt software using the Macquarie algorithm.

For the carbon content [C] prediction in molten steel, global optimization using 1stOpt software [4].

Obtaining the optimization results of the four independent variables Table 2:

Table 2. Optimization Results Table

Parameter	Best estimate
a_1	0.0229230611017383
b_1	-0.00106003032784488
c_1	0.032550101776134
d_1	0.133629450702696

The fitting figure of the carbon content prediction parameter of Figure 1 is obtained as follows

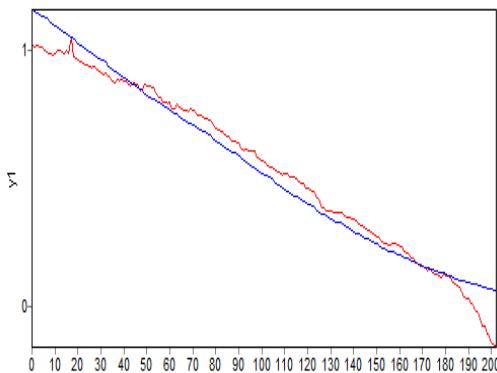


Figure 1. Annex I carbon content prediction parameter fitting map

For the prediction of molten steel temperature value [T], global optimization is performed using 1stOpt software. The optimization result of the four independent variables is shown in Table 3.

Table 3 Optimization Results Table

parameter	Best estimate
a_2	3.99673189762705
b_2	0.218602208105028
c_2	9.06185316790625
d_2	33.9940219335553

The temperature prediction parameter fitting graph of Figure 2 is obtained as follows

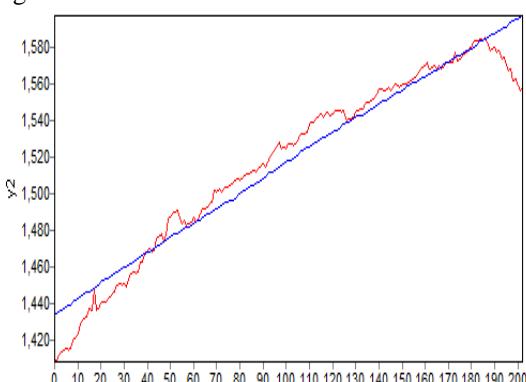


Figure 2. Annex I temperature prediction parameter fitting map

Error analysis of optimal results

From the results calculated by the 1stOpt software, the measured value $y(i)$ of the carbon content and temperature and the calculated value $y'(i)$ are extracted, as shown in Table 4.

Table 4 List of measured and calculated values of carbon content and temperature

No	Measured value y_1	Calculated value y_1	Measured value y_2	Calculated value y_2
1	1.1578	1.0236	1433.9090	1410.0814
2	1.1523	1.0091	1434.7196	1408.2516
3	1.1467	1.0160	1435.5302	1412.0868
4	1.1410	1.0137	1436.3426	1413.8154
5	1.1352	1.0093	1437.1532	1414.7272
6	1.1295	1.0047	1437.9604	1415.8596
7	1.1237	0.9926	1438.7625	1414.5406
.....
197	0.0739	-0.0772	1592.9522	1567.1767
198	0.0717	-0.0818	1593.6930	1568.1329
199	0.0696	-0.1109	1594.4355	1562.3402
200	0.0675	-0.1168	1595.1695	1562.9477
201	0.0655	-0.1397	1595.9171	1558.8608
202	0.0635	-0.1559	1596.6562	1556.5303
203	0.0616	-0.1614	1597.3919	1557.2080

According to Table 4, the carbon content error value calculated by 1stOpt software is obtained:

$$r = \sqrt{(y(i)_1 - y'(i)_1)^2} = 0.0508 \quad (9)$$

It can be seen from the calculation results that the carbon content error value is accurate to 4 digits after the decimal point, that is, the error is very small. Moreover, the squared

$R^2 = 0.981344527079898$ of the correlation coefficient is obtained from the calculation result of the software, which indicates that the fitting parameter [5] of the LM method is very effective, and the possible parameter values obtained are credible.

Find the temperature error value calculated by 1stOpt software:

$$r = \sqrt{(y(i)_2 - y'(i)_2)^2} = 8.3683 \quad (10)$$

It can be seen from the calculation results that the temperature error value is controlled within ten degrees, and the error is barely acceptable. Moreover,

the squared $R^2 = 0.95075039204762$ of the correlation coefficient is obtained from the calculation result of the software, which shows that the fitting effect of the LM method algorithm is very good, and the possible parameter values obtained are credible.

That is, the prediction model of carbon content and temperature [6] is

$$y_1 = 0.0229x_1 - 0.001x_2 + 0.0326x_3 + 0.1336x_4 \quad (11)$$

$$y_2 = 3.9967x_1 + 0.2186x_2 + 9.0619x_3 + 33.994x_4 \quad (12)$$

3. CONCLUSION

In this paper, the linear model is used to fit the curve, and the relationship between PQ, Q, [CO], [CO₂] and [C] & [T] is explored. The function is fitted by the Macquarie algorithm and the 1stOpt software is used to solve the problem. To minimize the sum of the squares of the residuals and achieve the best fit to solve the values of the respective variables. The prediction model expressions of carbon content and temperature are obtained respectively. The model expression has certain theoretical significance for the improvement of the precision hit rate of the converter steelmaking end point.

REFERENCES

- [1] Pan Xiulan, Wang Yanhong, et al. Iron and Steel Metallurgy Technology. Shenyang: Northeastern University Press, 2016.
- [2] Xu Wenpai. Converter Steelmaking. Beijing: Metallurgical Industry Press, 2014.
- [3] Zhu Guangjun, Liang Benchuan. Static Control Optimization Model for Converter Steelmaking. Beijing: Metallurgical Industry Press, 2013.
- [4] Zhang Jian, Cheng Guoguang. Current Status and Prospects of End-point Carbon Control. Henan: Journal of Zhengzhou University of Technology, 2017.
- [5] Yu Zhixiang. Modern Converter Steelmaking Technology (I). Steelmaking, 2001, (01): 13-18+34.
- [6] Wang Xinhua, Zhu Guosen, Li Haibo, Lv Yanchun. Research on steelmaking technology of “retaining slag + double slag” in oxygen converter. China Metallurgy, 2013, 23(04): 40-46.

Research on Balance Ability of the Elderly Based on Logistic Regression

Xinyan Dong^{1,2}, Liyan Dong^{1,3}, Hao Qin^{1,2,*}, Yang Han^{2,*}

¹Mathematical Modeling Innovation Lab, North China University of Science and Technology, Tangshan 063210, China

²College of Science, North China University of Science and Technology, Tangshan 063210, China

³College of Metallurgy and Energy, North China University of Science and Technology, Tangshan 063210, China

*E-mail: 729420132@qq.com

Abstract: As the high-speed and parallel processing features on FPGA, so it is widely used in high-speed information processing system. In this paper, the front-end data of X-ray energy spectrum is taken as processing object, high-speed data acquisition and processing methods based on the FPGA are proposed, which embodies the advantages of FPGA in the application of high-speed information processing. The compensation measures in the electronic measurement system are also discussed in this paper.

Keywords: FPGA; high-speed information processing; X-ray energy spectrum; electronic measurement system; compensation measures

1. INTRODUCTION

A Research Institute carried out random sampling by deploying 42 monitoring points on the elderly, from which monitoring data of selected points were analyzed. The human body is divided into 19 parts, such as head, neck and Spine shoulder. The sketch of the human body model is shown in Figure 1. The solid origin in the figure represents the center of gravity of each joint point.

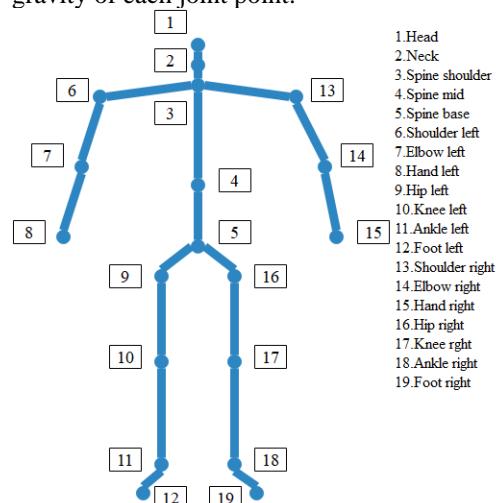


Figure 1. Twenty-five joints obtained Kinect

The data of 19 selected parts are extracted for feature extraction. Considering gait, center of gravity and movement, 25 characteristic indicators, such as support phase, swing phase, walking cycle, left step length, right step length, left step width, right step width, left step speed, right step

speed, step frequency, left foot deflection angle, right foot deflection angle, right foot deflection angle, step length, center parameter and arm amplitude, are finally obtained [1-3].

2. BALANCE ABILITY ASSESSMENT MODEL

An assessment model of balance ability of the elderly was established through 25 characteristic indicators.

2.1. Data Preprocessing

The 25 characteristic indices were divided into 4 groups, and their boxes were plotted separately. The distribution characteristics of the data were observed and the outliers were excluded.

Multivariate correlation analysis was conducted to remove outliers and dimensionality reduction was carried out. Multivariate analysis is to explore the correlation between various variables. The features in the linear regression model are distorted or difficult to estimate due to the existence of exact correlation or high correlation [4-7]. The correlation coefficient is 1 or -1. The correlation between the two is the largest, and the two groups of related variables can be treated one by one.

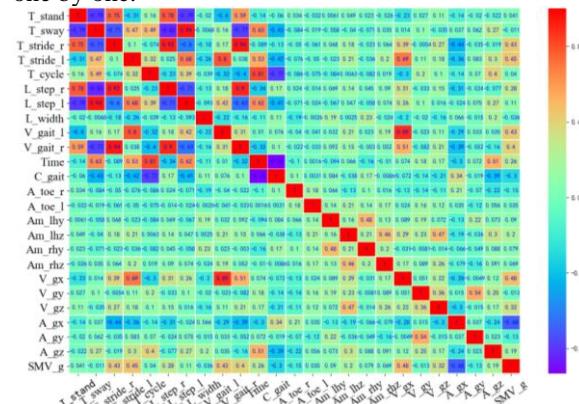


Figure 2. Multivariate correlation

From the multivariate correlation analysis in Figure 2, it can be seen that there is a significant difference in the correlation between the variables, so it is necessary to remove some of the eigenvalues. Generally, the correlation coefficient is greater than 0.75 and the variable culling can be performed. Therefore, 6 features such as $L_{stride}(l)$, $L_{step}(r)$, $L_{stride}(l)$, $V_{gait}(l)$, $V_{gait}(r)$, $Time$ and $Time$ are eliminated.

2.2. IV Statistical Principle

IV (Information of Value) that is the value of information. IV can be used to measure the predictive power of independent variables [8-10]. IV is derived from WOE, and the full name of WOE is “Weight of Evidence”, which is the weight of evidence. WOE is a coding form of the original independent variable. To perform WOE coding on a variable, the variable is first discretized. After grouping, for the i -th group:

$$WOE = \ln\left(\frac{py_i}{pn_i}\right) = \ln\left(\frac{y_i/n_T}{n_i/n_T}\right) = \ln\left(\frac{y_i/n_r}{y_T/n_T}\right) \quad (1)$$

Among them, the proportion of all the unfalls in all the samples in this group is the proportion of all the fallen old people in the group, which is the number of elderly people who have not fallen in this group. The number of fallen old people in this group is the number of all unfallen old people in the sample, which is the number of all fallen old people in the sample.

Similarly, the IV value corresponding to packet i is:

$$\begin{aligned} IV &= (py_i - pn_i) \times WOE = (py_i - pn_i) \times \ln\left(\frac{py_i}{pn_i}\right) \\ &= \left(\frac{y_i}{y_r} - \frac{n_i}{n_r}\right) \times \ln\left(\frac{y_i/n_T}{n_i/n_T}\right) \end{aligned} \quad (2)$$

The IV value of the entire variable, that is, the sum of the IV values of each group:

$$IV = \sum_i^n IV_i \quad (3)$$

Where n is the number of variables grouped.

The WOE and IV of each group of variables contain the meaning of this group for predicting the target variable, but the IV value does not require uniform grouping, because the definition of the IV value reflects the proportion of the number of individuals in the current group to the total number of individuals. If the features are unevenly grouped, the WOE is very sensitive to the government sample of each group and there will be negative numbers, which is not convenient for large-scale feature processing. Therefore, the IV value is selected for the screening of indicators.

Next, the IV statistic principle is selected for feature selection. According to the IV calculation formula, the IV values corresponding to the remaining 19 indicators are respectively calculated, and the corresponding bar graph is drawn as shown in Figure 3.

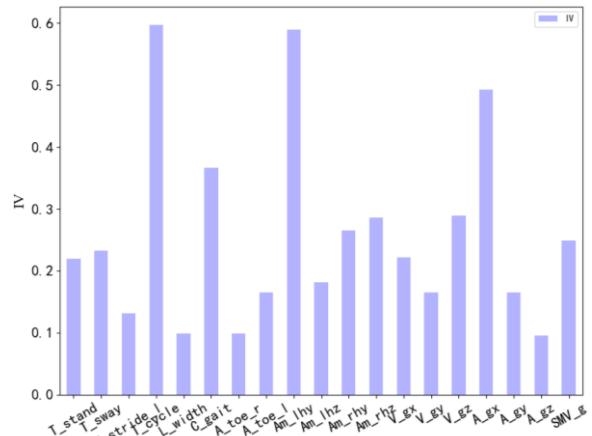


Figure 3. Features corresponding to the IV value

It can be seen from Figure 3 that there are significant differences in the IV values of different eigenvalues. Generally, the characteristic variables with IV greater than 0.2 are selected for subsequent training. From the above, it can be seen that 11 eigenvalues such as T_{stride} , T_{stay} , C_{gait} , Am_{i-y} , Am_{r-y} , Am_{r-z} , Vg_x , Vg_z , Ag_x , SMV_x etc. can be Enter follow-up data training.

2.3. Grading Card Model Based on Logistic Regression

The algorithm model used by the old man's balanced credit scorecard is logistic regression. Logistic model customer group changes are not as sensitive as other high complexity models, so they are more robust and robust. In addition, the model is intuitive, the coefficient meaning is well explained and easy to understand [11-13]. The advantage of using logistic regression is that a linear relationship between variables and corresponding feature weights can be obtained, which is convenient for turning it into a corresponding fractional form.

The Logistic regression model is itself a nonlinear regression model. By connecting the corresponding variable Y and the linear independent variable through the connection function transformation, a linear form can be obtained. The linear regression model is used to estimate the parameters. Therefore, the logistic regression model is a generalized linear regression model.

Consider a vector with n independent variables $x = (x_1, x_2, \dots, x_n)$, and let the conditional probability $P(y=1|x) = p$ be the probability that the observation will occur relative to an event x . Then the logistic regression model can be expressed as equation:

$$P(y=1|x) = \pi(x) = \frac{1}{1+e^{-g(x)}} \quad (4)$$

Usually $f(x) = \frac{1}{1+e^{-g(x)}}$ is called the Logistic function, and the probability that $g(x) = w_0 + w_1x_1 + \dots + w_nx_n$ does not occur under x

conditions is:

$$\begin{aligned} P(y=0|x) &= 1 - p(y=1|x) \\ &= 1 - \frac{1}{1+e^{-g(x)}} = \frac{1}{1+e^{g(x)}} \end{aligned} \quad (5)$$

Therefore, the ratio of the probability of occurrence of y to non-occurrence is given by equation:

$$\frac{P(y=1|x)}{P(y=0|x)} = \frac{p}{1-p} = e^{g(x)} \quad (6)$$

This ratio is called the occurrence ratio of the event and is written as odds. Take the logarithm of odds to get the formula:

$$\ln\left(\frac{p}{1-p}\right) = g(x) = w_0 + w_1x_1 + \dots + w_nx_n \quad (7)$$

The parameter formula of the classification model is usually obtained by using the maximum likelihood estimation:

$$L(w) = \prod_i^n (\pi(x_i))^{y_i} (1-\pi(x_i))^{1-y_i} \quad (8)$$

The maximum likelihood estimate is to find the parameter w_0, w_1, \dots, w_n so that $L(w)$ gets the maximum value.

The same logistic regression model applied to the elderly risk assessment is: according to the above filtered

data $(X_{i1}, X_{i2}, \dots, X_{in} : Y_i) (i=1, 2, \dots, 11)$, $X_i \in R^p$ is the indicator variable, $y_i \in [0, 1]$ is a 0-1 type variable, where $y_i = 0$ indicates that the category of the i -th old person is a fall, $y_i = 1$ indicates that the category of the i -th old person is not falling. In Logistic regression, the gradient descent method and Newton method are commonly used to solve the extremum, and lbfsgs is used to optimize the loss function. The ROC curve of the model obtained on the cross-validation set is shown in Figure 4:

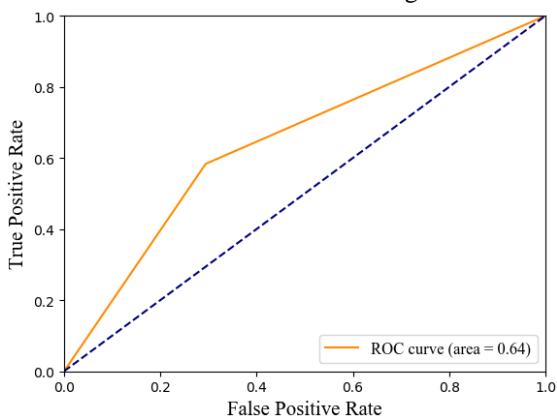


Figure 4. ROC_curve

For the ROC curve, the better the model classification effect, the closer the ROC curve is to the upper left, the AUC is getting closer to 1, and the AUC index we solved is 0.64, which can be considered as the available standard.

Similarly, the KS curve of the model on the

cross-validation set is shown in Figure 5:

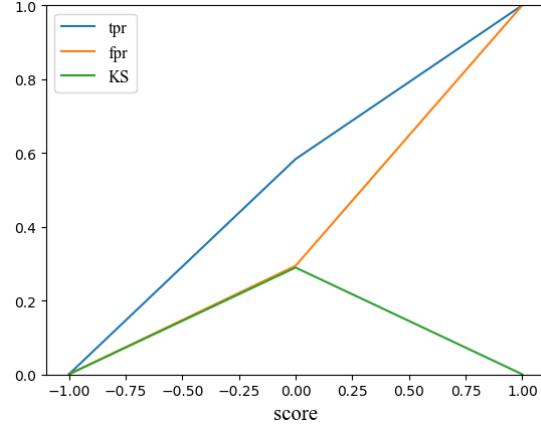


Figure 5. KS_curve

Generally, the KS of the wind control model is between 0 and 0.6, and the KS exceeds 0.6. Generally, there is over-fitting phenomenon. In practical applications, the KS value is 0.3, which is available. The training model KS is 0.39, so it can be considered the model meets the available standards.

2.4. Model Result Score

The score scale set by the score card can be defined as follow by expressing the score as a linear expression of the default and the normal probability logarithm $\log(odds)$:

$$Score = A - B \log(odds) \quad (9)$$

$$odds = \frac{p}{1-p} \quad (10)$$

In the previous process, we obtained the WOE value of each category after WOE and the (w_0, w_1, \dots, w_n) of each variable logistic regression model, then the $\log(odds)$ of the fall rate of the old man and the normal probability ratio of each group of data can be obtained.

To convert $\log(odds)$ to $Score$, you need to specify the factor and offset parameters:

$$factor = \frac{p}{\log 2} \quad (10)$$

$$offset = b - p \times \frac{\log o}{\log 2} \quad (11)$$

Where b is the base point, o is odds at base point, and p is point double odds.

Whether factor or offset, these parameters are simply used to convert to a suitable score, independent of the logistic regression itself. The score for each set of data is:

$$\begin{aligned} Score &= factor(w_0 \cdot woe_0 \cdot x_0 + w_1 \cdot woe_1 \cdot x_1 + \dots \\ &\quad + w_n \cdot woe_n \cdot x_n) \end{aligned} \quad (12)$$

According to the individual scores calculated by the 76 old people who entered the scoring standard, as shown in Figure 6, it can be seen that each person's score is different, and the fluctuation of the characteristic value is large.

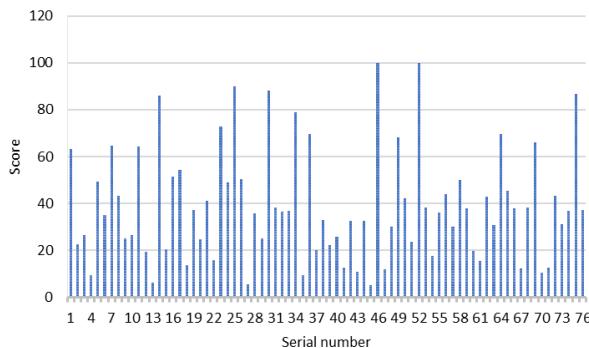


Figure 6. Score change chart

According to Figure 6, it can be seen that the scores of each old person are different, indicating that the old people themselves are affected by various characteristic values, and the balance ability is different.

3. SUGGESTIONS ABOUT BALANCE

Combining the scores of the balance ability of the elderly and the IV value scores of each characteristic factor, it can be found that the elderly with weak balance ability are mostly caused by gait non-standard, and some suggestions are given:

- (1) The elderly should strengthen the exercise of gait balance exercise in daily exercise.
- (2) For longer support for the right, the elderly are increasingly relying on the right lower limb to maintain gait balance. In this case, try to stretch the left leg more and strengthen the leg strength of the left leg.
- (3) Balance training to prevent wrestling. Tai Chi, Yoga, their main benefits are to improve mobility and balance, reducing the risk of wrestling and fracture.
- (4) Strength training to build muscle. Dumbbells, instruments, or body weight are all strength training. These exercises help increase muscle and bone strength and optimize posture.
- (5) Posture training to protect the spine. Attitude training can help the elderly protect the spine, reduce spinal pressure, and reduce the risk of wrestling and fractures, especially spinal fractures. Attitude training should run through daily life, and you should pay attention to maintaining a good posture when sitting, standing, and walking.

REFERENCES

- [1] L.M. Nashner, C.L. Shupert, F.B. Horak. Head-trunk movement coordination in the standing posture. *Progress in Brain Research*, 1988, 76: 243-251.
- [2] A. Shumwaycook, D. Anson, S. Haller. Postural sway biofeedback - its effect on reestablishing stance stability in hemiplegic patients. *Archives of Physical Medicine and Rehabilitation*, 1988, 69(6): 395-400.
- [3] D.L. Sturnieks, R. St George, S.R. Lord. Balance disorders in the elderly. *Neurophysiologie Clinique/Clinical Neurophysiology*, 2008, 38(6): 467-478.
- [4] H.W. Lin, N. Bhattacharyya. Balance disorders in the elderly: Epidemiology and functional impact. *Laryngoscope*, 2012, 122(8): 1858-1861.
- [5] M.K. Karlsson, T. Vonschewelov, C. Karlsson, M. Coster, B.E. Rosengen. Prevention of falls in the elderly: A review. *Scandinavian Journal of Public Health*, 2013, 41(5): 442-454.
- [6] M.J. Gibson. The prevention of falls in later life: A report of the Kellogg International Work Group on the Prevention of Falls by the Elderly. *Danish medical bulletin*, 1987, 34(Suppl 4): 1-24.
- [7] M.E. Tinetti, M. Speechley, S.F. Ginter. Risk-factors for falls among elderly persons living in the community. *New England Journal of Medicine*, 1988, 319(26): 1701-1707.
- [8] P. Kannus, J. Parkkari, S. Koskinen, S. Niemi, M. Palvanen, M. Jarvinen, I. Vuori. Fall-induced injuries and deaths among older adults. *JAMA-Journal of the American Medical Association*, 1999, 281(20): 1895-1899.
- [9] Guangzong Mu, Zhang Tuan. The development trend of China's population aging and its strategic response. *Journal of Central China Normal University (Humanities and Social Sciences Edition)*, 2011, 50(5): 29-36.
- [10] G. Allali, E.I. Ayers, J. Verghese. Multiple modes of assessment of gait are better than one to predict incident falls. *Archives of gerontology and geriatrics*, 2015, 60(3): 389-393.
- [11] H. Baezner, M. Oster, M. Daffertshofer, M. Hennerici. Assessment of gait in subcortical vascular encephalopathy by computerized analysis: A cross-sectional and longitudinal study. *Journal of Neurology*, 2000, 247(11): 841-849.
- [12] Tang Zhengyan. Research on the relationship between balance stability and fall of the elderly—based on the measurement of the center of gravity movement. *Sports Biomechanics Branch of the Chinese Academy of Sports Science. Compilation of abstracts of the 20th National Conference on Sports Biomechanics. Sports Biomechanics Branch of China Sport Science Society: Sports Biomechanics Branch of China Sports Science Society*, 2018: 3.
- [13] R.C. Wagenaar, R.E.A. van Emmerik, Resonant frequency of arms and legs identify different walking patterns. *Journal of Biomechanics*, 2000, 33: 853-861.

Endpoint Prediction of PSO-RBF Converter Steelmaking Based on Big Data

Liuye Zhang^{1,2}, Lingjie Ding^{1,2}, Liyan Dong^{1,3}, Cuihuan Ren^{4,}*

¹*Mathematical Modeling Innovation Lab, North China University of Science and Technology, Tangshan 063210, China*

²*College of Mechanical Engineering, North China University of Science and Technology, Tangshan 063210, China*

³*College of Metallurgy and Energy, North China University of Science and Technology, Tangshan 063210, China*

⁴*College of Science, North China University of Science and Technology, Tangshan 063210, China*

*E-mail: 979624482@qq.com

Abstract: The quality of molten steel is usually judged according to the hit rate of the end point. However, there are many factors influencing the steelmaking process. It is difficult to accurately predict the endpoint temperature and carbon content. In view of this, this paper proposes a method for predicting the temperature and carbon content of molten steel at the end point of PSO-RBF converter steelmaking based on big data. Firstly, based on the Spearman rank correlation coefficient of big data analysis, the rank correlation degree of 13 influencing factors and the end steel temperature and carbon content is analyzed. Then, based on the ability of RBF neural network arbitrary approximation function, a prediction model of converter steelmaking end point based on RBF neural network is constructed to predict the temperature and carbon content of the end steel. The simulation results show that the end-point molten steel temperature hit rate is 84.3%, and the carbon content hit rate is 81.2%. The prediction effect did not reach 90%, and the RBF network end point prediction rate was lower, and the mean square error was larger. Then, the inertia weight and convergence factor improved particle swarm optimization (PSO) algorithm is introduced, and the improved PSO is used to optimize the clustering radius of nearest neighbor clusters. Furthermore, a model based on improved PSO optimization RBF neural network is constructed to achieve a reasonable determination of the RBF basis function center. The experimental results show that the hit rate of the end steel temperature is 97.4%, and the hit rate of the end carbon content is 95.1%, which is better than the prediction effect of the RBF neural network.

Keywords: big data; RBF neural network; particle swarm algorithm; spearman correlation coefficient algorithm

1. INTRODUCTION

Steelmaking is one of the necessary links in steel production, especially in converter steelmaking. The output of single batch of molten steel reaches hundreds of tons. Improving the quality of molten steel is of key significance for steel enterprises to

reduce costs and achieve energy conservation and emission reduction [1]. Converter steelmaking is to replace molten iron, scrap steel, iron alloy and some auxiliary materials through blast furnace, through complex chemical and physical reactions, to replace the elements of iron and phosphorus in the molten iron that have a negative impact on steel performance, and according to the subsequent process requirements. The process of obtaining molten steel in accordance with the performance conditions of the product. Among them, the oxygen converter has been widely used due to its large single furnace output, short blowing time, high thermal efficiency and fast heating rate [2].

Due to the complex process of converter smelting reaction, there are many influencing factors, and various data will be generated at the same time. The changes in external environment, different operator habits and different schemes will result in different data, resulting in the entire steelmaking process. A large amount of data is generated, and certain requirements are imposed on the data processing capability of the prediction model.

In addition, the converter steelmaking process contains a very complex multi-phase multi-phase high-temperature reaction. Traditional mechanism analysis is difficult to effectively predict the quality of molten steel, and it is very difficult to construct accurate mathematical models [3]. The extremely high furnace temperature during the steel making process makes it difficult to measure the end temperature and composition of the furnace in real time and accurately. For a long time, the end point prediction of oxygen top-blown converter steelmaking has been the core of enterprise production.

The literature [4] proposes a prediction method based on the gray model, which affects the prediction accuracy due to the application of linear regression compensation. Applying artificial neural network technology to converter steelmaking control, establishing static, dynamic and hybrid control models based on artificial neural network can overcome the deficiencies of conventional models to

a certain extent, further improve the control precision of the model and improve the control effect [5]. BP neural network with strong approximation ability for nonlinear systems is used to predict the end temperature and carbon content of converter steelmaking [6], which can improve its prediction accuracy. However, BP network has slow convergence rate and is easy to fall into local area. Extreme point. In Ref. [7], the RBF neural network with fast convergence and strong approximation ability is used to establish the prediction model of the end temperature and carbon content of the converter steelmaking. The selection of the hidden layer center adopts the K-means clustering method, and the number of centers is fixed in advance. Depending on the initial position of the cluster center, it is possible to fall into local extremum points. The carbon content and the end temperature of the molten steel interact with each other. The literature [8] improved the network structure, and used the end carbon content and temperature as the output variables, and used the principal component analysis method to reduce the dimensionality of the input variables to simplify the network structure. The dual output neural network model improves the prediction. The robust correlation vector machine model and the kernel parameter adaptive optimization method proposed in Ref. [9] established the carbon content and temperature prediction model of the molten steel end point in the dynamic stage of converter steelmaking. The established model has a good hit rate and calculation accuracy, but the established models are all offline models, making it difficult to perform real-time analysis of data.

Based on big data analysis, this paper analyzes the large amount of data generated in the steelmaking process in real time, and can give the analysis results in a short time for the input, processing and discarding of data [10]. Then the nearest neighbor clustering method is used to select the RBF basis function center, and the prediction model of molten steel temperature and carbon content at the end of converter steelmaking based on RBF neural network is established. In addition, in order to eliminate the influence of human factors on the center vector in RBF, the improved particle swarm optimization algorithm is used to optimize the clustering radius of the nearest neighbor clustering algorithm, and the number and center vector of the optimal RBF hidden layer basis function are determined. The accuracy of the RBF neural network.

2. FACTORS AFFECTING THE END POINT OF CONVERTER STEELMAKING BASED ON BIG DATA

With the advent of the cloud era, the digitization of steel production processes has become the inevitable development of technology, and big data analysis is closely related to the end-point prediction research of converter steelmaking. Quickly obtain valuable

information from all types of data, forming the current end-point prediction big data technology. Based on the development needs to determine whether the quality of steelmaking is up to standard, Hadoop, the end-point big data platform for steelmaking process management, is hereby used. With the platform, the quality management of traceability, analysis and improvement of steelmaking end point data has effectively improved the management level of the steelmaking process. Tools and data support are provided to further improve steel quality [11].

2.1. Big Data Processing Technology

Big data technology is an emerging data processing technology derived from the Internet for fast storage and calculation of massive and multiple types of data [12]. It has the following characteristics: (1) Mass, that is, the data it can handle is very large, often measured in the range of hundreds of terabytes to several PBs; (2) Velocity, which is extremely high processing of massive data. Speed, can complete a large number of calculation processing work in a short time, get results; (3) Variety (Variety), that is, support a variety of different types of data, can handle a variety of structured data, but also a good deal Various unstructured images, texts, images, and other data.

Big data technology mainly realizes the high-speed and efficient processing of massive data through the following two technical means, namely distributed file system and parallel computing technology.

2.1.1. Hadoop distributed file system technology

Hadoop is an open source distributed file system developed by the Apache Foundation. This file system is referred to as HDFS (Hadoop Distribute File System) [13]. HDFS is created for mass storage. The file size stored on HDFS is generally on the order of GB to TB. Therefore, HDFS is tuned for distributed storage of large-scale steel data. An HDFS cluster can consist of hundreds or even tens of thousands of nodes, saving a very large data set. HDFS can be composed of hundreds or thousands of servers. Any server at any time may fail. This means that there is always a part of HDFS that does not work. Therefore, HDFS has designed data redundancy technology to ensure the storage of multiple copies of data. High availability of the entire system. HDFS is the primary goal of increasing the high throughput of data access, and sequential sequential reading of data becomes the key to its high-speed access. The processing of data is distributed to each node in the HDFS cluster, and each node only processes the data stored on the node, and does not need to perform data transmission across nodes, thereby greatly improving data throughput and reducing network congestion.

According to the conditions of molten iron temperature, molten iron composition, lime dosage, scrap quality, etc., query the whole process data information of each production process, and view the

distribution of key process parameter data of the specified process. The system also includes single parameter multi-batch process parameter query, querying the information of multiple batches according to process parameters, time or multiple batch number information, and then viewing the process parameter data of multiple batches at the same time, realizing the production process parameters and checking Traceability and analysis of laboratory information, decision data, etc.

2.1.2. MapReduce parallel computing technology

MapReduce is a computational framework proposed by Google. It uses massively parallel computing principles to implement computational processing for large-scale data, and is used for distributed calculation of large-scale data between steel quality influencing factors and endpoint temperature and carbon content. The MapReduce computing framework divides data processing into two functions, Map and Reduce [14]. The Map function refers to the division of the data set by the smallest element. These elements are then assigned to each processing node in the entire data processing cluster for the specified processing because each element is processed independently and the elements are completely independent. Therefore, each processing node can perform arithmetic logic processing completely independently. The entire process is highly parallelized, greatly improving the efficiency of data processing. The function of the MapReduce function is to summarize and simplify the results of the above-mentioned Map function processing, and finally obtain the processed result. The results after the operation of the Map function are relatively simple. Therefore, although MapReduce functions do not have the same degree of parallelism as Map functions, their efficiency is much higher than that of traditional single-node processing systems.

2.2. Steel Product Quality Control System

In the face of the current steel enterprise product quality related information system, the massive data cannot be effectively collected, stored, analyzed, the upstream and downstream production line information cannot be shared, the quality data cannot produce value status, through the use of big data technology, build cross-process flow, coverage Product quality control system for the entire production line. The logical architecture of the full-line product quality control system is shown in Figure 1:

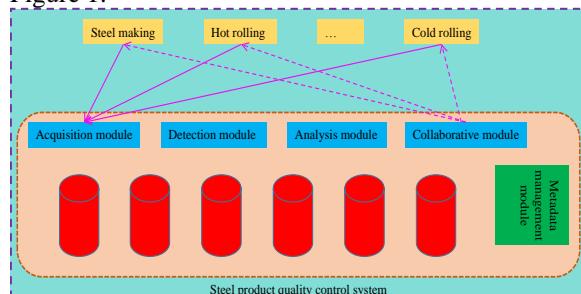


Figure 1. Logical architecture of the quality control

system of the full production line

Through the product quality control system, a large number of effective data can be obtained to solve the problem of solving the steel end point prediction of the oxygen top-blown converter. The Spearman rank correlation coefficient method shown below achieves the potential factors for finding the temperature and carbon content of the molten iron that may affect the endpoint. And record the unqualified information online.

2.3. Spearman Rank Correlation Coefficient Method for Analyzing Big Data

Since there are many factors affecting the end temperature and carbon content of the converter steelmaking, and the randomness is large, it is necessary to know the influence of each factor on the end point, that is, the correlation, when predicting the end point of the steel converter.

This paper uses the Spearman correlation coefficient algorithm based on statistics and analysis. The Spearman correlation coefficient method uses rank correlation to describe the degree and direction of linear or nonlinear correlation between two variables, and this algorithm has low sensitivity to abnormal data and is highly practical [15,16].

According to the relevant literature [17], the main factors affecting the endpoint prediction are 13 influencing factors: magnesium ball, molten iron temperature, molten iron composition, scrap loading, molten iron loading, pig iron loading, gun position, lime dosage, The age of the furnace, the amount of supplementary raw materials (such as: wild stone, dolomite, ore), the amount of oxygen added, the temperature of the molten steel measured by the sub-gun, and the carbon content of the molten steel measured by the sub-gun.

Assuming that the influence of a certain end point influencing factor X on the end point molten steel temperature y_T and carbon content y_C is considered, the Spearman rank correlation coefficient is

$$\left\{ \begin{array}{l} r_T = 1 - \frac{6}{n(n^2-1)} \sum_{i=1}^n (R_i - Q_{iT})^2 \\ r_C = 1 - \frac{6}{n(n^2-1)} \sum_{i=1}^n (R_i - Q_{iC})^2 \end{array} \right. \quad (1)$$

where, R_i is the rank of the influencing factor, Q_{iT} is the rank of the molten steel temperature and carbon content, respectively, of the Q_{iC} endpoint, and n is the number of data.

Taking the oxygen blowing amount as an example, the historical data of each influencing factor of a steel mill in the second half of 2017 is analyzed, and the rank correlation coefficient between the molten steel temperature and the carbon content at the end point is calculated.

The Spearman rank correlation coefficient was calculated for the molten steel temperature and carbon content at the end point, and the results

obtained are shown in Table 1 (partial results).

Table 1. Partial results of Spearman rank correlation coefficient analysis

Variable	Make up oxygen	Hot metal temperature	Furnace age	Magnesium ball
r_T	0.93	0.76	0.26	0.66
r_C	0.86	0.71	0.18	0.52

It can be seen from the Spearman rank correlation coefficient that the maximum effect on the molten steel temperature and carbon content at the end point is the amount of oxygen added. Among them, the age of the furnace, the rank correlation coefficient of the molten steel temperature and the carbon content of the gun position to the end point are less than 0.363. The rank correlation coefficient test table $r_{0.01} = 0.363$ [18], that is, the comparison is performed at 99% confidence, and the above results 0.32 and 0.29 are also smaller than $r_{0.01} = 0.363$. Conclusion: Not relevant. Therefore, in the latter study, 11 factors other than the furnace age and the gun position were considered.

3. DATA PREPROCESSING AND DETERMINATION OF INFLUENCING FACTOR IN CONVERTER STEELING END POINT PREDICTION

Big data analysis itself analyzes the laws and values hidden behind the data from a large number of incomplete, noisy, fuzzy, and random data [19]. Therefore, data preprocessing operations are required for these noisy, inconsistent data sources. Data preprocessing is mainly to provide high quality data for the analysis system [20]. The data extraction mainly selects the data source associated with the analysis target from the original data. If you can't exclude irrelevant data attributes, it will increase the complexity of data analysis and increase the time of data analysis. It also reduces the accuracy of data analysis.

The big data is analyzed according to the Spearman rank correlation coefficient method, and the input parameters x_1, x_2, \dots, x_n of the endpoint prediction model are preliminarily determined. More input parameters. Therefore, a partial correlation analysis between the determined influencing factors is required. The partial correlation coefficient is obtained between each parameter. If the partial correlation coefficient between the two factors is relatively small, indicating that the two are not linearly correlated, it can be used as the input of the model, so that the prediction effect of the model is better.

Through the partial correlation analysis of the influencing factors of the endpoint, the linear correlation between the magnesium sphere and the molten iron component was obtained, and the partial correlation coefficient was 0.369. The correlation coefficient between molten iron composition and other influencing factors is small. Therefore, the amount of magnesium balls added is no longer

considered. According to the comprehensive analysis, the two input factors of magnesium ball and molten iron temperature are not considered, and the final input parameter is 9.

4. PREDICTION MODEL OF CONVERTER STEELMACKING END POINT BASED ON RBF NEURAL NETWORK

4.1. RBF Neural Network Structure

The RBF neural network is usually composed of an input layer, a hidden layer, and an output layer. Similar to BP network in network characteristics, it also belongs to a multi-layer forward network. The difference with the BP network is that the function of the RBF network uses a radial basis function. It has the characteristics of local linearity of the output parameters, and network training can avoid nonlinear optimization. Therefore, there is no local minimum problem [21]. Moreover, the topology of the network can be determined during the learning process, the complexity of the calculation of the network weight coefficient is reduced, and the learning process is accelerated. Therefore, the learning speed of the RBF algorithm is much faster than the BP algorithm.

The general RBF neural network is expressed as [22]:

$$Y = f(X) = \sum_{i=1}^n \omega_i \times \varphi(\|X - C_i\|) + \omega_0 \quad (2)$$

Where $\varphi(\cdot)$ is the radial basis function, ω_i is the weight between the hidden layer and the output layer, and C_i is the center of the RBF.

Wherein the hidden layer radial basis function $\varphi(\cdot)$ is

$$\varphi(\|X - c_i\|) = \exp\left(-\frac{\|X - C_i\|^2}{2\eta^2}\right) \quad (3)$$

Where η is the mean square error of the neuron C_i :

$$\eta = \frac{d_m}{\sqrt{2M}}, d_m \text{ is the maximum distance between the selected centers; } M \text{ is the number of centers (which is the number of hidden layer units) are shown in Figure 2.}$$

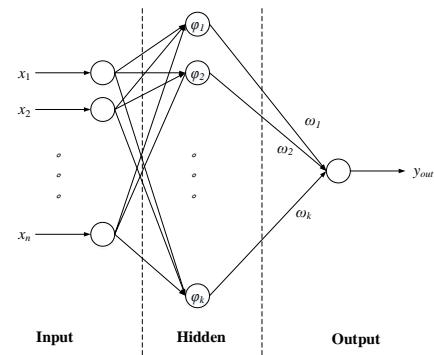


Figure 2. RBF neural network structure

4.2. Selection and Initialization of Input and Output
Based on the partial correlation analysis to determine the factors affecting the end point prediction, determine the nine factors affecting the end of the

converter steelmaking. The main targets of the final prediction of converter steelmaking are the molten steel temperature and the carbon content in the molten steel, and the end temperature y_T and the carbon content y_C of the end steel are output as models. Converter steelmaking is a process with multiple inputs and multiple outputs. Complex systems with severe nonlinear relationships can be represented by the following nonlinear system equations:

$$\begin{aligned} y_T &= f(x_3, x_4, x_5, x_6, x_7, x_8, x_9, x_{10}) \\ y_C &= g(x_3, x_4, x_5, x_6, x_7, x_8, x_9, x_{11}) \end{aligned} \quad (4)$$

In this paper, the nearest neighbor clustering learning algorithm is used to select the RBF basis function center [23]. After the center is determined, the weight of the output layer can be adjusted, using a recursive least squares method with a weighted forgetting factor [24].

4.3. Simulation Research

The production data of the converter record collected in the second half of 2017 collected by a steel plant is taken as the research object. After the data pre-processing and the screening of the influencing factors, the input layer nodes of the prediction model are taken as 9 (the molten iron loading (x_3), pig iron Loading amount (x_4), molten iron content (x_5), scrap loading (x_6), lime dosage (x_7), supplementary raw material addition amount (x_8), supplemental oxygen content (x_9), measured by sub-gun The temperature of the molten steel (x_{10}), the carbon content of the molten steel measured by the sub-lance (x_{11})). The learning efficiency is 0.9924, and the error criterion is $E = 0.001$, $r = 0.1$. The corresponding end-point molten steel temperature and carbon content prediction curves are shown in Figures 3 and 4.

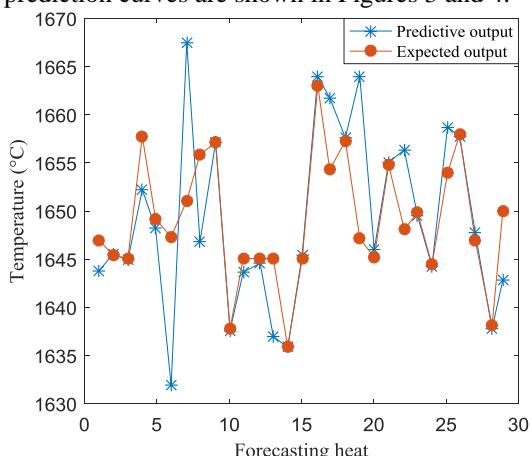


Figure 3. End point molten steel temperature prediction

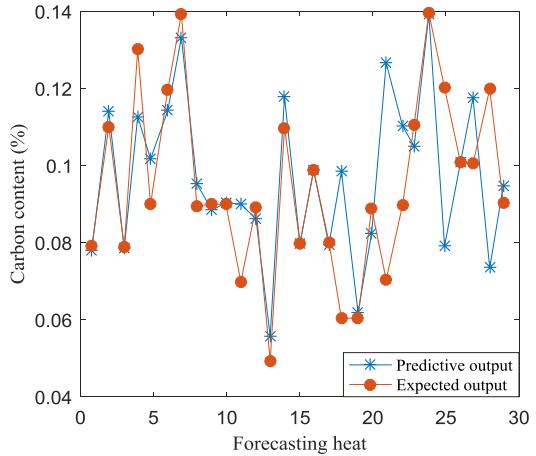


Figure 4. Endpoint carbon content prediction

It can be seen from Figure 3 that the end point molten steel temperature y_T predicted by most samples is substantially equal to the actual end point molten steel temperature y_{T0} . However, the predicted temperature of the molten steel of individual samples differs from the actual molten steel temperature by about 20°C, and the prediction is not accurate enough. This will directly lead to the quality of the molten steel that is not smelted, which will bring huge economic losses to the enterprise. It can be seen from Figure 4 that the predicted end point carbon content y_C of many samples differs greatly from the actual end point carbon content y_{C0} , with a maximum difference of 0.06%. This greatly affected the judgment of the end point of the converter steelmaking, resulting in the molten steel not meeting the production requirements, shown in Table 2.

Table 2. Results of the converter steelmaking end point prediction model of RBF neural network

Training sample ratio	Hit rate	Correlation coefficient	Mean square error
y_T accounts for 75% of the reasonable sample	84.3%	0.8130	5.4802
y_T accounts for 50% of the reasonable sample	80.1%	0.4383	8.9431
y_C accounts for 75% of the reasonable sample	81.2%	0.7621	5.8743
y_C accounts for 50% of the reasonable sample	76.7%	0.5393	9.3076

At the end point $[C] = (0.15 \pm 0.1)\%$ and the endpoint temperature (1645 ± 15) °C, the training sample accounted for 75% of the reasonable sample, the temperature hit rate was 84.3%, and the carbon content hit rate was 81.2%. None of them reached more than 90%. When using RBF network endpoint prediction, the hit rate is lower and the mean square error is larger.

In order to improve the hit rate during prediction, this paper uses the improved particle swarm optimization algorithm to optimize the clustering radius of the nearest neighbor clustering algorithm, so as to optimize the number and center vector of the optimal RBF hidden layer basis function, and eliminate the human factors in the existing algorithm. The influence

on the center vector greatly improves the predicted hit rate of the RBF neural network.

5. TMPROVED PSO OPTIMIZATION RBF NETURAL NETWORK

5.1. Improved Particle Swarm Optimization

The standard particle swarm optimization (PSO) algorithm is derived from the bionic study of foraging activities of birds. It is widely used in the optimization of complex industrial models due to its simple theory, rapid convergence and strong global search ability, and has achieved satisfactory results [25]. Particles fly to the global optimal solution by constantly tracking their own speed, individual extremum, and global extremum.

Suppose that in n-dimensional space, there are m particles forming a group, the position and velocity of the i -th particle in n-dimensional space $s_i = (s_{i1}, s_{i2}, \dots, s_{in})$, $v_i = (v_{i1}, v_{i2}, \dots, v_{in})$, $i = 1, 2, \dots, m$, the best position experienced by the i -th particle, denoted as $p_i = (p_{i1}, p_{i2}, \dots, p_{in})$, and p_i is called the individual extremum. Let $f(x)$ be the objective function, then the current best position of particle i is

$$p_i(t+1) = \begin{cases} p_i(t) & \text{If } f(s_i(t+1)) \geq f(p_i(t)) \\ s_i(t+1) & \text{If } f(s_i(t+1)) \leq f(p_i(t)) \end{cases} \quad (5)$$

The best position of all the particles in the group is recorded as p_g , called the global extremum

$$f(p_g) = \min f(p_i(t+1)), 1 \leq i \leq n \quad (6)$$

The parameters of the standard PSO algorithm are fixed, the accuracy of optimization for some functions is poor, the training of the data set takes a long time, and it is easy to fall into the local minimum. To solve this problem, the inertia weight is introduced to improve the algorithm [26]. During each iteration, the particle's speed is updated to

$$v_i = wv_i + c_1 \times r_1 \times (p_i - s_i) + c_2 \times r_2 \times (p_g - s_i) \quad (7)$$

w is the inertia weight, and the parameter w is dynamically adjusted according to the number of iterations, so that w gradually decreases as the number of iterations increases, and the search area becomes smaller and smaller, and the convergence speed becomes faster and faster, and the effect is better.

In order to effectively control the particle velocity and make the algorithm achieve the balance between global and local, Clerc constructs a PSO algorithm that introduces the contraction factor, and its evolution equation is [27,28]:

$$v_i = k \times [wv_i + c_1 \times r_1 \times (p_i - s_i) + c_2 \times r_2 \times (p_g - s_i)] \quad (8)$$

Among

$$k = \frac{2}{|2 - \phi - \sqrt{\phi^2 - 4\phi}|}, \phi = c_1 + c_2, \phi \geq 4$$

k is the shrinkage factor, used to control the flying speed of the constrained particles.

Combined with the above inertia weight model and convergence factor model, a new improved velocity equation is obtained:

$$v_i = k \times [wv_i + c_1 \times r_1 \times (p_i - s_i) + c_2 \times r_2 \times (p_g - s_i)] \quad (9)$$

Then, the fitness values of the particles are arranged in ascending order. According to the order of arrangement, the current position and velocity of the first half of the particle are replaced with the position and velocity of the latter half of the particle. However, the individual extreme values of the latter half of the particles are kept unchanged, and the population is concentrated in a relatively superior space. The improved PSO algorithm not only ensures convergence, speeds up the convergence, but also improves the accuracy of the solution.

5.2. Simulation Experiment and Result Analysis

From the numerous data, 2000 sets of data were selected as training samples, and 30 sets of data were used as test samples. Set the parameters, the number of particles is $m = 30$, the number of iterations is 100, the precision is 0.001, $c_1 = c_2 = 2$, the particle velocity range is [-0.1, 0.1], the position range [-1, 1], the shrinkage factor $k = 0.7278$. According to the flow of the training sample of Figure 5, a comparison chart between the predicted result of the predicted model and the actual result is obtained, as shown in FIGS. Figure 6 is an iteration curve of the training process in PSO.

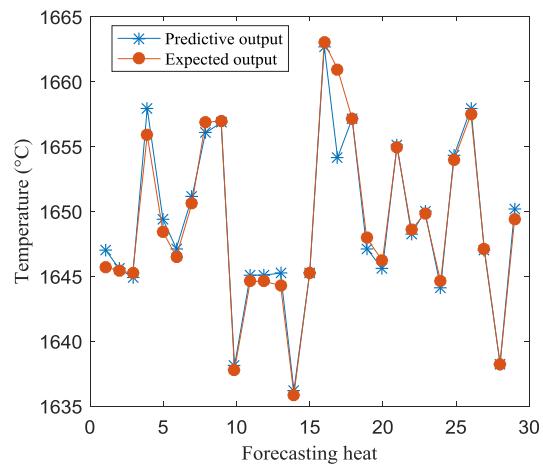


Figure 5. End point molten steel temperature prediction

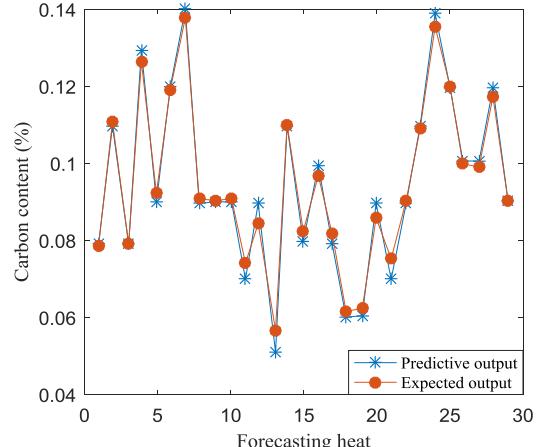


Figure 6. Endpoint carbon content prediction

It can be seen from Figure 5 that the end point molten steel temperature y_T predicted by most samples is consistent with the actual end point molten steel temperature y_{T0} , and only a few furnaces have a predicted result that differs from the actual temperature by less than 15°C. As can be seen from Figure 6, the predicted end point carbon content y_C of substantially all samples is substantially identical to the actual end point carbon content y_{C0} , with a difference of about 0.1%. The mean squared difference between the final endpoint temperature and the carbon content and the true value is 1.1583 and 0.0037, respectively. The hit rate of the endpoint temperature within $\pm 15^\circ \text{C}$ was 97.4%. The hit rate of the end carbon content at $\pm 0.1\%$ was 95.1%. It shows that the improved PSO optimized RBF neural network can accurately predict the end point of converter steelmaking.

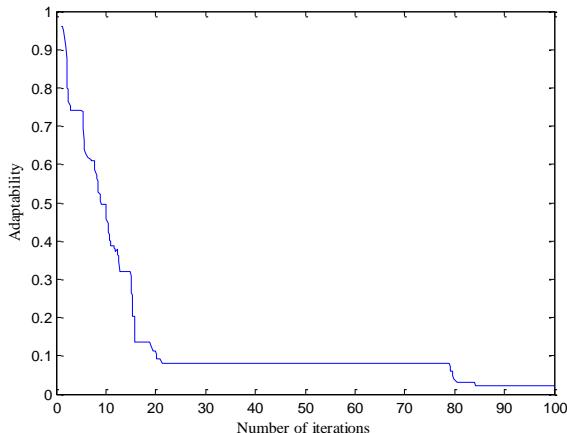


Figure 7. Improved PSO iterative process fitness curve

It can be seen from Figure 7 that after the number of iterations reaches 90, the fitness remains basically the same, indicating that the optimal solution has been found. The improved PSO achieves the purpose of optimizing the RBF neural network, and the establishment of the modified model is reasonable.

6. CONCLUSION

The carbon temperature at the end of the steelmaking is a key factor in determining whether the quality of the steel is up to standard. Based on the analysis of big data, this paper initially determines the factors affecting the endpoint. Then, an endpoint prediction method based on RBF neural network for big data processing is proposed. If the RBF neural network is used for prediction, the hit rate is less than 90%. Therefore, this paper proposes an improved particle swarm optimization algorithm to optimize the RBF neural network, so that the predicted hit rate is increased to more than 95%. The main innovations of this paper are as follows:

(1) Using the nearest neighbor clustering algorithm to determine the RBF basis function center, and automatically classify the data according to the sharp radius and find the cluster center, avoiding the choice

of the initial center and reducing the influence of human factors.

(2) Introduce inertia weight and shrinkage factor on the basis of standard PSO, arrange the fitness values in order of small to large, select particles with better fitness value instead of particles with fitness value difference, and make the group concentrate to relatively more. The excellent space improves the convergence speed and accuracy of the PSO algorithm.

REFERENCES

- [1] Han Hanping. Research and Application of Energy Saving and Emission Reduction Technology in Steelmaking Process of Steel Industry. Energy and Energy Conservation, 2016, 1: 96-97.
- [2] Zhao Yunzhu. Technical analysis of steelmaking process of “retaining slag + double slag” in oxygen converter. China New Technology and New Products, 2015, 20: 95.
- [3] Liu Wei, Han Min, Wang Xinzhe. Endpoint prediction model of oxygen converter steelmaking based on membrane algorithm evolutionary limit learning machine. Journal of Dalian University of Technology, 2014, 54(20): 124-130.
- [4] Xie Shuming, Chai Tianyou, Tao Wei. A New Method for Dynamic Endpoint Prediction of Converter Steelmaking. Acta Automatica Sinica, 2001, 1: 136-139.
- [5] Zhou Sheng-Gang, Sun Li-Da, Zhu Pei-Xian, Zhang Jin, Zhang Zhe. Application of BP Neural Network in Prediction of Cu-Pb Composite Plates Properties. Journal of Harbin Institute of Technology (English Edition), 2013, (5): 36-40.
- [6] Sun Yongtao, Wu Yonggang, Qin Bo. Research on Endpoint Prediction of Converter Steelmaking Based on IPSO Optimization BP. Inner Mongolia Science and Technology and Economy, 2017, 19: 71-73.
- [7] Zhai Ziyi, Gao Kun, Zhao Baofang, Li Yong, Li Wei. Application of RBF neural network in the prediction of converter steelmaking end point. Wireless Interconnect Technology, 2017, 4: 106-107+129.
- [8] Yang Lihong, Liu Liu, He Ping. Model of Converter Carbon Temperature Control Based on Double Output Neural Network. Iron and Steel, 2002, 37(11): 13-16.
- [9] Zhao Yao. Research on the end point prediction model of converter steelmaking based on correlation vector machine. Dalian University of Technology, 2010.
- [10] Jyoti V. Gautam, Harshadkumar B. Prajapati, Vipul K. Dabhi. Sanjay Chaudhary. Empirical Study of Job Scheduling Algorithms in Hadoop MapReduce. Cybernetics and Information Technologies, 2017, 17(1).
- [11] Wu ChienHeng, Chuang ChiaoNing, Chang Wen-Yi, Tsai Whey-Fone. Development of Big Data Multi-VM Platform for Rapid Prototyping of

Distributed Deep Learning. Springer International Publishing: 2018-07-11.

[12] Fuji Ren and Kazuyuki Matsumoto. Emotion Analysis on Social Big Data. ZTE Technology (English version), 2017, (z2): 30-37.

[13] Meng Guangshi. Computer Information Processing Technology in the Age of Big Data. Electronic Technology and Software Engineering, 2018, 15: 164.

[14] Sunil Tiwari, H.M. Wee, Yosef Daryanto. Big data analytics in supply chain management between 2010 and 2016: Insights to industries. Computers & Industrial Engineering, 2018, 115.

[15] Shengmei Luo, Zhikun Wang, Zhiping Wang. Big-Data Analytics: Challenges, Key Technologies and Prospects. ZTE Communications, 2013, 11(2): 11-17.

[16] Mohammed S. Hadi, Ahmed Q. Lawey, Taisir E.H. El-Gorashi, Jaafar M.H. Elmirghani. Big data analytics for wireless and wired network design: A survey. Computer Networks, 2018, 132.

[17] Zhou Wang, Feiming Xie, Bin Wang. The Control and Prediction of End-Point Phosphorus Content during BOF Steelmaking Process. Steel Research International, 2014, 4: 599-606.

[18] Li Jing. Modeling and prediction of blast furnace hot metal temperature based on data mining. Inner Mongolia University of Science and Technology, 2013.

[19] Shabnam Shadroo, Amir Masoud Rahmani. Systematic survey of big data and data mining in internet of things. Computer Networks, 2018, 139.

[20] Zhu Changming, Gao Daqi. Data preprocessing and re RE kernel clustering for letter. Journal of Electronics (China), 31(6): 552-562.

[21] Li Nan, Zhao JunHai, Wang Juan, Zhu Qian. Prediction of Hybrid Fiber Reinforced Concrete Strength on Base of RBF & BP. Advanced Materials Research, 2014, 3490(1035).

[22] Yang Xiao-hua, Huang Jing-feng, Wang Jian-wen, Wang Xiu-zhen, Liu Zhan-yu. Estimation of vegetation biophysical parameters by remote sensing using radial basis function neural network. Journal of Zhejiang University A (English Edition), 2007, 6: 883-895.

[23] Sun Yanfeng, Liang Yanchun, Meng Qingfu. Improved Neural Network Nearest Neighbor Clustering Learning Algorithm and Its Application. Journal of Jilin University: Information Science Edition, 2002, 1, 63-66.

[24] Xun Qian, Wang Peiliang, Li Zuxin, Cai Zhiduan, Qin Haihong. Parameter Identification of Permanent Magnet Servo System Based on Recursive Least Squares Method. Transactions of China Electrotechnical Society, 2016, 37(17): 161-169.

[25] Cheng Ze, Dong Mengnan, Yang Tianyu, Han Lijie. Parameter Identification of Photovoltaic Cell Model Based on Adaptive Chaotic Particle Swarm Optimization Algorithm. Transactions of China Electrotechnical Society, 2014, 29(9): 245-252.

[26] Duan Qichang, Zhao Min, Wang Daxing. A New Method for Improving PSO Optimized RBF Neural Network. Computer Simulation, 2009, 26(12): 126-129.

[27] M Clerc, J Kennedy. The particle swarm - explosion, stability, and convergence in a multidimensional comple space. IEEE Transactions on Evolutionary Computation, 2002, 6(1): 58-73.

[28] Li Hongliang, Hou Chaozhen, Zhou Shaosheng. An Efficient Improved Particle Swarm Optimization Algorithm. Computer Engineering and Applications, 2008, 1: 14-16+30.

Epidemiological Study on Synthetic Opioids

Yu Bi^{1,2}, Chenshuai Liu^{1,2}, Ruishan Li^{2,*}, Cuihuan Ren^{3,*}

¹Mathematical Modeling Innovation Laboratory, North China University of science and technology (NCUST), Tangshan 063000, Hebei, China

²University of the NCUST, Tangshan 063000, Hebei, China

³College of Science, North China University of Science and Technology, Tangshan 063210, Hebei, China

*E-mail: 979624482@qq.com

Abstract: In response to the opioid crisis, reducing drug addiction, death, and crime, we analyzed the spread and characteristics of opioid and heroin cases by analyzing five-state data. First, data preprocessing. We nondimensionalize the data by Zero Mean Standardization Processing the social economic dataset. And we found a strong correlation between some variables, by analyzing the thermal graph of correlation matrix, which can use exploratory factor analysis method. Next, using the NFLIS dataset provided, define specific synthetic opioids Popularity Index and study the trend of the opioids Popularity Index in the five U.S. states between 2010 and 2017. We found that drug crime tends to internationalize, and the transmission of opioids tends to spread from high epidemic index region to low epidemic index region. The transmission of opioids is correlated with geographical location and time.

Keywords: factor analysis; thermodynamic chart; data processin; drug dissemination

1. INTRODUCTION

Opioid analgesic tablets are alkaloids extracted from opium (Poppy) and their derivatives in vivo and in vitro. Long or high doses of opioids increase the risk of addiction, overuse and death. Heroin and opioids

are the most serious source of drug risk in the United States in recent years, we analyzed heroin and opioid crimes in five states of the United States, combined with socio-economic data in the United States, and analyze the spread and characteristics of opioids.

In this article, we divide our work into the following sections:

Using data provided by NFLIS, we analyzed the trends of opioid and heroin cases over time in five states.

The social and economic data provided by U.S. Census Bureau were deleted seriously, and then the zero-mean standardized processing was carried out. Using standardized data, exploratory factor analysis was carried out.

2. DATA ANALYSIS PROCESSING

2.1. Part I

The data provided by NFLIS were processed, and the total number of synthetic opioid and heroin cases in five states was summed up by year, and the total number of cases in five states was obtained. Combining the geographical location of the five states, this paper shows how the number of cases in the five states changes over time through the map bar chart of Figure 1.

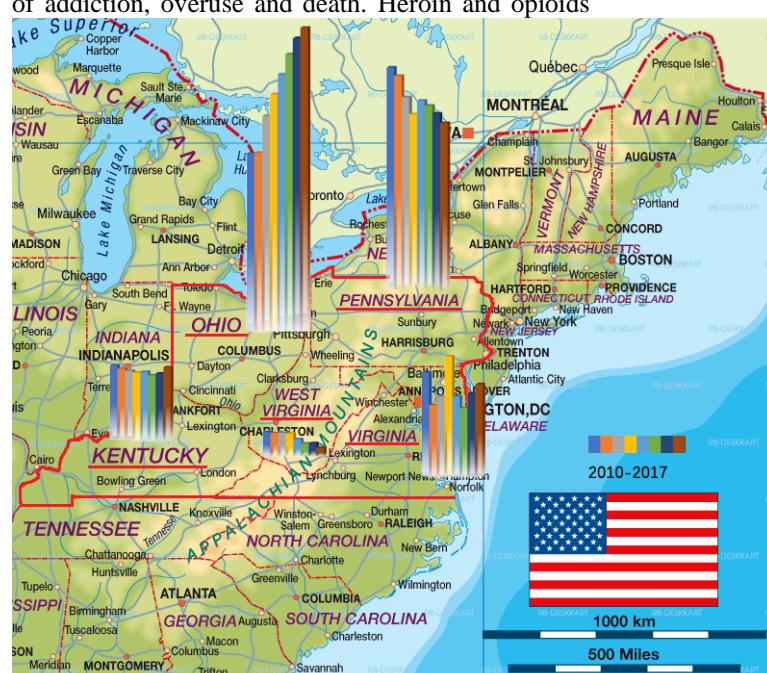


Figure 1. Number of drug cases reported in five states in 2010-2017

As can be seen from Figure 2, observing the geographical location of the five states, we can see that the two states with the largest number of drug cases are located at the national border, which can be used as an example of the internationalization of drug crimes. It can also be inferred that the drug problem is serious in the border areas. When the United States government is dealing with the problem of overflow of opiates and heroin, it can strengthen the governance of the border areas.

2.2. Part II

The data set 2 is normalized by zero-mean [1], and the time formula (1). This can eliminate the influence of dimension difference among different variables and prepare for factor analysis.

$$X_{std} = \frac{X - \mu}{\sigma} \quad (1)$$

Among them, X_{std} is the normalized matrix, X is the original data matrix, μ is the mean of the original data matrix, is a row vector of $1 \times n$, μ_i is the mean of the i variable. σ is the standard deviation of the

original data matrix, is a row vector of $1 \times n$, and σ_i is the standard deviation of the i variable.

3. CORRELATION ANALYSIS

Finally, exploratory factor analysis [2] is carried out on the data processed by Part II. We have completed this work in SPSS 25.0 software.

Firstly, we calculate the correlation matrix of standardized data, in which the formula is

$$R = \begin{bmatrix} \rho_{11} & \rho_{12} & \cdots & \rho_{1n} \\ \rho_{21} & \rho_{22} & \cdots & \rho_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \rho_{n1} & \rho_{n2} & \cdots & \rho_{nn} \end{bmatrix} \quad (2)$$

Among them,

$$\begin{aligned} \rho_{ij} &= \frac{\text{cov}(X_i, X_j)}{\sqrt{DX_i} \sqrt{DX_j}}, \text{cov}(X_i, X_j) \\ &= E((X_i - E(X_i)) \cdot (X_j - E(X_j))) \end{aligned} \quad (3)$$

Calculate the correlation matrix and draw the relevant heat map, as shown in Figure 2.

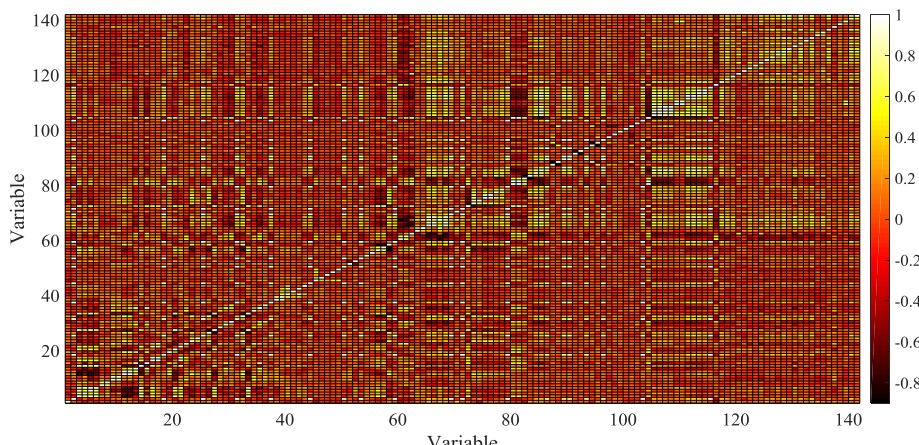


Figure 2. Relevance Matrix Thermodynamic Diagram of 141 Variables

As can be seen from the above figure, some variables have strong correlation, so exploratory factor analysis can be done.

4. OPIOID EPIDEMIC INDEX MODEL

By analyzing the drug types of each county in 2010 and 2017 separately, and comparing them intuitively in the form of thermodynamic charts, we can get Figures 3 and 4.

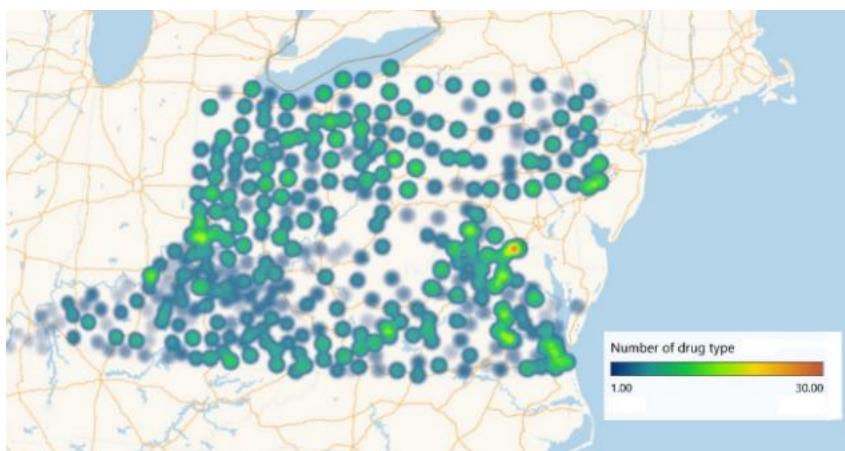


Figure 3. Thermal map of drug types in five states in 2010

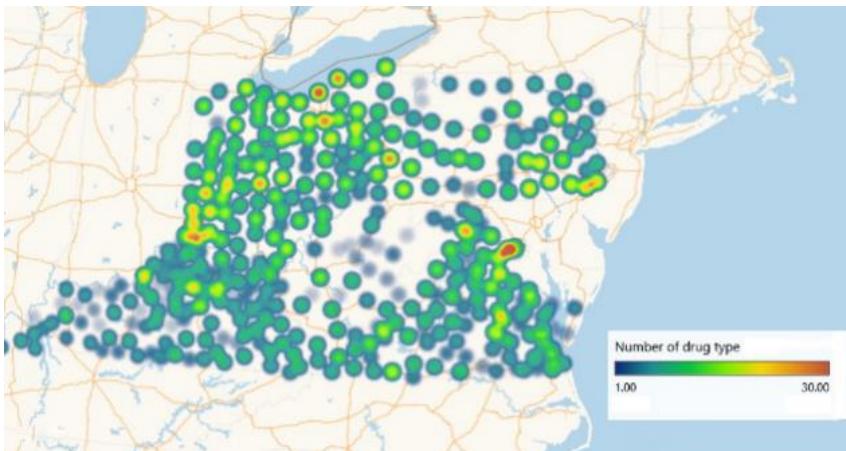


Figure 4. Thermal map of drug types in five states in 2017

By comparing the number of drug types in five counties and states in 2010 and 2017, we found that when new drugs appeared more in one place, they would spread to the surrounding counties. Most of the major transmission points in the five states remain unchanged, and the number of cases in the five states is at the forefront.

Define a specific synthetic opioid prevalence index based on the data set provided by NFLIS:

$$\gamma = \frac{D_i}{D_0} \quad (4)$$

Among them, γ is the specific drug epidemic index; D_i is the number of specific drug years; D_0 is the total number of drug year cases. When the epidemic index of a particular drug in a certain place rises year by year, it shows that the drug is spreading more and more widely in this area. Thirty percent of synthetic opioids in MCM_NFLIS_Data were randomly selected as samples to study their epidemic index trends in five states from 2010 to 2017. Taking Tramadol as an example, the trend of its epidemic index is shown in Figure 5.

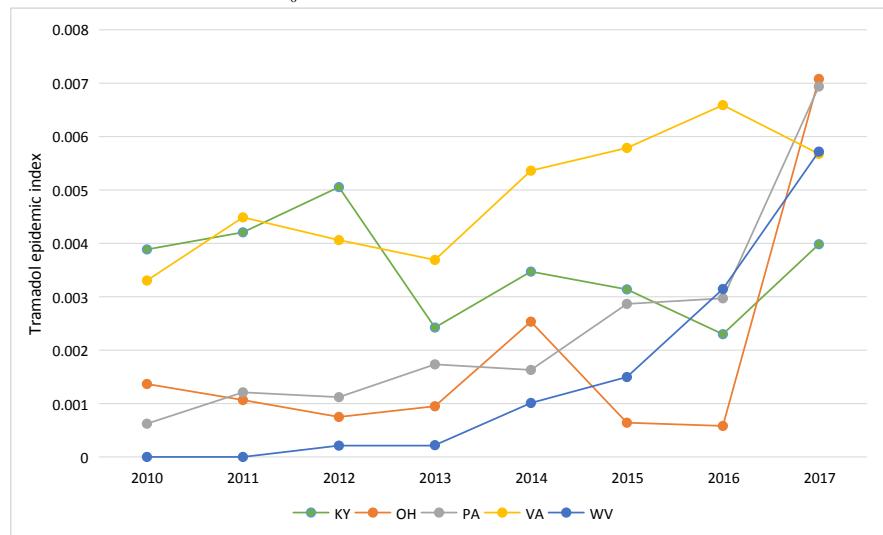


Figure 5. 2010-2017 Tramadol epidemic index in five state

Comprehensive analysis of Figures 3, Figure 4 and Figure 5 shows that a drug is transmitted from its high epidemic index region to high epidemic index region, indicating that the degree of drug transmission is correlated with geographical location and time.

5. CONCLUSIONS

Through exploratory analysis of standardized data and the study of opioid epidemic index, the conclusion is drawn: Drug crime tends to internationalize. The transmission of opioids [3] tends to spread from high epidemic index region to low epidemic index region. The transmission of opioids is

correlated with geographical location and time.

REFERENCES

- [1] Tu Jianjun, Guo Jingjia. Data standardization for oil monitoring of ship equipment. Lubrication and Sealing, 2018, 43(7).
- [2] Fan Shuo. Comprehensive evaluation of inter-provincial health security capability. Capital University of Economics and Trade, 2018.
- [3] Yu Shiying. Rational use of opioids remains a key issue in the treatment of cancer pain. Journal of Clinical Practical Hospital, 2006, 3(1).

Color and Concentration Identification Based on Regression Model

Xiangyu Li^{1,2}, Xiangyu Li^{1,3}, Xue Zhao², Xu Zhou^{4,*}

¹Innovation Laboratory of Mathematical Modeling, North China University of Technology, Tangshan 063210, China

²College of Chemical Engineering, North China University of Science and Technology, Tangshan 063210, China

³College of Metallurgical Engineering, North China University of Technology, Tangshan 063210, China

⁴College of Science, North China University of Science and Technology, Tangshan 063210, China

*E-mail: 625525957@qq.com

Abstract: For the problem of color and substance concentration identification, multi-linear regression model is often used. This paper considers the correlation between color values, introduces the concept of gray value, establishes a linear regression equation between gray value and substance concentration, and finally obtains the relationship between color value and substance concentration. The results of the model are well fitted, which can satisfy people's judgment by color value. The need for concentration.

Keyword: Linear regression model; RGB model; Fitting goodness test; F test; T test

1. INTRODUCTION

Five color indicators are given: B, G, R, H and S. RGB and HSV belong to two different color evaluation systems. The model is based on the three primary colors of human vision - red (R), green (G) and blue (B). The HSV model is based on the human visual perception characteristics. The hue (H) represents different colors, the saturation (S) represents the depth of the color, and the brightness (V) represents the brightness and shade of the color [1]. RGB model is widely used. In this paper, RGB color value is used.

Draw scatter plots of substance concentration and B, G, R values respectively [2-4]. Judge the possible relationship between them by observing the trend of image, and then determine the relationship between color reading and substance concentration. Considering the relativity of three groups of RGB data, this paper puts forward the concept of gray value for highly correlated data, so as to get the relationship between color reading and substance concentration.

2. REGRESSION MODEL

2.1. Data Preprocessing

Because there are many errors in the experiment, avoid the influence of accidental factors and show the universality and accuracy of the data. It is necessary to average the data and get the result Table 1.

Table 1. Mean value processing

Concentration (ppm)	B	G	R
0	66.5	110	120.5

12.5	65	101.5	118
25	53	93	118.5
50	46	87	117.5
100	36	65	109.5

To observe the characteristics of the data, scatter plots are made using origin Figure 1.

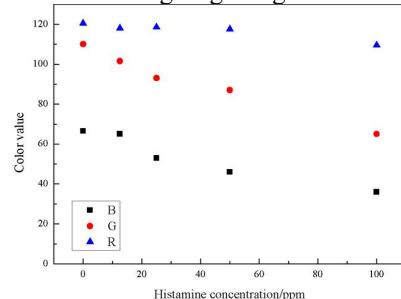


Figure 1. Colour concentration scatter plot

As can be seen from the above Figure 1, the values of B, G and R all change with the change of histamine concentration, and the changes of B and G values are more obvious than those of R values. Before establishing the model, we first explore the correlation among the three variables: import the data of B, G and R values into SPSS to do Pearson correlation analysis, and judge the correlation among the three variables. The results of SPSS analysis are as follows Table 2.

Table 2. Data correlation analysis

Related indicators		B	G	R
B	Pearson correlation	1	0.969	0.889
	Significance (Bilateral test)		0.006	0.044
	Confidence level		99%	95%
G	Pearson correlation	0.969	1	0.960
	Significance (Bilateral test)	0.006		0.009
	Confidence level	99%		99%
R	Pearson correlation	0.889	0.960	1
	Significance (Bilateral test)	0.044	0.009	
	Confidence level	95%	99%	

From the analysis of the results, Pearson correlation values are above 0.8, and the significance is less than 0.05, indicating that B, G, R values have obvious autocorrelation.

2.2. Model Establishment

The concentration of histamine is related to the values of B, G and R, and the values of B, G and R have obvious autocorrelation. At this time, we

consider converting RGB values into gray values. Because human eyes have different perceptions of RGB color, different weights need to be given in the conversion process:

$$\text{Gray} = \alpha R + \beta G + \gamma B \quad (1)$$

For the values of alpha, beta and gamma, there are different values for different color spaces. For linear color space, the values of alpha, beta and gamma are 0.2126, 0.7152 and 0.0722 respectively; for sRGB color space, the values of alpha, beta and gamma are 0.299, 0.587 and 0.114 respectively. Because most of the manufacturers of digital image acquisition equipment support the sRGB standard all the way and are widely used, the weight of sRGB color space is used, that is to say, the conversion formula is as follows:

$$\text{Gray} = 0.299R + 0.587G + 0.114B \quad (2)$$

According to the above conversion rules, two sets of data of histamine RGB values are converted to gray values, as follows Table 3.

Table 3. Histamine gray value data

Histamine concentration (ppm)	Gray1	Gray2	Average value
0	108.501	107.86	108.181
12.5	102.680	101.865	102.273
25	101.061	100.833	100.947
50	91.296	91.595	91.446
100	75.850	74.149	75.000

The linear regression equation of histamine concentration (y) and average Gray value (x) was established:

$$y = ax + b \quad (3)$$

The data of histamine concentration and average Gray value were imported into SPSS for linear regression, and the coefficients of linear regression equation were obtained:

$$a = -3.038 \quad b = 327.875 \quad (4)$$

By synthesizing the above data, a linear regression equation is obtained:

$$y = -3.038x + 327.875 \quad (5)$$

2.3. Model Checking

For the linear regression equation obtained from the above formula, the corresponding goodness of fit test, F test and T test are made [3]. Firstly, the scatter plots of the predicted and actual concentration values under the same Gray value are drawn Figure 2.

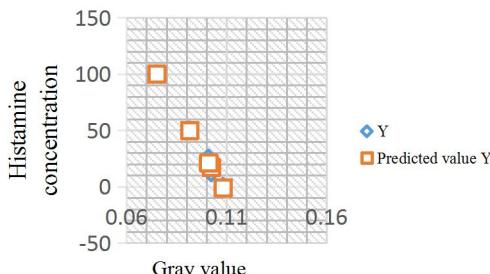


Figure 2. Scattered plots of predicted and actual values

From the above figure, it can be seen that the predicted concentration is close to the actual value, which indicates that the linear regression model has certain accuracy [4].

Next, the goodness of fit test, F test and T test are carried out between the predicted data and the actual data. The test results are summarized in the following Table 4.

Table 4. Model test results

	R ²	F test	T test
Numerical value	0.9921	0.00019	0.00014
Evaluation criterion	Close to 1	<0.05	<0.05

From the above test results, we can see that the resolvable coefficient R² is very close to 1, and the F and T test values are far less than 0.05, which shows that the linear regression equation of one variable is in good agreement with the reality and the effect is good.

3. CONCLUSIONS

By introducing the concept1 of gray value, the relationship between three color variables with strong autocorrelation and substance concentration is established, and the relationship between histamine concentration and RGB color value is obtained:

$$y = -0.908R - 1.783G - 0.346B + 327.875 \quad (6)$$

The concentration of histamine can be directly obtained by RGB color reading of substance, which can directly correspond to the concentration of substance. It provides a way to deal with the problem under the condition of strong dependence of independent variables.

REFERENCES

- [1] H.M. Shi, L. Shen, S.Z. Long, X.M. Hu. Amendment of color space conversion formula from RGB to HSV. Journal of Basic Science of Textile University, 2008, (03): 351-356.
- [2] G.Q. Chen, B. Zhang, Y.L. Song. Flame recognition based on RGB statistical color model. Journal of Jiangsu University of Science and Technology (Natural Science Edition), 2017, 31(02): 178-184.
- [3] X. Zhang, G. Yang. Case study of river flow data extension based on linear regression model. Jilin Water Conservancy, 2019, (03): 45-47+57.
- [4] D.M. Jin, N. Rong. Prediction of water demand in Changchun City based on regression analysis. Northeast Water Resources and Hydropower, 2018, 36(10): 19-21+29+71.

On Clinical Value of Low kV Coarse Pitch Combined with IRIS in Reduction of Radiation Dose in Chest Multi-Slice Spiral CT Examination

Jianghua Huang

Department of Radiology, Jingzhou Central Hospital, Jingzhou, Hubei 434020, China

E-mail: hubeiwenbo@163.com

Abstract: Objective: to summarize the application effect of low kV coarse pitch combined with iterative reconstruction in image space (IRIS) in reduction of radiation dose in chest multi-slice spiral CT examination. Method: the time of study was from April 2017 to June 2018, and the objects of study were 80 patients who needed chest CT examination. They were classified into control group and observation group according to random number table. Control group: 40 cases, 110 kV, Pitch 0.8, FBP; observation group: 40 cases, 80 kV, Pitch 2.0, IRIS. The scanning time, effective radiation dose and image quality of both groups were compared and analyzed. Results: the scanning time and effective radiation dose of observation group were lower than that of control group, and data comparison had statistical significance ($p<0.05$). Objective score and subjective score of image quality in both groups had no difference ($p>0.05$), without statistical significance. Conclusion: low kV coarse pitch combined with IRIS contributes to reducing radiation dose in chest multi-slice spiral CT examination, accelerating scanning time and guaranteeing good imageological examination quality, so it deserves to be promoted and applied.

Keywords: low kV coarse pitch; IRIS; chest examination; multi-slice spiral CT; radiation dose; clinical value.

1. INTRODUCTION

Multi-slice spiral CT plays an important role in early screening and diagnosing multiple clinical diseases. There are many studies about the application of multi-slice spiral CT in clinical chest disease diagnosis. Although spiral CT has higher accuracy rate than conventional chest X-ray examination and diagnosis, its CT radiation dose is dozens of times of conventional X-ray. So, it is required to consider the harm of large CT dose to the groups who receive early screening and repeated examinations in a short term, and children [1]. Thus, clinical trials were conducted to reduce CT radiation dose while ensuring image quality through optimizing scanning parameters of spiral CT and applying post-processing technology. In this study, the patients who were received by our hospital from April 2017 to June 2018 and needed chest

CT examination were chosen as the objects to explore the application of low kV coarse pitch combined with IRIS in reduction of radiation dose in chest multi-slice spiral CT examination. Relevant analysis content is as follows:

2. DATA AND METHOD

2.1. General Data

The time of study was from April 2017 to June 2018, and the objects of study were 80 patients who needed chest CT examination. They were classified into control group (40 cases) and observation group (40 cases) according to random number table. Observation group: 22 male cases, 18 female cases, age 3-9 years old, average age 6.4 ± 0.8 ; control group: 20 male cases, 20 female cases, age 3-8 years old, average age 6.2 ± 0.9 . The family members of all patients knew the objective of study, and signed the informed consent form. Relevant examination data were completed. The general data of both groups differed a little, which conformed to clinical comparison requirements ($p>0.05$).

2.2. Method

The child patients in both groups received spiral CT examination with the instrument SOMATOM Sensation 16-slice spiral CT. Before the examination, psychological counseling was carried out for the patients to improve their examination compliance. If the compliance was poor, chloral hydrate clysis could be applied. CT examination was implemented after the patients fell asleep. During the examination (1) parameters of control group: tube voltage 110 kV; Pitch 0.8; image reconstruction was conducted for image data with filtered back projection (FBP); (2) parameters of observation group: tube voltage 80 kV; Pitch 2.0; image reconstruction was conducted for image data with IRIS. Other parameters were same, and slice thickness and inter-slice spacing were set as 5.0mm; matrix 512×512 , FOV 200-300 mm; collimation width 16×0.6 mm; lung window reconstruction function B80s/I80s; mediastinum window reconstruction function B41s/I41s; window width WW1500HU, WW350HU; window level WL-600HU, WL-45HU. All examinations in this study were operated by the same operator in our hospital [2]. All original image data were evaluated by two clinicians with double

blind method, and they reach a consensus finally through exchanging views.

2.3. Observation Indicators

Observation indicators included: (1) CT scanning time and effective radiation dose; (2) objective score and subjective score of image quality.

2.4. Evaluation Indicators

CTDIvol and its scanning length L were used to calculate dose length product DLP. Then, DLP multiplied by the specific conversion coefficient k to estimate effective dose E: $E = k \cdot DLP$. The conversion coefficient k ($\text{mSv} \cdot \text{mGy}^{-1} \cdot \text{cm}^{-1}$) was determined according to patients' examination part and age [3]. Subjective scoring method of image quality adopted 5-score method. The higher the score, the better the quality [4]. Objective image quality evaluation

adopted signal to noise ratio (SNR) and carrier noise ratio (CNR).

2.5. Statistical Method

In this study, relevant data were analyzed with SPSS21.0 software. All kinds of parameter data belonged to measurement data and were expressed with “ $x \pm s$ ”. T test was used for differences. $p < 0.05$ means the difference has statistical significance.

3. RESULTS

3.1. Comparison of Scanning Time and Effective Dose

CT scanning time and effective dose of observation group were lower than that of control group, and the data comparison had statistical significance ($p < 0.05$), as shown in Table 1.

Table 1. Comparison of scanning time and effective dose ($\bar{x} \pm s$)

Group	No.	Scanning time (s)	Effective dose (mSv)
Observation group	40	1.12 ± 0.13	0.85 ± 0.31
Control group	40	2.59 ± 0.24	1.86 ± 0.46
<i>t</i>	/	34.061	11.515
<i>p</i>	/	<0.05	<0.05

Table 2. Comparison of image quality evaluation ($\bar{x} \pm s$)

Group	No.	Image quality score (score)	SNR	CNR
Observation group	40	4.52 ± 0.37	10.15 ± 0.85	0.58 ± 0.14
Control group	40	4.55 ± 0.29	9.89 ± 0.82	0.56 ± 0.16
<i>t</i>	/	0.403	1.392	0.594
<i>p</i>	/	>0.05	>0.05	>0.05

3.2. Comparison of Image Quality Evaluation

Image quality score, SNR and CNR of both groups differed a little, without statistical significance ($p > 0.05$) (Table 2).

4. DISCUSSION

As clinical medical image examination becomes increasingly frequent, more and more scholars started to focus on CT scanning dose problem, and proposed low-dose spiral CT. In other words, the radiation dose that the patient suffers can be reduced through optimizing CT scanning parameters and adjusting tube current, tube voltage or pitch. Meanwhile, imageological data quality can be guaranteed [5-7].

As low-dose spiral CT technology is proposed, the new problem also occurs. For example, radiation dose can decline through decreasing scanning voltage, but image noise will increase when scanning voltage drops, which will affect practical application value of image data. Even film scrapping will happen. Thus, effective post-processing technology should be applied while scanning parameters are optimized. The application of post-processing technology can make sure the image data meet requirements of clinical disease diagnosis [8,9].

In this study, different voltage and post-processing technology were adopted for the patients receiving spiral CT examination. The study showed that, the examination time declined obviously under low kV

coarse pitch combined with IRIS. At the same time, radiation dose of chest multi-slice spiral CT examination decreased, which ensured examination safety. In terms of image data quality evaluation, subjective quality parameters and objective quality parameters of both groups had no difference basically, and the two examination methods brought good image quality. The scholar Peng Xiaoxing applied low kV coarse pitch combined with IRIS in chest CT examination of preschool children, and the research indicated that the above examination method presented high safety and could reduce radiation dose. Meanwhile, he pointed that that IRIS belongs to a brand-new CT reconstruction method, and that it cannot just reduce CT radiation dose greatly, but also have more obvious advantages than traditional FBP technology. This is highly consistent with the result of this study [10].

In conclusion, low kV coarse pitch combined with IRIS contributes to reducing radiation dose in chest multi-slice spiral CT examination, accelerating scanning time and guaranteeing good imageological examination quality, so it deserves to be promoted and applied.

REFERENCES

- [1] Ke Li, Daniel Gomez-Cardona, Jiang Hsieh. Statistical model based iterative reconstruction in clinical CT systems. Part III. Task-based kV/mAs optimiza-

- tion for radiation dose reduction. *Med. Phys.*, 2015, 42(9): 5209–5221.
- [2] K. Müller, S. Datta, M. Ahmad. Interventional dual-energy imaging—Feasibility of rapid kV-switching on a C-arm CT system. *Med. Phys.*, 2016, 43(10): 5537–5546.
- [3] Bria M. Moore, Samuel L. Brady. Size-specific dose estimate (SSDE) provides a simple method to calculate organ dose for pediatric CT examinations. *Med. Phys.*, 2014, 41(7): 071917.
- [4] Mareike Held, Florian Cremers. Assessment of image quality and dose calculation accuracy on kV CBCT, MV CBCT, and MV CTimages for urgent palliative radiotherapy treatments. *J. Appl. Clin. Med. Phys.*, 2016, 17(2): 279–290.
- [5] Ömer Yilmaz, Esma Dilek Üstün, Mustafa Kayan. Diagnostic quality of CT pulmonary angiography in pulmonary thromboembolism: A comparison of three different kV values. *Med. Sci. Monit.*, 2013, 19: 908–915.
- [6] Jihang Sun, Tong Yu, Jinrong Liu, et al. Image quality improvement using model-based iterative reconstruction in low dose chest CT for children with necrotizing pneumonia. *BMC Medical Imaging*, 2017, 17(1): 1063-1075.
- [7] Jing Hua, Gui Qin Liu, Han Bao, et al. The role of liver stiffness measurement in the evaluation of liver function and esophageal varices in cirrhotic patients. *Journal of Digestive Diseases*. 2015, 16(2): 98-103.
- [8] Delko Tarik, Mattiello Diana, Koestler Thomas, et al. Computed tomography as primary postoperative follow-up after laparoscopic Roux-en-Y gastric bypass. *World Journal of Radiology*. 2018, 10(1): 1-6.
- [9] N.R. van der Werf, M.J. Willemink, et al. Influence of dose reduction and iterative reconstruction on CT calcium scores: a multi-manufacturer dynamic phantom study. *The International Journal of Cardiovascular Imaging*, 2017, 33(6): 899-914.
- [10] Michael M. Lell, Ulrike Fleischmann, Hubertus Pietsch. Relationship between low tube voltage (70 kV) and the iodine delivery rate (IDR) in CT angiography: An experimental in-vivo study. *PLoS One*, 2017, 12(3): e0173592.

Comprehensive Evaluation of College Students Based on Self-Organizing Feature Mapping Neural Network

Yuanxin Li, Hang Su*

College of Engineering, Ocean University of China, Qingdao, China

**E-mail: 842708989@qq.com*

Abstract: In the current era of rapid technology development such as machine learning and big data, the evaluation of the performance needs to be revolutionized. Due to the historical limitations, these evaluations have not been able to fully and comprehensively assess personal performance, especially when some non-quantifiable factors are included. More importantly, in the settings of students' performance, similar judging parameters exist everywhere and on almost every stage, which cannot be neglected since they also have crucial effects on the scholarship distribution and other awards that relate tightly to their future careers. Here, by reconstructing the self-organizing feature mapping model, we created and testified a new neural network of this category, the new network is both efficient and more accurate in categorizing students by these non-quantifiable parameters. We have also exemplified its application in a general instance of student's evaluation. We believe this new neural network would be a better tool in evaluating working performances in other similar fields as well.

Keywords: neural network; machine learning; performance evaluation; self-organizing feature mapping

1. INTRODUCTION

The comprehensive evaluation generally includes self and external evaluations. It is a process evaluation of long-term comprehensive elements in the entire basic education for the students. A reasonable and comprehensive evaluation system is a lively, orderly, rigorous, and interlocking process with reciprocating and spiraling steps onward. Thus for college students, it is not only a process, but also a result as well as a valued judgment of the actual implementation for the essential-qualities-oriented education.

The quality of higher education is ultimately reflected in the success of students. The main indicators of the evaluation system are based on the students' achievements. At the same time, students are encouraged to win prizes, publish papers, apply for patents, participate in projects, etc. The traditional methods used are mostly weighted including average points and average grade points and thus are not able to reflect the aforementioned evaluation categories. In fact, higher education trains not only the professional

academic ability of students, but also aids greatly in building up students' knowledge, innovation and courage. Additionally and ultimately, it fosters students' sense of rightful social responsibility and values.

The comprehensive evaluation of students is quite a complicated evaluation system. With the rapid development of technology and constant improvement of educational conditions, it is normal for students to enter key laboratories and participate in research projects even at the undergraduate level. At present, the big data processing technology has rapidly evolved and improved, and the artificial intelligence technology based on this has also entered a period of accelerated and even exponentially explosive round [1-6]. The social changes brought about by artificial intelligence and big data can be seen everywhere [7-20]. For example, behind the network shared transportation is a platform [21-23] based on the real-time traffic conditions of the entire city. The technical support for unmanned cruise ship travel is inseparable from the forecasting the extreme marine environment [24-29]. Another category of examples is computer system and network security [30-33]: the advanced behavior-based and heuristics-based system isolation and patching [34-38] could be enhanced in a non-trivial manner with these technologies. For daily life, the "Smart Supply Chain" uses machine learning and operational optimization techniques to build a data-driven intelligent analysis system, including automatic intelligent pricing systems based on history and environment to achieve human-free replenishment and delivery of information. Similar examples can also be seen in inventory system, logistics in the self-regulating warehouse robot intelligent system. Robots developed by Boston Dynamics can already jump on the complex terrain. The artificial intelligence players developed by Google have already defeated top professionals in Go games. The Texas Hold'em artificial intelligence developed by Carnegie Mellon has beaten the human world champion. In addition to these games, in the practical health science field, modeling based machine learning assisted projects have been exemplified in various fields, such as the anti-cancer drug design, X-ray structure building and cancer mechanism searching [39-52]. And both big data

analysis and machine learning have been employed for network performance enhancement through spectrum agility [53-57].

Based on the depth of big data, machine learning and cloud computing act as the supplements to nowadays' production, education and research. And this new wave of "artificial intelligence + X" combining training mode makes the original student performance evaluation system too outdated, since the factors such as students' practical ability, innovation and entrepreneurship were extremely difficult to be quantified under the previous old system. To tackle this problem, in this study, we applied Self Organizing Feature Mapping (SOFM), which is a neural network gradually reducing the functional neighbors between neurons in the learning process, while enhancing the activation degree of the central neurons according to the relevant learning rules, thereby removing the lateral connection between the neurons to achieve the simulation of brain function that is human like. This could achieve the effect of the so called "near excitement and far suppression" in the central nervous system. Based on the self-organizing feature mapping neural network with an improved structure and according to the high-dimensional data features that SOFM can handle, the results are mapped into low-dimensional space through learning and training, therefore students' performances can be integrated in combination from multiple perspectives and across disciplines. This new evaluation system greatly improves the fairness and rationality of judgement for the students' comprehensive abilities.

2. DESIGN OF THE COMPREHENSIVE EVALUATION SYSTEM

The structure of the self-organizing feature mapping neural network consists of a two-layer network with an input layer and a self-organizing feature mapping layer. The input layer is a retina that simulates the input of externally-informed information. This layer has a node with the same number of nodes as the sample dimension, and the input information is transmitted to the neurons in the output layer by real time weighting. The output competitive layer is the cerebral cortex that simulates the response. The arrangement of neurons can be divided into multiple structures: one-dimensional linear, two-dimensional planar and three-dimensional grid arrays. The two-dimensional planar array is the embodied as SOFM which is the most typical organization of the network. The schematic diagram is shown in Figure 1. In the self-organizing feature mapping neural network, not only the weights and thresholds corresponding to the winning neurons are adjusted, but also other neurons in the vicinity of the range have the opportunity to regulate their weights and thresholds, which will greatly improve the overall results as well as the learning ability and generalization ability of the network.

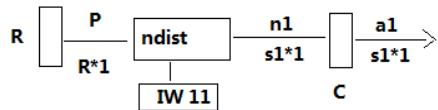


Figure 1. Structure of SOFM in two dimensions

The learning process of the self-organizing feature mapping network can be described as: for each input vector, the best matching neuron is selected, and all the weight vectors are separated from each other in the input vector space to represent the input space, and the steps are as follows:

(1) Primary state initialization. Assign a small random number to each weight vector of the output layer $\hat{W}_j(0)$, $j=1,2,\dots, m$ and determine the initial learning rate after normalization $\alpha(0)(0 < \alpha(0) < 1)$; determine the initial value $N_r(0)$ of the neighborhood $N_r(t)$. The neighborhood $N_r(t)$ refers to the winning neuron r determined by step (3), which is a collection of neurons. The typical neighborhood is a square or circular neighborhood in shape. The total number of learnings is determined as T .

(2) Input wake-up. Randomly select an input mode X^P from the input mode P to get \hat{X}^P , $P \in \{1, 2, \dots, P\}$.

(3) Obtaining the winning neurons. The winning neurons r are obtained through the euclidean minimum distance and the competitive process of the neurons.

$$\left\| \hat{X}^P - \hat{W}_r \right\| = \min_j \left\| \hat{X}^P - \hat{W}_r \right\|, j = 1, 2, \dots, m \quad (1)$$

(4) Connection correction. Correct the connection right between all neurons in the neighborhood of the competition layer and the input layer:

$$\hat{W}_j(t+1) = \hat{W}_j(t) + \alpha(t) \left\| \hat{X}_p - \hat{W}_j(t) \right\|, j \in N_r(t), 0 < \alpha(t) < 1 \quad (2)$$

(5) Mode jumping and conversion. Select another learning mode to provide to the input layer of the network, and return to step (3) until all P learning modes are provided to the network for processing.

(6) Weighted normalization, continuous assignment to $\hat{W}_j(t+1)$, so there is

$$\hat{W}_j(t+1) = \frac{\hat{W}_j(t+1)}{\left\| \hat{W}_j(t+1) \right\|}, j = 1, 2, \dots, m \quad (3)$$

(7) Update the learning rate $\alpha(t)$ and the neighborhood $N_r(t)$. The value of $\alpha(t)$ is reduced to 0, and $N_r(t)$ decreases with the increase of the numbers of training.

(8) Make $t = t + 1$, return to step (2) until $t = T$ is reached.

In the following, according to the self-organizing feature mapping network principle, a new comprehensive evaluation system is designed through

cluster analysis. A small random number is added as the initial value of the weight vector on the basis of the sample center vector to obtain an accurate clustering result. At the same time, the learning rate $\alpha(t)$ is reduced by a linear function that is first smooth and then linearly decreased to improve the efficiency and accuracy of the algorithm:

(1) Weight vector initialization: Calculate the center vector of the whole sample $\bar{X} = \frac{1}{P} \sum_{p=1}^P X^p$, and

superimpose the small random number as the initial value of the weight vector on the basis of the center vector. This method can greatly reduce the training times.

(2) Network structure establishment. Select four indicators (custom adjustment can be added to the number of indicators as needed) as the basis for comprehensive evaluation of students, that is: the input of a four-dimensional vector, with the outputs listed as excellent+, excellent-, good+, good, good-, five neurons.

(3) Parameter design. Set $\alpha(t)$ as a piecewise function:

$$\alpha(t) = \begin{cases} \alpha(0), & 0 < t \leq T_p \\ \alpha(0)\left(1 - \frac{t-T_p}{T-T_p}\right), & T_p < t \leq T \end{cases} \quad (4)$$

(4) In the early stage of network training, in order to quickly capture the general structure of the input sample space, it is desirable to have a strong weight adjustment ability, so when the number of training times meets $t \leq T_p$, $\alpha(t)$ takes the maximum value $\alpha(0)$. When the number of training times meets

$t > T_p$, $\alpha(t)$ evenly reduces to 0 to finely adjust the weight, making it suits the sample space. When the weight of the network neuron matches the sample space structure, the corresponding number of trainings is T . T_p can be the fraction of T , such as taking $T_p = 0.5T$. In this study, $\alpha(0) = 0.95$, $T = 2000$, $T_p = 1000$. Since $N_r(t)$ decreases with the training number increases, so make $N_r(t) = \text{INT}[N_r(0)(1 - \frac{t}{T})]$, where INT is the rounding symbol.

3. EXAMPLES OF COMPREHENSIVE EVALUATION OF UNDERGRADUATE STUDENTS

A total of 28 college students (2014) from engineering major were evaluated. The reference was based on the class's performance in the first half of 2015-2016. The student's corresponding number is u_1, u_2, \dots, u_{28} . So the sample set is generated as $U = \{u_1, u_2, \dots, u_{28}\}$. The four indicators of test scores, social activities, scientific research ability and independent innovation projects were selected as the reference factors with 25 points as the full score. The variables were set to v_1, v_2, v_3 and v_4 , and the indicator set was generated accordingly as $V = \{v_1, v_2, v_3, v_4\}$. According to the above four aspects, there could be the results of the student's comprehensive assessment (Table 1); the distribution of student scores can be obtained from Table 1, as in Figure 2.

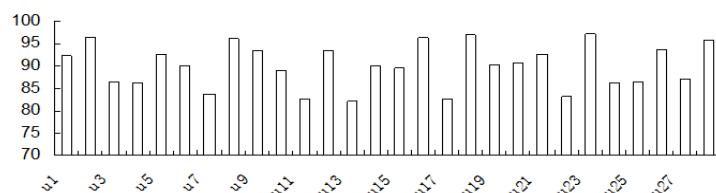


Figure 2. Distribution of the students' scores

Table 1. Comprehensive evaluation

Indicators Students	v_1	v_2	v_3	v_4	Total Score	Indicators Students	v_1	v_2	v_3	v_4	Total Score
u1	20.033	24.019	24.145	24.135	92.332	u15	18.778	23.602	23.612	23.548	89.54
u2	21.894	24.912	24.856	24.625	96.287	u16	21.983	24.954	24.836	24.712	96.485
u3	17.317	23.12	23.112	23.012	86.561	u17	15.094	22.514	22.641	22.534	82.783
u4	17.106	23.105	23.019	23.101	86.331	u18	22.333	24.897	24.872	24.801	90.903
u5	20.156	24.154	24.019	24.201	92.53	u19	19.578	23.571	23.569	23.548	96.266
u6	19.294	23.517	23.647	23.546	90.004	u20	19.844	23.601	23.645	23.624	90.714
u7	15.989	22.53	22.451	22.654	83.624	u21	20.122	24.142	24.111	24.108	92.483
u8	21.583	24.845	24.916	24.678	96.022	u22	15.594	22.534	22.547	22.631	83.306
u9	20.961	24.21	24.103	24.199	93.473	u23	22.594	24.895	24.901	24.756	97.146
u10	18.233	23.564	23.646	23.587	89.03	u24	16.883	23.107	23.098	23.105	86.193
u11	14.906	22.612	22.634	22.621	82.773	u25	17.294	23.142	23.065	23.112	86.613
u12	20.839	24.201	24.106	24.116	93.262	u26	21.033	24.204	24.099	24.202	93.538
u13	14.411	22.613	22.534	22.654	82.212	u27	17.7	23.054	23.156	23.189	87.099
u14	19.206	23.612	23.625	23.526	89.969	u28	21.411	24.854	24.931	24.758	95.954

Clustering and analysis of results shows that students are divided into five categories:

$\{u_1, u_5, u_9, u_{12}, u_{21}, u_{26}\}$, $\{u_2, u_8, u_{16}, u_{18}, u_{23}, u_{28}\}$, $\{u_3, u_4, u_{24}, u_{25}, u_{27}\}$, $\{u_6, u_{10}, u_{14}, u_{15}, u_{19}, u_{20}\}$, $\{u_7, u_{11}, u_{13}, u_{17}, u_{22}\}$. By the difference between classes and classes, we can see that the average score of six students $\{u_1, u_5, u_9, u_{12}, u_{21}, u_{26}\}$ is 92.936; the average score of six students $\{u_2, u_8, u_{16}, u_{18}, u_{23}, u_{28}\}$ is 96.466; the average score of five students $\{u_3, u_4, u_{24}, u_{25}, u_{27}\}$ is 86.559; the average total score of the students of six students $\{u_6, u_{10}, u_{14}, u_{15}, u_{19}, u_{20}\}$ is 89.921; the average score of the five students $\{u_7, u_{11}, u_{13}, u_{17}, u_{22}\}$ is 82.940. Because the average total scores of the five categories for the students have a reasonable gap, the level of students in this class is more obvious, therefore the classification results are satisfying. According to the average total score $\{u_2, u_8, u_{16}, u_{18}, u_{23}, u_{28}\}$ can be judged as excellent+, $\{u_2, u_8, u_{16}, u_{18}, u_{23}, u_{28}\}$ students are excellent-, $\{u_6, u_{10}, u_{14}, u_{15}, u_{19}, u_{20}\}$ students are good+, $\{u_3, u_4, u_{24}, u_{25}, u_{27}\}$ students are good, and $\{u_7, u_{11}, u_{13}, u_{17}, u_{22}\}$ students are good-. This result can also be used to give scholarships results correspondingly. $\{u_2, u_8, u_{16}, u_{18}, u_{23}, u_{28}\}$ students can be assessed as first-class scholarships, $\{u_2, u_8, u_{16}, u_{18}, u_{23}, u_{28}\}$ students are second-class scholarships, and $\{u_6, u_{10}, u_{14}, u_{15}, u_{19}, u_{20}\}$ students are third-class scholarships.

4. CONCLUSIONS AND SUMMARY

Comprehensive evaluation is a long-term and eclectic evaluation process. In the evaluation content, we must not only pay attention to comprehensiveness, but also pay attention to the hierarchy of inborn structures. The evaluation index system should be dynamically adjusted according to the different educational objects, sections, goals, requirements and characteristics. More specifically:

- (1) Our results showed that only the consistency of the evaluation objectives, the continuity of the evaluation methods, and the sustainability of the evaluation results can make the students develop comprehensively and harmoniously in all aspects.
- (2) There is a must to establish a dynamic evaluation system that can reflect students' ability to solve practical problems and gaining research and innovation talents. The future destination must be to improve not only the evaluation of students' professional knowledge accumulation, but based on the static evaluation system of learning results, it

should also achieves objective and scientific assessment of all aspects of students' intellectual education.

(3) Self-organizing feature mapping neural network also has some problems to be improved. For example, when processing large sample data, it is bound to greatly increase the network size: the number of neurons and complexity. There are also problems such as distortion or losing information from high-dimensional mapping to low-dimensionality. Therefore, there is still a boundless research and developing space for self-organizing feature mapping neural networks.

REFERENCES

- [1] PONCE-LÓPEZ V., CHEN B., OLIU M. ChaLearn LAP 2016: First Round Challenge on First Impressions - Dataset and Results. Computer Vision – ECCV 2016 Workshops. Springer, Cham, 2016: 400–418.
- [2] Zhang S.F., Shen W., Li D.S., Zhang X.W., and Chen B. Nondestructive ultrasonic testing in rod structure with a novel numerical Laplace based wavelet finite element method. Latin American Journal of Solids and Structures, 2018, 15(7): 1-17, e48.
- [3] Escalante H.J., Ponce-López V., Wan J., et al. ChaLearn Joint Contest on Multimedia Challenges Beyond Visual Analysis: An overview. 2016 23rd International Conference on Pattern Recognition (ICPR), 2016: 67–73.
- [4] Liu X., He Y., Fu H., Chen B., Wang M., Wang Z. How Environmental Protection Motivation Influences on Residents' Recycled Water Reuse Behaviors: A Case Study in Xi'an City. Water2018, 10, 1282.
- [5] Jiang Song, Lian Minjie, Lu CaiWu, Ruan Shunling, Wang Zhe, and Chen Baiyu. SVM-DS fusion based soft fault detection and diagnosis in solar water heaters, Energy Exploration & Exploitation, DOI: 10.1177/0144598718816604
- [6] Chen B., Escalera S., Guyon I., et al. Overcoming Calibration Problems in Pattern Labeling with Pairwise Ratings: Application to Personality Traits. Computer Vision – ECCV 2016 Workshops. Springer, Cham, 2016: 419–432.
- [7] Liu X., He Y., Fu H., Chen B., Wang M., Scientometric of Nearly Zero Energy Building Research: A Systematic Review from the Perspective of Co-Citation Analysis. Journal of Thermal Science.
- [8] Wang L.P., Chen B., Zhang J.F., Chen Z. A new model for calculating the design wave height in typhoon-affected sea areas. Natural Hazards. Springer Netherlands, 2013, 67: 129–143.
- [9] Chen B., Yang Z., Huang S., Du X., Cui Z., Bhimani J., et al. Cyber-physical system enabled nearby traffic flow modelling for autonomous vehicles. 36th IEEE International Performance Computing and Communications Conference, Special Session on Cyber Physical Systems: Security,

- Computing, and Performance (IPCCC-CPS) IEEE, 2017.
- [10] Anthony Barrs, Chen Baiyu. How Emerging Technologies Could Transform Infrastructure. <http://www.governing.com/gov-institute/voices/cole-hyperlane-emerging-technologies-transform-infrastructure.html>.
- [11] Chen B. and Wang B. Location Selection of Logistics Center in e-Commerce Network Environments. American Journal of Neural Networks and Applications, Science Publishing Group, 2017, 3(4): 40-48.
- [12] Wang L., Xu X., Liu G., Chen B., Chen Z. A new method to estimate wave height of specified return period. Chin. J. Oceanol. Limnol. Science Press, 2017, 35: 1002–1009.
- [13] Deng Z.Q., Tian Y., Tang D.W., et al. Research on new structure coring bit for extraterrestrial bodies exploration. Chin. J. Mech. Eng., 2013, 49(19), 104–110
- [14] Tian Ye, Deng Zongquan. Coring Bit with Enhanced Structural Parameters for Improved Lunar Soil Sampling and Reduced Mechanical Disturbance. Journal of aerospace engineering, American Society of Civil Engineers, 2016, 29(4): 04016015.
- [15] Tian Y., Deng Z.Q., Tang D.W., et al. Drilling Power Consumption Analysis of Coring Bit in Lunar Sample Mission. Journal of aerospace engineering, American Society of Civil Engineers, 2017, 30(5): 04017055.
- [16] Tian Y., Sun Z.H., Zhang L. Analysis of Structural Parameters of Flexible Spiral Conveyor Blades and Study of its Transmission Power. Ammonia Plant Safety and Related Facilities, 2012, 200: 455–458.
- [17] Tian Y., Tang D., Deng Z., et al. Drilling power consumption and soil conveying volume performances of lunar sampling auger. Chinese Journal of Mechanical Engineering, Chinese Mechanical Engineering Society, 2015, 28(3): 451–459.
- [18] Tian Y., Deng Z.Q., and Tang D.W. Structure parameters optimization and simulation experiment of auger in lunar soil drill-sampling device. Chin. J. Mech. Eng., 2012, 48(23): 10–15 (in Chinese).
- [19] Tian Ye, Yuan Panpan, Yang Fei, et al. Research on the Principle of a New Flexible Screw Conveyor and Its Power Consumption. Applied Sciences. 2018, 8(7): 1038-1045.
- [20] Tian Y., Deng Z.Q., Tang D.W., et al. Power consumption of lunar subsurface coring driller and earth environment stimulant experiments. Journal of Jilin University Engineering and Technology Edition, 2016
- [21] Chen B., Liu G., Wang L. Predicting Joint Return Period Under Ocean Extremes Based on a Maximum Entropy Compound Distribution Model. International Journal of Energy and Environmental Science, 2017, 2(6): 117-126.
- [22] Wang L.P., Chen B.Y., Chen C., Chen Z.S., Liu G.L. Application of linear mean-square estimation in ocean engineering. China Ocean Eng. Chinese Ocean Engineering, 2016, 30: 149–160.
- [23] Chen Baiyu, Liu Guilin, Zhang Jianfang et al. A calculation method of design wave height under the three factors of typhoon: China, ZL 2016 1 0972118.X. Patent, 2016-10-31.
- [24] Wang Liping, Liu Guilin, Chen Baiyu et al. Typhoon influence considered method for calculating combined return period of ocean extreme value: China, ZL 2010 1 0595807.6. Patent, 2013-03-20.
- [25] Liu Guilin, Zheng Zhenjun, Wang Liping, et al. Power-type wave absorbing device and using method thereof: China, ZL 2015 1 0575336.5. Patent, 2017-11-03.
- [26] Wang Liping, Liu Guilin, Chen Baiyu, et al. Typhoon based on the principle of maximum entropy waters affect the design wave height calculation method: China, ZL 2010 1 0595815.0. Patent, 2015-08-19.
- [27] Liu G., Chen B., Wang L., et al. Wave Height Statistical Characteristic Analysis. Journal of oceanology and limnology. 2018, 36(4): 1123-1136.
- [28] Chen Baiyu, Liu Guilin, Wang Liping, Zhang Kuangyuan, Zhang Shuaifan. Determination of Water Level Design for an Estuarine City. Journal of oceanology and limnology, 2019, <https://doi.org/10.1007/s00343-019-8107-z>
- [29] Chen Baiyu, Zhang Kuangyuan, Wang Liping, Jiang Song, Liu Guilin, Generalized Extreme Value - Pareto Distribution Function and Its Applications in Ocean Engineering. Chinese Ocean Engineering, 2019, 2.
- [30] Chen Y., Zhang Y., Wang Z., Wei T. Downgrade Attack on TrustZone. arXiv preprint arXiv:1707.05082. 2017, Jul 17.
- [31] Hong J.B., Nhlabatsi A., Kim D.S., Hussein A., Fetais N., Khan K.M. Systematic Identification of Threats in the Cloud: A Survey. Computer Networks, 2018.
- [32] Zhou Y., Wang X., Chen Y., Wang Z. Armlock: Hardware-based fault isolation for arm. In Proceedings of the 2014 ACM SIGSAC Conference on Computer and Communications Security, 2014 Nov 3, pp. 558-569.
- [33] Chen Y., Wang Z., Whalley D., Lu L. Remix: On-demand live randomization. In Proceedings of the Sixth ACM Conference on Data and Application Security and Privacy 2016 Mar 9, pp. 50-61.
- [34] Wang X., Qi Y., Wang Z., Chen Y., Zhou Y. Design and implementation of SecPod, a framework for virtualization-based security systems. IEEE Transactions on Dependable and Secure Computing, 2017 Mar 2.
- [35] Wang X., Chen Y., Wang Z., Qi Y., Zhou Y. SecPod: a Framework for Virtualization-based Security Systems. In USENIX annual technical conference, 2015 Jul 8, pp. 347-360.

- [36] Chen Y., Zhang Y., Wang Z., Xia L., Bao C., Wei T. Adaptive android kernel live patching. In Proceedings of the 26th USENIX Security Symposium (USENIX Security 17), 2017 Aug.
- [37] Li J., Lin Z., Caballero J., Zhang Y., Gu D. K-Hunt: Pinpointing Insecure Cryptographic Keys from Execution Traces. In Proceedings of the 2018 ACM SIGSAC Conference on Computer and Communications Security, 2018 Oct 15, pp. 412-425.
- [38] Zhang Y., Chen Y., Bao C., Xia L., Zhen L., Lu Y., Wei T., Baidu X. Adaptive kernel live patching: An open collaborative effort to ameliorate android n-day root exploits. Proceedings of Black Hat USA, 2016.
- [39] Cheun Y., Kou Y., Stevenson B., Kim H.-K., Koag M.C., Lee S. Synthesis of C17-OH-north unit of ritterazine G via “Red-Ox” modifications of hecogenin acetate. *Steroids*. 2013, 78: 639–643.
- [40] Kou Y. and Lee S. Unexpected opening of steroid E-ring during hypoiodite-mediated oxidation. *Tetrahedron Lett.* 2013, 54: 4106–4109.
- [41] Kou Y. Structural and kinetic study of N7-methyl, N7-benzyl and C8-chloro guanine lesions using human DNA polymerase β . 2015. Available: <https://repositories.lib.utexas.edu/handle/2152/46815>
- [42] Lee S., Kou Y., Koag M. Mechanism of alkylation and platinination-induced mutagenesis. *Environmental and Molecular Mutagenesis*, 59: 107–107.
- [43] Kou Y., Koag M.-C., Lee S. N7 methylation alters hydrogen-bonding patterns of guanine in duplex DNA. *J. Am. Chem. Soc.* 2015, 137: 14067–14070.
- [44] Cheun Y., Koag M.C., Kou Y., Warnken Z., Lee S. Transterification-mediated E-ring opening and stereoselective “Red-Ox” modification of furostan. *Steroids*, 2012, 77: 276–281.
- [45] Lei X., Kou Y., Fu Y., Rajashekhar N., Shi H., Wu F., et al. The cancer mutation D83V induces an α -helix to β -strand conformation switch in MEF2B. *J. Mol. Biol.* 2018, doi:10.1016/j.jmb.2018.02.012
- [46] Lei X., Shi H., Kou Y., Rajashekhar N., Wu F., Sen C., et al. Crystal Structure of Apo MEF2B Reveals New Insights in DNA Binding and Cofactor Interaction. *Biochemistry*, 2018, 57: 4047–4051.
- [47] Koag M.C., Kou Y., Ouzon-Shubeita H., Lee S. Transition-state destabilization reveals how human DNA polymerase β proceeds across the chemically unstable lesion N7-methylguanine. *Nucleic Acids Res.* 2014, 42: 8755–8766.
- [48] Yang Y., Chen L., Pan H.Z., Kou Y., Xu C.M. Glycosylation modification of human prion protein provokes apoptosis in HeLa cells in vitro. *BMB Rep.* 2009, 42: 331–337.
- [49] Koag M.C., Cheun Y., Kou Y., Ouzon-Shubeita H., Min K., Monzingo A.F., et al. Synthesis and structure of 16,22-diketocholesterol bound to oxysterol-binding protein Osh4. *Steroids*, 2013, 78: 938–944.
- [50] Kou Y., Koag M.C., Cheun Y., Shin A., Lee S. Application of hypoiodite-mediated aminyl radical cyclization to synthesis of solasodine acetate. *Steroids*, 2012, 77: 1069–1074.
- [51] Kou Y., Cheun Y., Koag M.C., Lee S. Synthesis of 14',15'-dehydro-ritterazine Y via reductive and oxidative functionalizations of hecogenin acetate. *Steroids*, 2013, 78: 304–311.
- [52] Kou Y., Koag M.C., Lee S. Structural and Kinetic Studies of the Effect of Guanine N7 Alkylation and Metal Cofactors on DNA Replication. *Biochemistry*, 2018, 57: 5105–5116.
- [53] Cui P., Tonnemacher M., Rajan D., Camp J. WhiteCell: Energy-efficient use of unlicensed frequency bands for cellular offloading. In Proceedings of 2015 IEEE International Symposium on Dynamic Spectrum Access Networks (DySPAN), Stockholm, Sweden, 29 Sep.–2 Oct. 2015, IEEE: Piscataway, NJ, 2015, pp.188-199.
- [54] Cui P., Liu H., He J., Altintas O., Vuyyuru R., Rajan D., Camp J. Leveraging diverse propagation and context for multi-modal vehicular applications. In Proceedings of 2013 IEEE 5th International Symposium on Wireless Vehicular Communications (WiVeC), 2 June–3 June 2013, IEEE: Dresden, Germany
- [55] Cui P., Liu H., Rajan D., Camp J. A measurement study of white spaces across diverse population densities. . In Proceedings of), 2014 12th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks (WiOpt), 12-16 May 2014, Hammamet, Tunisia.
- [56] Cui P., Chen S., Camp J. Green Loading: Using the Citizens Band Radio for Energy-Efficient Offloading of Shared Interests. In Proceedings of the 21st ACM International Conference on Modeling, Analysis and Simulation of Wireless and Mobile Systems.
- [57] Song J., Feng Q., Wang X., Fu H., Jiang W., Chen B. Spatial Association and Effect Evaluation of CO₂ Emission in the Chengdu-Chongqing Urban Agglomeration: Quantitative Evidence from Social Network Analysis. *Sustainability*, 2019, 11, 1.

Application of Econometrics Models in Risk Evaluation of Logistics Project

Dafeng Xu¹, Chao Song¹, Tongtong Xu^{2,*}

¹Economics and Management, Shandong Jiaotong University, Jinan, Shandong, China

²Shandong University of Finance and Economics, Jinan, Shandong, China

*E-mail: xtong2018@163.com

Abstract: Logistics risk cost measurement is the basis and premise of logistics risk cost management, and also quantify the cost of business due to risk. As the basis of logistics risk cost management, logistics risk cost measurement is an important part of logistics risk cost management, which is of great significance to strengthening the logistics risk cost management. Without the measurement of logistics risk cost, the management of logistics risk cost will become the foundationless building, the lack of reliable measurement data, there will be no basis for the management of logistics risk cost, the role of decision-making will be greatly reduced, thus losing the management significance and application value. Because of the uncertainty of logistics risk cost as a basic feature, so how to measure the cost of logistics risk has become a problem, people conducted a variety of analysis and research for it, until today is still a challenging subject. In this paper, I mainly use Fuzzy Comprehensive Measurement method and BP network to do the risk evaluation of logistics project. Meanwhile, I consider the risk of cost. By comparing the results among different models, I could conclude that Fuzzy Comprehensive Measurement Method and BP network has some distinct advantages in evaluating the risk of logistics project.

Keywords: application of econometrics models; logistics project; risk evaluation; fuzzy comprehensive measurement method; BP network

1. FUZZY COMPREHENSIVE MEASUREMENT METHOD

1.1. The Model of Fuzzy Comprehensive Measurement Method

In practical work, the evaluation (or assessment) of a thing often involves a number of factors or indicators, then requires the evaluation of things based on a number of factors, but not on a case by case basis to evaluate things. This is a comprehensive evaluation. Fuzzy comprehensive evaluation is a very effective multivariate decision-making method for making a comprehensive assessment of things affected by many factors [1].

Assuming $U = \{u_1, u_2, u_3, \dots, u_n\}$ are n factors, $V = \{v_1, v_2, \dots, v_m\}$ are m judgments, their number of elements and names can be subjectively defined by people according to practical problems. Due to the different status of various factors, the role is not the

same, of course, the weight is also different, so the judgment is also different. People are not absolutely positive or negative about m kinds of judgments, so the comprehensive judgment should be a fuzzy subset of V , and $B = \{b_1, b_2, \dots, b_m\} \in \Phi(V)$, where $b_j (j = 1, 2, \dots, m)$ reflects the j 's position- v_j in the comprehensive judgment(that is v_j degree of membership of fuzzy sets [2]: $B(v_j) = b_j$). Comprehensive judgment B depends depends on the weight of each factor, and each weight is a fuzzy subset $A = \{a_1, a_2, \dots, a_n\} \in \Phi(U)$ on U , and $\sum_{l=1}^n a_l = 1$, a_l denotes the weight of the I factor. Therefore, once a weight is given, a comprehensive judgment B can be obtained accordingly.

According to the specific problems, we need to establish a fuzzy transformation T from U to V . If we make a separate judgment $f(u_i)$ for each factor u_i , this can be regarded as the fuzzy projection f from U to V , that is, $f: U \rightarrow \Phi(V)$ and $U_i \mapsto f(U_i) \in \Phi(V)$.

From f we can derive a fuzzy transformation Tf from U to V , and we can regard Tf as the mathematical model of comprehensive evaluation B obtained from weight A [3].

From the above analysis we can see that the mathematical model of fuzzy comprehensive evaluation consists of three elements, the steps are divided into four steps [4]:

- (1) Factor Set $U = \{u_1, u_2, u_3, \dots, u_n\}$;
- (2) Judgment Set $V = \{v_1, v_2, \dots, v_m\}$;
- (3) Single Factor Evaluation: $f: U \rightarrow \Phi(V)$ and $u_i \mapsto f(u_i) = (r_{i1}, r_{i2}, \dots, r_{il}) \in \Phi(V)$. Fuzzy mapping f can induce a fuzzy relationship $R_f \in (U \times V)$, that is $R_{f(u_i, v_i)} = f(u_i)(v_i) = r_{ij}$, Thus R_f can be represented by the fuzzy matrix $R \in \mu n \times m$:

$$R = \begin{bmatrix} r_{11}, r_{12}, r_{13}, r_{14}, r_{1m} \\ r_{21}, r_{22}, r_{23}, r_{24}, r_{2m} \\ \dots & \dots & \dots & \dots \\ r_{n1}, r_{n2}, r_{n3}, r_{n4}, r_{nm} \end{bmatrix}$$

We call R a single factor evaluation matrix, and the fuzzy transformation Tf from U to V can be induced by the fuzzy relation R . $U (U_1, U_2, \dots, U_n)$ form a fuzzy comprehensive decision-making model, U_1, U_2, \dots, U_n is the n elements of the model.

- (4) Comprehensive Evaluation [5]. For the weight A

= (a₁ a₂ a₃ a₄ a₅ a₆), according to fuzzy mathematical evaluation model formula A × R = B, fuzzy comprehensive evaluation operation, where B = (b₁ b₂ b₃ b₄ b₅ b₆) is the total assessment results. In accordance with the principle of maximum membership, the highest value of b_{jmax} in b_j corresponding to the grade V_j is the result of comprehensive evaluation, that is, the risk level of the object being evaluated.

1.2. Design of Risk Evaluation Index System for Logistics Project

The design of investment risk index system is of great significance to the formulation of decision-making. There are many indicators of project evaluation [6], different projects can be based on their actual situation and focus on the selection of different indicators to investigate.

The formulation of the risk assessment index system must follow the principles of scientificity and practicability, integrity and operability, incompatibility and systematization, combination of qualitative and quantitative indicators, and the unification of static and dynamic indicators with the following aspect: (1) Comprehensive principle. Indicator system should be able to fully reflect the comprehensive evaluation of the object [7]. It can analyze environmental, economic and technological aspects (ie., three major characteristics of green products) to make full use of multidisciplinary knowledge and interdisciplinary and comprehensive knowledge to ensure the comprehensiveness and reliability of comprehensive assessment. (2) Scientific principle. Strive to objectively, truly and accurately reflect the “green attribute” of the evaluated object. Some indicators may not yet be necessary to obtain data or difficult to obtain the exact data, but with a larger relationship with the comprehensive assessment, can still be proposed indicators. (3) Systematic principle. It is necessary to fully reflect the environmental indicators, resource attributes, energy attributes and economic attributes of the products, and pay attention to seize the major factors that affect them. (4) Feasibility principle. Evaluation indicators should have a clear meaning and to a certain degree of realistic statistics as a basis, according to the number of calculations and analysis. At the same time, the standard project should be appropriate, the content should be concise, suitable for the actual method is feasible. To meet the validity of the premise, as clear and easy as possible [8]. (5) The principle of combining static assessment with

dynamic assessment. Some evaluation indicators are subject to market and user needs and other factors, and the design of the index system requirements will also continue to change with the development of technology and social development. In the assessment, we must take into account the existing state of the object being evaluated, but also give full consideration to the future development. (6) The principle of combining qualitative assessment and quantitative assessment. In the assessment, it is necessary to grasp one side of the “quality” of the object being evaluated, conduct a qualitative analysis of the object, and grasp the “quantity” side of the object to be evaluated to conduct quantitative analysis of the evaluation index as much as possible. However, it is more difficult to quantify some indicators, at this time, qualitative indicators can also be used to describe, in order to obtain the scientific assessment conclusion from the perspective of quality and quantity. (7) Incompatibility principle. As many assessment projects should be avoided as much as possible similar or indicators repeated, and can be concise, general and representative.

According to the actual situation of the logistics project, with reference to the research results at home and abroad, I set 23 indicators for the existence of six types of risk in the above-mentioned logistics project to evaluate the risk investment of the logistics project (Figure 1) [9].

- (1) Market Risk (U₁): Service innovation (U₁₁); Customer demand level (U₁₂); Logistics services competitors (U₁₃); Logistics market growth (U₁₄);
- (2) Manage Risk (U₂): Entrepreneurial style (U₂₁); Management quality (U₂₂); Management ability (U₂₃); Management moral hazard (U₂₄); Corporate culture (U₂₅);
- (3) Technical Risk (U₃): Substitutability of Technology (U₃₁); Advanced technology (U₃₂); Technical applicability (U₃₃); Technical reliability (U₃₄);
- (4) Financial Risk (U₄): Changes in interest and exchange rate (U₄₁); Changes in the rate of return on investment (U₄₂); Difficulties in property transactions (U₄₃); Financial risk (U₄₄);
- (5) Operational Risk (U₅): Equipment condition (U₅₁); Operator condition (U₅₂); Standardization of operation (U₅₃);
- (6) Environment Risk (U₆): National Macro-political Economics Environment (U₆₁); Policies and regulations (U₆₂); Micro basic environment of investment sites (U₆₃);

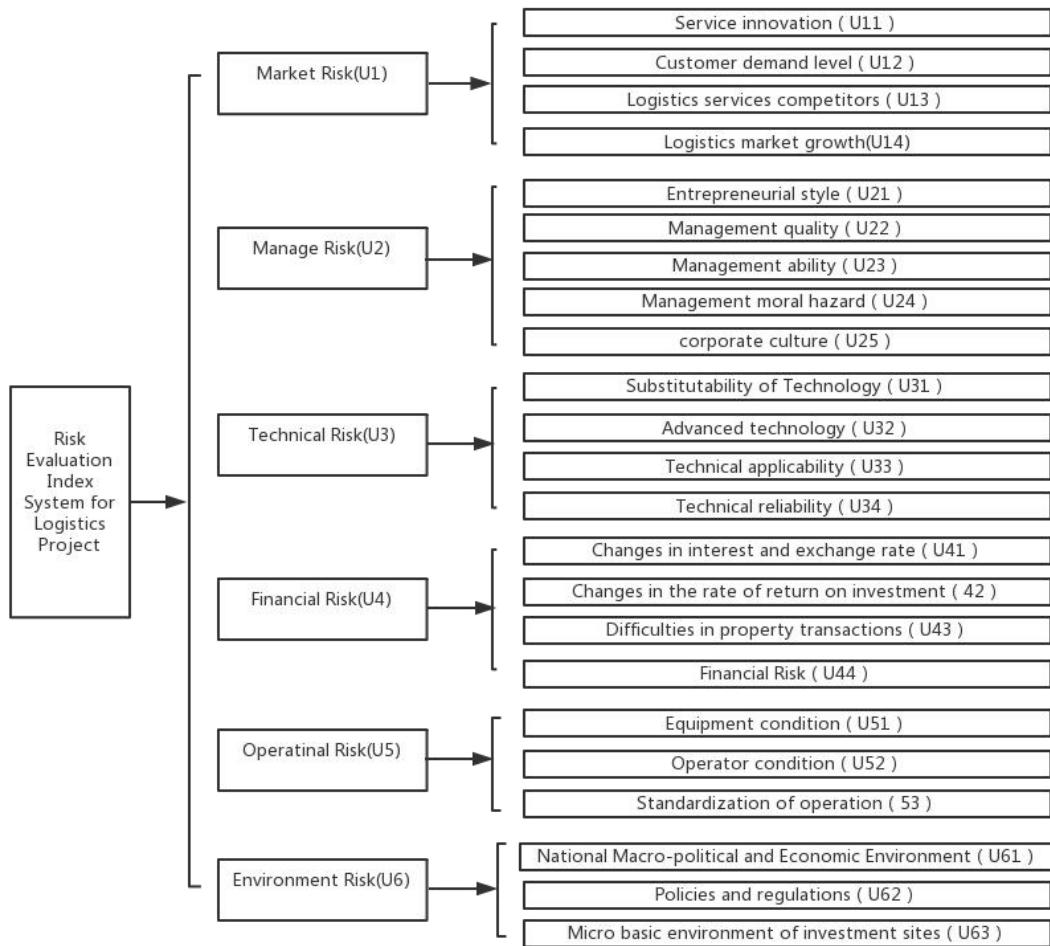


Figure 1. The Main Parts of Risk Evaluation Index System

1.3. Measurement of Risk on Logistics Company

As a large state-owned enterprise, a big logistics company has many years of transport, warehousing, freight forwarding and other service experience and strong financial strength, and the enterprise faces enormous market opportunities and challenges in its transition to a logistics enterprise. Investment in the construction of large-scale logistics projects will have to consider many risk factors as a basis for decision-making. The following will be based on the actual situation of the enterprise, according to the logistics project risk assessment index system to carry out its risk assessment of logistics projects. Since each index cannot be evaluated by a simple quantitative analysis method, the fuzzy comprehensive evaluation method is used to make a fuzzy comprehensive evaluation of the risks. The indicator design is divided into two layers, which need two fuzzy operations. The specific operation process is as follows.

1.3.1. Grade classification of logistics project risk evaluation

The risk level is divided into 5 levels: low risk (V_1), medium low risk (V_2), general risk (V_3), medium high risk (V_4) and high risk (V_5). The above 5 evaluation rank elements constitute the evaluation level set. $V = \{V_1, V_2, V_3, V_4, V_5\}$. According to the

standards of each evaluation index, the classification of each evaluation index is shown in Figure 1.

1.3.2. Weight allocation of evaluation index

For the six weights of the evaluation indicators, I used the Delphi method to issue a consultation letter to 10 experts (including scholars, business leaders and managers) and scored the weight of 6 sub-sets of evaluation indicators. The results of the consultation are then studied and the weights of the evaluation indicators and subsets determined, see Table 1.

Table 1. Weight of evaluation index subset of logistics project

Evaluation index subset	U_1	U_2	U_3	U_4	U_5	U_6
Weight	0.29	0.21	0.11	0.13	0.19	0.07

where $A_1 = (a_{11} a_{12} a_{13} a_{14}) = (0.2 0.3 0.3 0.2)$; $A_2 = (a_{21} a_{22} a_{23} a_{24} a_{25}) = (0.25 0.2 0.2 0.25 0.1)$; $A_3 = (a_{31} a_{32} a_{33} a_{34}) = (0.15 0.25 0.3 0.3)$; $A_4 = (a_{41} a_{42} a_{43} a_{44}) = (0.3 0.3 0.1 0.3)$; $A_5 = (a_{51} a_{52} a_{53}) = (0.4 0.3 0.3)$, and $A_6 = (a_{61} a_{62} a_{63}) = (0.35 0.25 0.4)$.

1.3.3. Determination of evaluation matrix

At first, I determine the evaluation matrix, and the tailored logistics project risk evaluation level classification criteria and the logistics project index system are submitted to the jury. If the committee has m reviewers, the index U_t has k items, and the

indicator U_{ik} has a total of m_{ikj} individuals on the V_j level draws “√”, then it can be considered that the evaluation of the U_{ik} evaluation index by the whole evaluation committee is the probability of selecting “√”:

$$R_{ikj} = m_{ikj}/n_j \quad (j = 1, 2, 3, 4, 5) \quad (1)$$

The above formula is the result of the statistics of single index. According to the frequency data of the “√” in the five grades of the index, it can be written as a row matrix of single index evaluation:

$$\begin{aligned} R_{ik} &= (r_{ik1} \ r_{ik2} \ r_{ik3} \ r_{ik4} \ r_{ik5}) = (m_{ik1}/n \\ &\quad m_{ik2}/n \ m_{ik3}/n \ m_{ik4}/n \ m_{ik5}/n) \end{aligned} \quad (2)$$

If there is no “√” in the evaluation committee at a certain level at V_j , the r_{ikj} is 0, indicating that the enterprise does not belong to this level in this index. Thus, the rating matrix R_i is obtained:

$$R_i = \begin{bmatrix} R_{i1} \\ R_{i2} \\ \dots \\ R_{ik} \end{bmatrix} = \begin{bmatrix} r_{i11} & r_{i12} & r_{i13} & r_{i14} & r_{i15} \\ r_{i21} & r_{i22} & r_{i23} & r_{i24} & r_{i25} \\ \dots & \dots & \dots & \dots & \dots \\ r_{ik1} & r_{ik2} & r_{ik3} & r_{ik4} & r_{ik5} \end{bmatrix} \quad (3)$$

According to the current situation and development forecast of the logistics project investment in a large state-owned enterprise, the calculation results were calculated and sorted, and the evaluation matrix was obtained as follows:

$$(a_{i1}a_{i2}a_{i3}a_{i4}a_{i5}) * \begin{bmatrix} r_{i11} & r_{i12} & r_{i13} & r_{i14} & r_{i15} \\ r_{i21} & r_{i22} & r_{i23} & r_{i24} & r_{i25} \\ \dots & \dots & \dots & \dots & \dots \\ r_{ik1} & r_{ik2} & r_{ik3} & r_{ik4} & r_{ik5} \end{bmatrix} = (b_{i1}b_{i2}b_{i3}b_{i4}b_{i5}) \quad (4)$$

The fuzzy subset $B_i = (b_{i1}b_{i2}b_{i3}b_{i4}b_{i5})$ ($i = 1, 2, 3, 4, 5, 6$, $b_{ij} \in [0, 1]$) is the first level of comprehensive evaluation results, indicating that each U_i ($i = 1, 2, 3,$

$$R_1 = \begin{bmatrix} R_{11} \\ R_{12} \\ R_{13} \\ R_{14} \end{bmatrix} = \begin{bmatrix} 0.2 & 0.3 & 0.3 & 0.1 & 0.1 \\ 0.3 & 0.5 & 0.2 & 0 & 0 \\ 0.3 & 0.5 & 0.2 & 0 & 0 \\ 0.4 & 0.3 & 0.2 & 0.1 & 0 \end{bmatrix}$$

$$R_2 = \begin{bmatrix} R_{21} \\ R_{22} \\ R_{23} \\ R_{24} \\ R_{25} \end{bmatrix} = \begin{bmatrix} 0.2 & 0.5 & 0.2 & 0.1 & 0 \\ 0.3 & 0.5 & 0.2 & 0 & 0 \\ 0.5 & 0.3 & 0.2 & 0 & 0 \\ 0.2 & 0.5 & 0.2 & 0.1 & 0 \\ 0.3 & 0.4 & 0.2 & 0.1 & 0 \end{bmatrix}$$

$$R_3 = \begin{bmatrix} R_{31} \\ R_{32} \\ R_{33} \\ R_{34} \end{bmatrix} = \begin{bmatrix} 0.3 & 0.5 & 0.2 & 0 & 0 \\ 0 & 0.3 & 0.3 & 0.3 & 0.1 \\ 0.6 & 0.3 & 0.1 & 0 & 0 \\ 0.7 & 0.3 & 0 & 0 & 0 \end{bmatrix}$$

$$R_4 = \begin{bmatrix} R_{41} \\ R_{42} \\ R_{43} \\ R_{44} \end{bmatrix} = \begin{bmatrix} 0.1 & 0.7 & 0.2 & 0 & 0 \\ 0 & 0.4 & 0.4 & 0.2 & 0 \\ 0.2 & 0.3 & 0.2 & 0.2 & 0.1 \\ 0.6 & 0.3 & 0.1 & 0 & 0 \end{bmatrix}$$

$$R_5 = \begin{bmatrix} R_{51} \\ R_{52} \\ R_{53} \end{bmatrix} = \begin{bmatrix} 0.7 & 0.2 & 0.1 & 0 & 0 \\ 0.3 & 0.6 & 0.1 & 0 & 0 \\ 0.2 & 0.6 & 0.2 & 0 & 0 \end{bmatrix}$$

$$R_6 = \begin{bmatrix} R_{61} \\ R_{62} \\ R_{63} \end{bmatrix} = \begin{bmatrix} 0.2 & 0.7 & 0.1 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 0.6 & 0.3 & 0.1 & 0 & 0 \end{bmatrix}$$

1.3.4. Fuzzy comprehensive measurement

Apply mathematical model $A_i \times R_i = B_i$

4, 5, 6) within the scope of the logistics project, respectively, to the extent of the percentage is in five levels: “low risk”, “medium low risk”, “general risk”, “medium high risk”, “high risk”.

$$R = \begin{bmatrix} B_1 \\ B_2 \\ B_3 \\ B_4 \\ B_5 \\ B_6 \end{bmatrix} = \begin{bmatrix} b_{11} & b_{12} & b_{13} & b_{14} & b_{15} \\ b_{21} & b_{22} & b_{23} & b_{24} & b_{25} \\ b_{31} & b_{32} & b_{33} & b_{34} & b_{35} \\ b_{41} & b_{42} & b_{43} & b_{44} & b_{45} \\ b_{51} & b_{52} & b_{53} & b_{54} & b_{55} \\ b_{61} & b_{62} & b_{63} & b_{64} & b_{65} \end{bmatrix} = \begin{bmatrix} 0.3 & 0.42 & 0.22 & 0.04 & 0.02 \\ 0.29 & 0.45 & 0.2 & 0.06 & 0 \\ 0.435 & 0.33 & 0.135 & 0.1 & 0 \\ 0.27 & 0.43 & 0.19 & 0.08 & 0.03 \\ 0.43 & 0.44 & 0.13 & 0 & 0 \\ 0.56 & 0.365 & 0.075 & 0 & 0 \end{bmatrix} \quad (5)$$

The weight vector $A = (a_1 a_2 a_3 a_4 a_5 a_6)$, According to the fuzzy mathematical evaluation model formula, the

second level fuzzy comprehensive evaluation operation is carried out: $A \times R =$

$$(a_1 a_2 a_3 a_4 a_5) * \begin{bmatrix} r_{11} & r_{12} & r_{13} & r_{14} & r_{15} \\ r_{21} & r_{22} & r_{23} & r_{24} & r_{25} \\ \dots & \dots & \dots & \dots & \dots \\ r_{61} & r_{62} & r_{63} & r_{64} & r_{65} \end{bmatrix} = (b_1 b_2 b_3 b_4 b_5) \quad (6)$$

Here $B = (b_1 \ b_2 \ b_3 \ b_4 \ b_5)$ is the overall evaluation results. According to the principle of maximum membership, the largest value of b_{jmax} in b_j ,

corresponding to the level of V_j is the risk level of the enterprise.

$$B = [0.29 \ 0.21 \ 0.11 \ 0.13 \ 0.19 \ 0.07] * \begin{bmatrix} 0.3 & 0.42 & 0.22 & 0.04 & 0.02 \\ 0.29 & 0.45 & 0.2 & 0.06 & 0 \\ 0.435 & 0.33 & 0.135 & 0.1 & 0 \\ 0.27 & 0.43 & 0.19 & 0.08 & 0.03 \\ 0.43 & 0.44 & 0.13 & 0 & 0 \\ 0.56 & 0.365 & 0.075 & 0 & 0 \end{bmatrix} \quad (7)$$

The calculated results: $B = (0.35175 \ 0.41765 \ 0.1753 \ 0.0456 \ 0.0097)$

The result shows that the maximum membership degree of matrix B is 0.4, and the overall risk level of the logistics project is low risk.

2. PSO-AHP Method

The study can be separated into two parts. The first part is to use AHP to confirm that some components in a product need to be changed, in order to meet the minimum customer requirements for a product. In other words, the product needs to be able to maintain its basic operations and functions. Therefore, expert interviews are used to analyze the product and to find out which module has caused most frequent failures, and also to confirm which module change could create the greatest benefits under limited resources available. The second part follows the product part change, which is to set up the parameters for developing a supplier selection model, and to develop an optimization algorithm based on PSO, hoping to utilize the outstanding performance of PSO to help identify the best supplier package and the allocation amount in quick and accurate manner. This information will be given to policy makers for their reference use in decision making [10].

2.1. Basic Models

2.1.1. First step: AHP

AHP is a multi-criteria decision-making method

Table 2. Fundamental scale used in AHP

Intensity of Importance	Definition	Explanation
1	Equal Importance	Two activities contribute equally to the objective
2	Weak	--
3	Moderate Importance	Experince and judgment slightly favour one activity over other
4	Moderate Plus	--
5	Strong Importance	Experiece and judgment strongly favour one activity over other
6	Strong Plus	--
7	Very Plus	An activity is favoured very strongly over another
8	Very strong	--
9	Extreme Importance	The evidence favouring one activity over another is of highest possible order of affirmation

As can be seen from Table 2, the ranking must be as follows: 1 is equally important, 3 is medium, 5 is strong, and 7 is very important. If one element of comparison is more important than the other, you must give nine points. If the decision maker is hesitant between two values, other options can be used. From these comparisons, a pairwise comparison matrix is obtained [12].

The next step is to calculate the ratio of inconsistencies for each matrix. These ratios can determine the possible error assessments in the

developed by Saaty in 1976. Due to its outstanding advantages, this method has been successfully applied in various fields. As mentioned earlier, this method considers both tangible and intangible factors, and this attribute is consistent with the subjective characteristics of real-world problems. In addition, a hierarchical structure containing multiple time periods, decision makers and standards can be called another advantage. However, this hierarchical model facilitates decision makers' participation in the solution process and reevaluates the judgment if necessary. Therefore, policy makers can also provide mutual agreement before final decision.

Even if there are differences in each study, the core of AHP is four general steps. First, alternatives, major standards and substandards must be identified. In the next step, the decision problem is hierarchically modeled by considering the previously selected criteria. Decision makers' judgments are collected through pair-wise comparisons in the third step [11]. In this step, the importance of substitutes and criteria will be determined by analyzing and comparing these data obtained. Therefore, a comparison must be made between these standards and alternatives.

In this process, Saaty's relative importance scale will be used, ranging from 1 to 9. The ratio is given in Table 2 below.

comparison. In general, 0.10 is the upper limit of this ratio, but according to some scholars, this ratio can be accepted to 0.20. If consistency is guaranteed in all matrices, this process will continue. If not, pairwise comparisons must be repeated for inconsistent pairwise comparisons until a ratio within limits is provided. The determination of the relative importance level according to the judgment can be defined as the following step [13]. The synthesis of this result and the choice of the best choice provide the solution for the final step.

2.1.2. Second step: PSO

PSO was proposed by Kennedy and Eberhart (1995). The fundamental concept stem from the behavior of predatory birds, and it is gradually developed into an intelligence-based optimization algorithm for assessment of biological systems. This is an evolutionary search method. The main characteristics of PSO algorithm lie in minimal parameter adjustments, easy implementation, and simple

$$A_d = \frac{\max_{i=1}^n(x_{id}) - \min_{i=1}^n(x_{id})}{\text{abs}(\max_{i=1}^n(x_{id}) + \text{abs}(\min_{i=1}^n(x_{id})))} \text{ if } r \geq 0.1$$

$$A_d = \begin{cases} A_{\max}, & \text{if } A_d < A_{\min} \\ A_{\min}, & \text{if } A_d > A_{\max} \\ A_d, & \text{otherwise} \end{cases} \text{ if } r \geq 0.1$$

$$v_{id}^{j+1} = \begin{cases} A_d \times (v_{id}^j + \varphi_1 \times \text{rand}() \times (p_{id} - x_{id}^j) + \varphi_2 \times \text{rand}() \times (g_{id} - x_{id}^j)) & \text{if } r \geq 0.1 \\ v_{id}^j + \varphi_1 \times \text{rand}() \times (p_{id} + x_{id}^j) + \varphi_2 \times \text{rand}() \times (g_{id} + x_{id}^j) & \text{if } r < 0.1 \end{cases}$$
(8)

2.2. Application of PSO-AHP

I consider a Chinese big Logistic Company, which is a company that provides services for more than 120 countries each year. The company is owned by Chinese government, which operates in more than 30 countries, serves 22 million customers, and owns other brands. After the decision to open a new logistic company, the Cooperate recently faced location problems. As an important strategic decision, it should include tangible and intangible standards. Therefore, in order to solve this problem, the AHP method is accepted as a methodology. In the first step alternative, the main criteria and substandards were identified. After several interviews, three locations were identified and renamed L1, L2, L3, L4, L5 and

instructions. Therefore, it is extensively used by many scholars and has wide applications. Present applications are found in the neural network, engineering optimization and fuzzy system control areas, all yielding very good results [14]. However, PSO is not flawless, a number of improved and newer versions of PSO have been introduced by scholars. The main equations include:

L6 due to the company's privacy policy [15]. Based on the different advantages of these locations, more than 40 standards were proposed, of which five were standard; sectoral factors, environmental factors, investment costs, labor potential, and regional potential were selected as the main criteria. The first two and last major standards define different sub-criteria, these are as follows (See Figure 2):
 -Sectoral factors: Near Market (NM), Regional Business Activity (RCA), Customer Potential (CP), Subjective Factor (SF), Competitor Availability (AC);
 -Environmental factors: transportation, climate, urbanization rate, land area and security;
 -Regional potential: Number of big companies in the area (NC), Area ratio of logistic service (ALS).

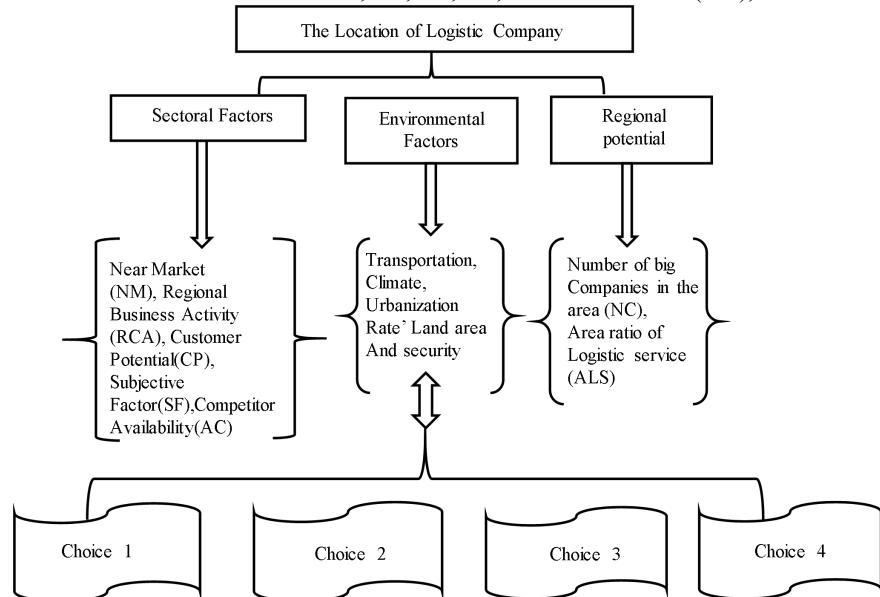


Figure 2. The Detail of Factors

After modeling decision problems as shown above, data is collected from decision makers through

pairwise comparisons. Using the scale shown in Table1, a pairwise comparison matrix is obtained.

Table 3 shows an example of these matrices, including an assessment of senior managers.

Table 3. Pairwise comparison matrix of the main criteria

	Sectoral Factors	Environmental Factors	Investment Cost	Labor Cost	Regional Potential
Sectoral Factors	1	6	7	7	1/7
Environmental Factors	1/6	1	13	1/3	1/7
Investment Cost	1/7	3	1	2	1/5
Labor Cost	1/7	3	2	1	1/4
Regional Potential	7	7	5	4	1

According to this matrix, sectoral factors are of great importance compared to environmental factors and are of great importance to investment costs and labor potential. Regional potential seems to be the most important factor in all major standards. After all matrices were obtained, the inconsistency ratio was detected and all ratios were between 0 and 0.09. Since these results are below 0.10, it can be clearly shown that all matrices are also consistent. In the analysis step of the AHP, calculating the relative weights of all alternatives and standards can solve the problem. To achieve this result, expert selection 11 is used and the relative weights of the criteria are given in Table 4 below.

Table 4. Relative weights of main and sub-criteria

Criteria	Relative Weights
Sectoral Factors	0.187
-Nearness to market	0.623
-Regional commercial activity	0.573
-Customer potential	0.217
-Subjective factors	0.127
-Availability of competitors	0.056
Environmental Factors	0.176
-Transportation	0.145
-Climate	0.268
-Urbanization rate	0.364
-Land size	0.212
-Security	0.189
Investment Cost	0.184

Table 6. The results of RI

Dimensional	1	2	3	4	5	6	7	8	9
RI	0.00	0.00	0.58	0.96	1.12	1.24	1.32	1.41	1.45

3. Fuzzy model: Establishment of risk assessment based on bp neural network

As we know, there are many successful neural network models and algorithms, but the most commonly used ones are the former artificial neural network model and the BP network model. The former artificial neural network model has good function approximation ability, which can well reflect the complex non-linear relationship between the input/output of the object by learning the training samples. The former artificial neural network is divided into input layer, hidden layer and output layer. In this paper, I consider another fuzzy model, which is BP neural network. I basically introduce the

Labor Potential	0.057
Regional Potential	0.468
-Number of big companies in the area	0.148
-Area ratio of logistic service	0.378

According to Table 5, regional potential standards are the most important criteria for the location of the Company. Followed by departmental factors, investment costs, labor potential and environmental factors. These results and their effectiveness have been approved by the team before selecting a location. Therefore, the importance of the major criteria is calculated and given in Table 5.

Table 5. Importance values and the ranking of alternatives

Alternatives	Importance Values	Ranking
L1	0.794	1
L2	0.106	2
L3	0.027	3
L4	0.018	4
L5	0.016	5
L6	0.007	6

As can be seen from Table 6, the best location is L1. The execution of this result is the final step of this process.

I also do CI test, the formula is:

$$CI = \frac{\lambda_{max} - n}{n - 1} \quad (9)$$

According to this formula, I could get the following results, where $CI = 0.02$, which means our result is convincing.

theoretical background of BP neural network, and apply it to evaluate the risk assessment [16].

3.1. Theoretical Review of BP Neural Network

There are many successful neural network models and algorithms, but the most commonly used ones are the former artificial neural network model and the BP network model. The former artificial neural network model has good function approximation ability, which can well reflect the complex non-linear relationship between the input/output of the object by learning the training samples. The former artificial neural network is divided into input layer, hidden layer and output layer. All layers are connected by layers, and there is no interconnection between units

on the same layer. The learning process of BP network model consists of forward transmission and error reverse transmission, which embodies the essence of artificial neural network [17]. Due to its good self-learning and self-associative functions in various neural network models, it has become the most widely used artificial neural network. BP network can approximate any continuous function with arbitrary precision, so it is widely used in nonlinear modeling, function approximation and pattern classification. Therefore, this paper chooses BP network model to evaluate the logistics risk (Cong, 2003).

3.1.1. Basic introduction of BP neural network

Artificial neural network is a kind of information processing system constructed by imitating the structure and function of the living body neural network, which is constructed artificial neural network based on the understanding of biological neural network (Tian et al., 2006). Its focus is not on using physical devices to completely reproduce the neural network structure in an organism, but rather to extract the available parts to overcome the problems that cannot be solved by current computers or other systems, such as learning, control and recognition [18].

So far, dozens of artificial neural networks including the Kohonen self-organizing network model have been developed. Among them, the most widely used is the multi-layer perceptron neural network model. The BP neural network proposed by Rumelhart et al. in 1986 is the classic representative in the multi-layer perceptron neural network model. Statistics show that in the practical application of artificial neural network, 80% to 90% of the neural network model uses BP neural network or its variation (Nielson, 1998). On the basis of fully considering the current ease of understanding of various artificial neural network algorithms, the paper chooses BP neural network as the evaluation model of this paper [19], which has the advantages of simple structure and easy to understand, and more importantly, can well realize the purpose of logistics risk evaluation.

Structurally, BP neural network is a typical multi-layer network, which consists of an input layer, an output layer and a number of hidden layers (also known as the middle layer). Connections between units in the same layer are not allowed, and units in each layer can only output activation signals to units in higher layers. In BP neural network, the hidden layer has single or multiple layers, which have no direct connection with the outside world. The neurons in the hidden layer are called hidden units. Although the hidden layer is not connected with the outside world, but their status affects the relationship between input and output. That is to say, changing the weight coefficient of the hidden layer can change the performance of the whole multi-layer neural network. The structure of BP neural network is shown in

Figure 3:

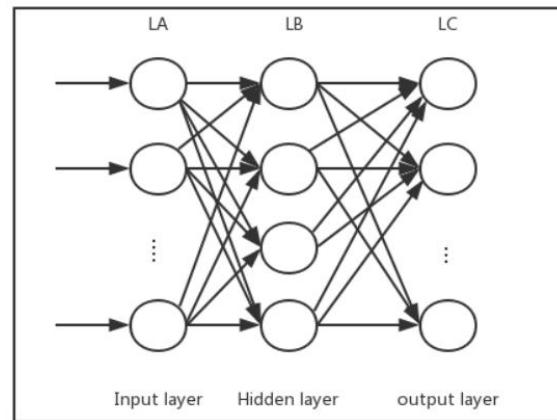


Figure 3. Structure of BP Neural Network

3.1.2. BP neural network learning algorithm

BP neural network learning is a typical tutorial learning, its learning algorithm (hereinafter referred to as BP algorithm) is the promotion and development of simple δ learning rules. Figure 4 is a simple diagram of the BP algorithm Figure 4:

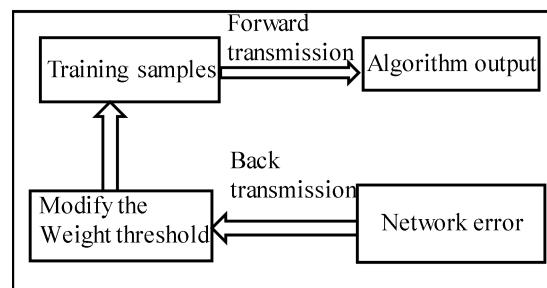


Figure 4. Graphics of BP algorithm

In the BP algorithm, the learning process is divided into two stages: forward transmission and reverse transmission. Forward transmission is used to calculate the former network, that is, a certain input information, calculated through the network to find its output; Back transmission is used to transfer errors layer by layer and modify connection weight and closing value between neurons so that the network can achieve the expected error requirements after the input information is calculated. The learning method is to train the network using a set of training samples. Each training sample includes two parts: input and expected output [20].

The learning process of BP learning algorithm can be described as follows (Wei, 2005):

- (1) The working signal propagates forward. The input signal is transmitted from the input layer to the output layer via the hidden unit, producing an output signal at the output, which is the forward transmission of the working signal. The weight of the network in the process of signal transmission is fixed, the state of each layer of neurons only affects the state of the next layer of neurons. If the desired output cannot be obtained at the output layer, the incoming error signal propagates backwards.
- (2) The error signal propagates backwards. The

difference between the actual output of the network and the expected output is the error signal. The error signal is propagated layer by layer from the output end, which is the back transmission of the error signal. During the reverse transmission of the error signal, the weight of the network is adjusted by error feedback. Through the constant revision of the weights, the actual output of the network is closer to the expected output.

Structurally speaking, as shown in the figure, the three-layer BP network is divided into the input layer LA, the hidden layer LB, the output layer LC. There is no correlation between nodes in the same layer, and the connections between the different layers of neurons are forward. The LA layer contains m nodes corresponding to m inputs perceptible to the BP network. The LC layer contains n nodes, corresponding to n outputs of the BP network. The number of nodes in the LB layer u can be set as needed.

Let the link between node a_i of layers LA and node b_r of layer LB be w_{ir} and the link between node b_r of layers LB and node c_j of layer LC should be v_{rj} . T_r is the threshold of the LB layer node, θ_j is the threshold of the LC layer node, then the output function of the node in the LB layer is:

$$b_r = f \left(\sum_{r=1}^m w_{ir} \cdot a_i + T_r \right) (r = 1, 2, \dots, u) \quad (10)$$

The output function of the node in the LC layer is:

$$c_j = f \left(\sum_{r=1}^m v_{rj} \cdot b_r \right) (j = 1, 2, \dots, n) \quad (11)$$

Among them, $f(\cdot)$ is the transfer function, usually choose S type transfer function, that is $f(x) = (1 + e^{-x}) - 1$.

Specific BP network learning process is as follows: Give w_{ir} , T_r , v_{rj} , θ_j randomly assigned a smaller value. For each mode $(A(k), C(k))$ ($k = 1, 2, \dots, p$) do the following:

① Input the value $(a_i(k))$ of $A(k)$ to the LA layer node, that is, to become the LA layer node activation value a_i , and according to the formula (6-10) and (6-11), the forward calculation is in turn:

$$v_{rj} = v_{rj} + \alpha \cdot b_r \cdot d_j \\ b_r = f \left(\sum_{r=1}^m w_{ir} \cdot a_i + T_r \right) (r = 1, 2, \dots, u) \quad (12)$$

② Calculate the LC layer node output c_j and expected output value $c_j(k)$ error, so

$$d_j = c_j \cdot (1 - c_j) \cdot (c_j^{(k)} - c_j) \quad (13)$$

③ To the LB layer node reverse allocation error, so

$$e_r = b_r \cdot (1 - b_r) \cdot \left(\sum_{j=1}^n v_{rj} \cdot d_j \right) \quad (14)$$

④ Adjust LB layer and LC layer node connection right v_{ri} and LC layer node close value that is θ_j :

$$v_{rj} = v_{rj} + \alpha \cdot b_r \cdot d_j \quad (15)$$

$\theta_j = \theta_j + \alpha \cdot d_j (0 < \alpha < 1)$

⑤ Adjust LA layer and LB layer node connection right w_{ir} and LC layer node close value that is T_r :

$$w_{ir} = w_{ir} + \beta \cdot a_i \cdot e_r \\ T_r = T_r + \beta \cdot e_r (0 < \beta < 1) \quad (16)$$

⑥ Step ② is repeated until the error EAV becomes small enough for $j = 1, 2, \dots, n, k = 1, 2, \dots, p$.

$$E_{AV} = \frac{1}{p} \sum_{k=1}^p \sum_{j=1}^n (c_j^{(k)} - c_j)^2 \quad (17)$$

Among them, E_{AV} is the objective function of training.

3.1.3. The algorithm flow of BP neural network
BP neural network model involves many mathematical formulas, parameters and operating rules. In order to understand the basic logic of BP neural network model in the analysis and evaluation of the research object, we need to briefly understand the algorithm flow of the BP neural network model. As shown in Figure 5.

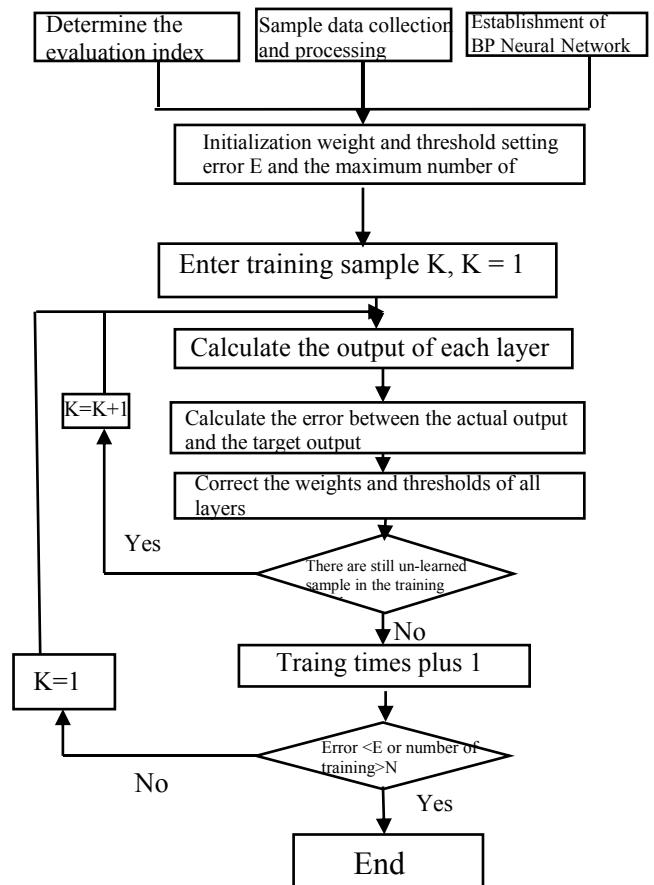


Figure 5. Flow chart of BP algorithm

3.2. Establishment of BP Neural Network Model

3.2.1. Determine the network layer

BP algorithm is very sensitive to the network structure, different network structures have different ability to solve the problem. The more complex the structure of a neural network, the stronger its ability to handle complex nonlinear problems, but the longer the training time. If the structure of the neural

network is too simple, the network training will hardly converge or the convergence time will be too long [21].

The research shows that increasing the number of hidden layers can improve the nonlinear mapping ability of BP neural network and enhance the ability of the network to solve complex nonlinear problems. However, too many hidden layers will prolong the learning time of the network. For BP neural network, Hecht Niclson proved that any continuous function in the closed interval can be approximated by a hidden layer BP neural network, so a three-layer BP neural network can complete any n-dimensional to m-dimensional mapping, which in fact has given us a basic principle for designing BP neural networks (Wen, 2003). In fact, there are two ways to reduce error and improve accuracy in BP neural network. One is to increase the number of network layers and the other is to increase the number of neurons in the hidden layer. The former often makes the network too complicated and the network training time greatly increases. Compared with the former, the latter training effect is easier to observe and adjust than the former. Therefore, this paper uses a three-layer BP neural network with a hidden layer.

3.2.2. Determine the number of neurons in each layer

(1) Determine the number of neurons in the input layer

According to the evaluation index system established above, we can determine the number of input neurons in the BP neural network model and set 20 indexes as the input nodes of the BP model: time risk, technology maturity, information integration and sharing risk, information transfer Risk, resource risk, climate risk, traffic distribution rationality, rationality of logistics center construction, planning comprehensiveness, organizational effectiveness, communication risk, decision risk, improper management control mechanism, cost risk, human resource risk, The accuracy of the operation, the rate of operation of the equipment, and the degree of cohesion between the operating activities.

(2) Determine the number of neurons in the hidden layer

In BP neural network, the choice of the number of hidden layer neurons is not only related to the number of nodes in the input and output layers, but also depends on the complexity of the problem to be solved, the form of the transfer function and the characteristics of the sample data. It is a very complicated problem [22]. If the number of hidden neurons is too small, the network may not be able to train at all or the network performance is poor; If the hidden layer neurons too much, although the network system error can be reduced, but on the one hand to extend the network training time, on the other hand lead to training easily fall into the local minimum without the optimal point, but also the internal reason for the training of “over fitting”. In order to avoid

“over-fitting” phenomenon as much as possible while training, and at the same time to ensure a sufficiently high network performance and generalization ability, the basic principle of determining the number of hidden layer neurons is that under the premise of meeting the accuracy requirement, we should take the compact structure as possible, that is, if we can solve the problem, we add 1 to 2 neurons to accelerate the descent speed of error.

At present, there is no scientific and universal method for determining the number of hidden layer neurons. Zeng (2004) gives some of the empirical formulas on the number of hidden neurons (Zeng, 2004), where n is the number of hidden layer neurons, m is the number of output layer units, n is the number of input layer units, and a is a constant between 1 and 10. However, in practice, in order to obtain better network performance, the number of neurons in the hidden layer is generally determined by training the number of neurons in different hidden layers and comparing the errors.

(3) Determine the number of neurons in the output layer

The selection of the output node corresponds to the evaluation result, so the desired output needs to be determined first. In this paper, the expected output of the research object is the overall evaluation of the magnitude of the logistics risk. Therefore, the number of neurons in the output layer is selected as 1.

3.2.3. Selection of network learning parameters

(1) Selection of Initial Weight

Because the system is non-linear, the initial value is very important for learning whether to reach the local minimum, whether it can converge and the training time. If the initial weight is too large, the weighted inputs will fall into the saturation region of the S-type stimulus, leaving the adjustment almost halted. If the initial weight is too large, the weighted inputs will fall into the saturation region of the S-type stimulus, leaving the adjustment almost halted. Therefore, it is generally expected that the output value of each neuron after the initial weighting is close to zero, so as to ensure that each neuron's weights can be adjusted where the S-type excitation function changes most. The general initial weight takes a random number between (-1, 1) and the initial weight of this paper is set to 0. In addition, the threshold of this article is also set to 0 at initialization.

(2) Choose a learning rate

The learning rate determines the weight and threshold variation that occur during each cycle of training. A large learning rate may lead to system instability. However, a small learning rate may lead to long training time and slow convergence, but ensure that the network error value does not jump out of the bottom of the error surface and eventually approaches the minimum error value. Therefore, in general, it is preferable to select a smaller learning rate to ensure the stability of the system. The selection rate of

learning rate is generally between 0.01 and 0.8. In a neural network design process, the network generally goes through several different learning rate training, by observing the decline rate of the squared error sum of each training to determine whether the selected learning rate is appropriate. If the learning rate drop quickly, then the appropriate learning rate, if the concept of oscillation phenomenon, then the learning rate is too large. There is a suitable learning rate for each specific network; however, for more complex networks, different learning rates may be required for different parts of the error surface. In order to reduce the number of trainings to find the learning rate and the training time, this paper uses a different adaptive learning rate to make the training of the network automatically set the learning rate at different stages.

3.3. Model Application and Case Study

3.3.1. Model training and testing

(1) Selection of sample data

Table 7. Sampled data of logistics risk assessment

	1	2	3	4	5	6	7	8	9	10	11	12
B1	0.235	0.242	0.262	0.251	0.173	0.215	0.314	0.273	0.175	0.132	0.245	0.265
B2	0.318	0.237	0.152	0.346	0.155	0.192	0.256	0.412	0.353	0.232	0.203	0.272
B3	0.276	0.250	0.162	0.325	0.213	0.217	0.313	0.450	0.346	0.246	0.349	0.242
B4	0.458	0.458	0.438	0.508	0.358	0.479	0.643	0.532	0.635	0.543	0.635	0.603
B5	0.786	0.453	0.665	0.582	0.575	0.616	0.521	0.356	0.448	0.382	0.525	0.645
B6	0.375	0.253	0.376	0.412	0.326	0.353	0.204	0.352	0.561	0.324	0.403	0.363
B7	0.335	0.376	0.328	0.374	0.261	0.323	0.526	0.385	0.351	0.493	0.654	0.322
B8	0.401	0.393	0.254	0.356	0.613	0.379	0.378	0.462	0.525	0.328	0.403	0.416
B9	0.284	0.438	0.281	0.285	0.301	0.312	0.567	0.473	0.346	0.506	0.428	0.421
B10	0.472	0.405	0.263	0.317	0.426	0.265	0.156	0.273	0.215	0.324	0.416	0.208
B11	0.318	0.298	0.246	0.231	0.302	0.334	0.346	0.424	0.456	0.256	0.306	0.341
B12	0.543	0.479	0.604	0.475	0.662	0.545	0.483	0.585	0.332	0.273	0.472	0.346
B13	0.328	0.315	0.408	0.374	0.377	0.435	0.575	0.313	0.495	0.362	0.424	0.221
B14	0.438	0.512	0.345	0.457	0.374	0.440	0.482	0.434	0.334	0.513	0.318	0.271
B15	0.356	0.383	0.475	0.371	0.172	0.251	0.402	0.366	0.232	0.463	0.330	0.262
B16	0.162	0.166	0.112	0.151	0.213	0.283	0.413	0.235	0.325	0.341	0.613	0.383

At the same time, this paper also obtained the result of expert group scoring the overall risk status of each

Table 8. Score table of logistics risk assessment

Project	1	2	3	4	5	6	7	8	9	10	11	12
Expert evaluation	0.34	0.247	0.174	0.268	0.194	0.221	0.432	0.383	0.348	0.264	0.531	0.391

(2) Determine the network structure

When writing a good program to train the network model, the number of hidden layer neurons was finally determined to be eight by comparing the number of different hidden layer neurons.

Therefore, the network structure established in this paper, namely the neural network logistics risk evaluation model network is $16 \times 8 \times 1$ (ie., 16 input layer neurons, 8 hidden layer neurons and 1 output layer neuron), the structure of BP neural network risk assessment model is shown in Figure 6:

This article selects 12 logistics projects in China in recent years as BP neural network model training and testing samples. Because of the professionalism and particularity of logistics risk, this paper adopts the expert score method to obtain the sample data of the index system.

In this paper, I scored eight experts (one enterprise leader, four project managers and three project executives) in the form of a rating scale. The weight of the leaders and project developers is 0.1, and the weight of the project manager is 0.15. Each indicator is divided into five levels: low risk, medium low risk, general risk, medium high risk and high risk. The five risk levels correspond to the values in five intervals: (0, 0.2), (0.2, 0.4), (0.4, 0.6), (0.6, 0.8), (0.8, 1), respectively. The lower the risk level, the lower the corresponding score. Through the statistical analysis, the index value of the evaluation index system of 12 samples is obtained, as shown in Table 7.

logistics project, as shown in Table 8.

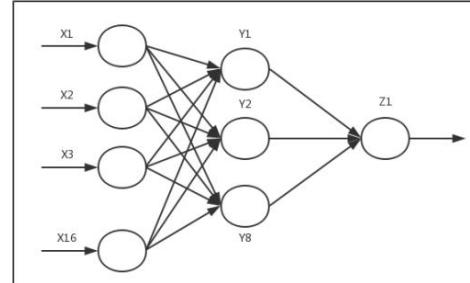


Figure 6. Structure of logistics risk assessment based on BP neural network

3.3.2. Model training results

In this paper, the sample data of the first 10 sets of sample data as a training sample, the sample index value system as the input node, corresponding to the

expert group score to determine the overall risk of the software project as the output expected value, and MATLAB software Write neural network simulation program to create BP neural network and training. In the program, several important training parameters are set as follows (the rest of the parameters not specified in the text adopt the default value):

Network layer: 3

Expected error: $S = 0.00001$

The maximum number of training: $N = 3000$

Training function: traingdx function. This function combines the algorithm of adaptively modifying the learning rate and the gradient descent algorithm of momentum to make the network have the characteristics of fast training speed and small convergence error.

Weight adjustment rules: learnsgdm function. This

Table 9. Table of the comparison between the BP neural network stimulation training outputs and the expect outputs

No.	Expected output	Actual output	Error	Risk level
1	0.340	0.339	0.0006	Medium low risk
2	0.247	0.239	0.0077	Medium low risk
3	0.174	0.174	0.0000	Low risk
4	0.268	0.270	0.0022	Medium low risk
5	0.194	0.197	0.0033	Medium low risk
6	0.221	0.222	0.0014	Low risk
7	0.432	0.431	0.0012	General risk
8	0.383	0.384	0.0015	Medium low risk
9	0.348	0.346	0.0022	Medium low risk
10	0.264	0.268	0.0038	Medium low risk

3.3.3. Model test results

In the sample data, 11-12 sets of sample data is the test data. The index value data in 11-12 sample data and corresponding risk score determined by the Table 10. Test result of BP neural network model

No.	Expected output	Actual output	Error	Risk level
11	0.531	0.528	0.003	General risk
12	0.391	0.387	0.004	Medium low risk

Through the test results in Table 10, we can see that the error between the expected output and the actual output is small and almost consistent, which fully shows that the logistics risk evaluation model established by BP neural network model is effective. We can use this already trained and passed detection BP neural network model of logistics risk assessment empirical research.

4. Conclusion

Risk evaluation is a critical decision for companies in today's competitive environment. No matter how the business line is properly decided, it will bring many advantages to the company. In the risk evaluation problem, the impact of each method may be different, and these effects may conflict with each other. Therefore, these problems present a complex structure composed of tangible and intangible factors [23], so it can be said that Fuzzy Comprehensive Model is a convenient way to solve these problems. In this study, the risk evaluation of the Company was

function uses the method of momentum gradient descent to adjust the weight and threshold, which can effectively avoid the local minimum problem in network training.

Performance function: mse function. This function represents the mean square error between the actual output and the expected output.

The type of incentive function at each layer: {"tansig", "logsig"}

The built BP neural network through training, you can draw the following training results:

When the network training to 997 steps, the network performance to the desired level, BP neural network training ended.

Specific training output and expected results compared as shown in Table 9:

Table 9. Table of the comparison between the BP neural network stimulation training outputs and the expect outputs

expert group are used as the input node and the output control value of the model respectively. The specific test results are shown in Table 10:

addressed. This problem is modeled according to three different models. Based on the results I get, we could see compared with other two models, Fuzzy Comprehensive model is easy to implement by software.

As we know, there are many uncertainties in the objective world. Fuzzy mathematics is a discipline that attempts to solve fuzzy phenomena by using mathematical tools. The fuzzy set theory method is used to evaluate and judge the multi-factors and multi-objectives of people, things and programs involved in decision-making activities. The basic principle is: first determine the set of factors (indicators) and evaluation (level) of the object to be judged; then determine the weight of each factor and their membership degree vector separately, obtain the fuzzy evaluation matrix; finally, the fuzzy evaluation matrix and the factor The weight vector is subjected to fuzzy operation and normalized to obtain a comprehensive result of fuzzy evaluation [24].

Based on the above three different models, we could see the advantage of this method is that the mathematical model is simple and easy to grasp, and the evaluation effect on multi-factor and multi-level complex problems is better, which is another method that is difficult to replace with other mathematical branches and models. This model is widely used. In many aspects, the practical model of fuzzy comprehensive evaluation has achieved good economic and social benefits.

Meanwhile, the BP network is a hidden layer of multilayer feed forward network. Structurally, it is a kind of hierarchical network, having an input layer, hidden layer and output layer of the three layer structure. For a BP network, the hidden layer can have more than two, and has a hidden layer BP network is a kind of basic BP network model. The method of neural network has the ability of learning, extensive adaptability and nonlinear mapping ability, by learning to obtain the dependency relations between sample data. Neural network for prediction of stock market, is the use of stock history data consisting of time series, through the self-learning ability of neural network to carry on the analysis, the analog network between output and input function, and this function is used for the prediction of future price. In this paper, I consider another fuzzy model, which is BP neural network. I basically introduce the theoretical background of BP neural network, and apply it to evaluate the risk assessment [25,26].

In order to overcome the limitations of the existing research methods such as FCMM I mention above, I propose a logistic alliance risk identification and analysis method based on the particle swarm optimization algorithm (PSO) and penalty function method. These two methods are combined to analyze and calculate the optimization problem, which makes the result of virtual emergency logistic alliance risk identification more accurate and realistic. Also, I combine the methods AHP and PSO to do the analysis, which will be divided into two parts: the first part is to use AHP to confirm that some components in a product need to be changed, in order to meet the minimum customer requirements for a product. In other words, the product needs to be able to maintain its basic operations and functions [27].

References

- [1] Allred, C.R., Fawcett, S.E., Wallin, C. and Magnan, G.M. A dynamic collaboration capability as a source of competitive advantage. *Decision Sciences*, 2011, 42(1): 129-161.
- [2] Bowersox, D.J. and Daugherty, P.J. Emerging patterns of logistical organizations. *Journal of Business Logistics*, 1987, 8(1): 46-60.
- [3] Braunscheidel, M.J. and Suresh, N.C. The organizational antecedents of a firm's supply chain agility for risk mitigation and response. *Journal of Operations Management*, 2009, 27(2): 119-140.
- [4] Briner, R.B., Denyer, D. and Rousseau, D.M. Evidence-based management: concept cleanup time? *Academy of Management Perspectives*, 2009, 23(4): 19-32.
- [5] Cao, M. and Zhang, Q. Supply chain collaboration: impact on collaborative advantage and firm performance. *Journal of Operations Management*, 2011, 29(3): 163-180.
- [6] Carter, C.R., Rogers, D.S. and Choi, T.Y. Toward the theory of the supply chain. *Journal of Supply Chain Management*, 2015, 51(2): 89-97.
- [7] Cassivii, L. Collaboration planning in a supply chain. *Supply Chain Management: An International Journal*, 2006, 11(3): 249-258.
- [8] Charmaz, K. Grounded theory: methodology and theory construction", in Smelser, N.J. and Baltes, P.B. (Eds), *International Encyclopedia of the Social and Behavioral Sciences*, Pergamon, Amsterdam, 2001, pp. 6396-6399.
- [9] Chen, H., Daugherty, P.J. and Roath, A.S. Defining and operationalizing supply chain process integration. *Journal of Business Logistics*, 2009, 30(1): 63-84.
- [10] Chen, H., Tian, Y., Ellinger, A.E., Daugherty, P.J. Managing logistics outsourcing relationships: an empirical investigation in china. *Journal of Business Logistics*, 2010, 31(2): 279-299.
- [11] Chen, H. et al. Global fiscal risk, fiscal crisis and fiscal balance and governance. *Fiscal Research*, 2014, 7.
- [12] Clandinin, D.J. Developing rhythm in teaching: the narrative study of a beginning teacher's personal practical knowledge of classrooms. *Curriculum Inquiry*, 1989, 19(2): 121-141.
- [13] Corsten, D. and Kumar, N. Do suppliers benefit from collaborative relationships with large retailers? An empirical investigation of efficient consumer response adoption. *Journal of Marketing*, 2005, 69(3): 80-94.
- [14] Creswell, J.W. *Qualitative Inquiry and Research Design: Choosing Among Five Approaches*, Sage, Thousand Oaks, CA, 2013.
- [15] Cui, Z., Loch, C., Grossman, B. and He, R. How provider selection and management contribute to successful innovation outsourcing: an empirical study at Siemens. *Production and Operations Management*, 2012, 21(1): 29-48.
- [16] Daugherty, P.J. Review of logistics and supply chain relationship literature and suggested research agenda. *International Journal of Physical Distribution & Logistics Management*, 2011, 41(1): 16-31.
- [17] Daugherty, P.J., Richey, R.G., Roath, A.S., Min, S., Chen, H., Arndt, A.D. and Genchev, S.E. Is collaboration paying off for firms? *Business Horizons*, 2006, 49(1): 61-70.
- [18] Davies, H.T.O. and Crombie, I.K. Getting to grips with systematic reviews and meta-analyses. *Hospital Medicine*, 1998, 59(12): 955-958.
- [19] Day, G.S. Managing market relationships.

- Journal of the Academy of Marketing Science, 2000, 28(1): 24-30.
- [20] Denyer, D. and Tranfield, D. Producing a systematic review, in Buchanan, D. and Bryman, A. (Eds), *The Sage Handbook of Organizational Research Methods*, Sage Publications, London, 2009, pp. 671-689.
- [21] Denzin, N. and Lincoln, Y. *Handbook of Qualitative Research*, Sage, Thousand Oaks, CA, 1994.
- [22] Devaraj, S., Krajewski, L. and Wei, J.C. Impact of ebusiness technologies on operational performance: the role of production information integration in the supply chain. *Journal of Operations Management*, 2007, 25(6): 1199-1216.
- [23] Ding, R.G., Gao, H. and Zhang, N. Differentiation and analysis of related concepts in project management. *Journal of Shandong University (Philosophy and Social Sciences)*, 2013.
- [24] Ellinger, A.E. Improving marketing/logistics cross-functional collaboration in the supply chain. *Industrial Marketing Management*, 2000, 29(1): 85-96.
- [25] Ellram, L.M. and Cooper, M.C. Supply chain management, partnership, and the shipper-third party relationship. *International Journal of Logistics Management*, 1990, 1(2): 1-10.
- [26] Ellram, L.M. and Cooper, M.C. Supply chain management: It's about the journey, not the destination. *Journal of Supply Chain Management*, 2014, 50(1): 8-20.
- [27] Ellram, L.M., Tate, W.L. and Billington, C. Offshore outsourcing of professional services: a transaction cost economics perspective. *Journal of Operations Management*, 2008, 26(2): 148-163.

Rolling Mill Teaching Case Design of Control System Simulation based on the Plan for “Training Outstanding Engineers”

Yue Zhang^{1,}, Baozhong Liu², Jianxin Zhou¹, Ruicheng Zhang¹, Jun Pan³, Yan Wang³*

¹*College of Electrical Engineering, North China University of Science and Technology, Tangshan, 063210, China*

²*Tangshan Sanyou Group Ltd. Xingda Chemical Fibre Co., Ltd., Tangshan, 063305, China*

³*No.1 Steel Rolling Mill of HBIS Group Tang Steel Company, Tangshan, 063016, China*

*E-mail: zhizizhizi@aliyun.com

Abstract: After comprehensive investigation of the related course reform and methods for control system simulation, and under the talents training plan for “Training Outstanding Engineers”, this paper designs an engineering teaching case for rolling mill production process simulation. The engineering teaching case is designed from the use cases of No.1 Steel Rolling Mill of HBIS Group Tang Steel Company, and has been adopted as key discipline in college and heavy industrial city in Tangshan. The teaching method for rolling mill process used multi-software tool, multi-theory simulation and multi-course fusion. The first step of the design is to teach engineering cases in the computer room and carry out simple simulation. And the second step is to introduce technological process of rolling mill, combined with equipment teaching model in metallurgical engineering virtual simulation experiment center, and pictures and videos of Steel Rolling Mill of HBIS Group Tang Steel Company. Finally, rolling mill model and related theories are explained in integrated real-time automation simulation center for process industry. The effect of teaching case shows that it can promote undergraduate students’ engineering and scientific research ability.

Keywords: control system simulation; engineer teaching case; rolling mill; multi-course fusion; multi-method simulation

1. INTRODUCTION

According to general and industry standards of personnel training for engineering practice and innovation ability in university, the policy of training outstanding engineers plan requires enterprises’ close participation in students’ cultivation process [1]. For the past several years, North China University of Science and Technology (NCUST) has reformed the teaching content and system of curriculums based on outstanding train objective, and gained a lot of valuable experiences. But the course of control system simulation in automation major still has some problems. Because of relative independence between courses and lack of content overlaps, this makes

students’ professional knowledge fragmented [2]. Consequently, the exploratory teaching reform scheme of merging related courses for control system simulation course is presented in many colleges. For example, Shandong University of Technology: motion control systems and process control systems have been merged, “double closed-loop DC speed control system” and “boiler water level control system” have been taken as teaching cases [3]. Jiangxi University of Science and Technology: process control systems and computer control systems have been merged, and three algorithms including PID control, smith predictive control and Dahlin algorithm are introduced in experimental curriculum [4]. It can be seen that multi-curriculum integration teaching has become a new trend.

In some domestic research-oriented universities, automation majors, with research hotspots nowadays and characteristics of its own discipline, requires multi-software to teach. The construction of subject has now formed distinct characteristics and achieved outstanding achievements. For example, Northeastern University: the research and practice of course reform is based on the project of the national excellent course, and is constructing quality engineering by enhancing the course basic, optimizing the course structure and highlighting the course characteristic. Teaching content introduces system identification and solving optimization problem by means of typical case study and thematic explanation. “Control System Simulation and CAD” teaching team has independently developed CtrlLAB which was software of feedback control system teaching [5]. Zhejiang University: Data analysis and data mining technology is introduced to classroom teaching, and the software of Matlab is employed to simulate stock investment. The software of ADAMS, Matlab/Simulink and AMESim is used to co-simulation in electromechanical system. Furthermore, an interesting game of whack-a-mole by Matlab is added to teaching contents [6]. Nanjing University of Aeronautics and Astronautics: integrated optimization with digital simulation of Matlab software and analog simulation of learning

machine. "Motor Servo Control System Platform" is self-developed with a strong engineering background, and introduced to experiment teaching. "Three level division" experiment contents including digital simulation experiments, analog simulation experiments and physical system experiments are developed [7]. All the reforms and practices show that college has already put emphasis on the cultivation of students' ability for integration of industry-learning-research and innovative talents, according to its own discipline characteristics.

Furthermore, there are many valuable experiences worth learning from the same course for non-automation major and automatic control major for graduate students. For example, school of automotive studies in Tongji university: more than 4 modes of course portfolios abroad are summarized, then control system simulation is integrated 5 courses, including computer control fundamental, principles and application of sensors, principles of automatic control, automotive fundamentals and automobile electronics. Based on the concluded result, the course target and orientation are defined on specific automotive engineering education system, for example, adaptive cruise control and automatic assistant steering control [8]. Post-graduate course of China University of Petroleum: the teaching content is integrated into courses of process flow sheering and optimization simulation, advanced control system simulation and power system simulation, and the software tool mainly includes Matlab, gPROMS, UniSim, ETAP and so on [9].

The course of control system simulation published in [3-9] is typical. The software of Matlab is employed to simulate automatic control fundamentals in traditional teaching method of control system simulation. And nowadays, many colleges have expanded their teaching contents and method by multi-software simulation, physical simulation, multi-curriculum integration teaching, industry and research integration teaching, innovative talents training and experimental case design. But design of engineering case has not been published before. This paper inherits the essences of reform and practice in domestic university, and designs an engineering teaching case, with the purpose of "Training Outstanding Engineers".

2. ENGINEERING TEACHING CASE DESGIN

Rough mill of narrow-strip hot continuous rolling line can be classified into four main solutions: the one-half narrow-strip hot continuous rolling lines, full continuous rolling lines, third-fourth continuous rolling line and tandem double-rough stand rolling line [10]. The engineering teaching case comes from an abstraction of third-fourth continuous rolling line, and is called simulation of rolling mill monitoring system.

The process of automatic rolling mill monitoring system is shown in Figure 1 and system control

requirements are as follows. When pressing the On/Off button, eight sensors for monitoring the position of steel start up at the same time. The first rolling: when sensor S₁ detects the arrival of steel, the electric motor M₁ starts up, and conveyor belt C₁ turns to steel. And when sensor S₂ detects the arrival of steel, the electric motor M₂ starts up, and the roller Y₁ screws down. The process of the second and third rolling are the same as the first rolling. Finally, when sensor S₇ detects the arrival of steel, the electric motor M₇ starts up, and conveyor belt C₄ turns to steel. And when sensor S₈ detects the arrival of steel, screw-down ends and the whole process completes. If the process needs to be restarted, the On/Off button should be pressed again [11].

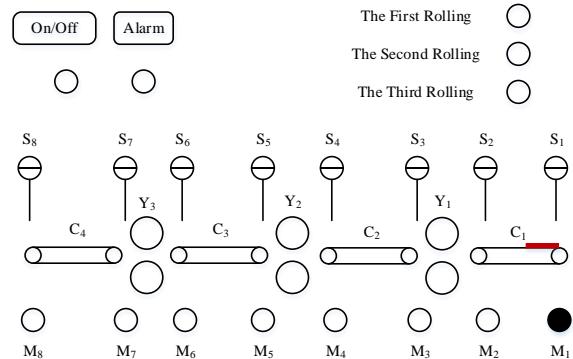


Figure 1. Automatic Rolling Mill Monitoring System
The basic contents and requirements of engineering teaching case are as follows. (1) The strip steel rolling process in automatic rolling mill. (2) Instrument and its detecting parameters. (3) Control of programmable logic controllers (PLC) in automatic rolling mill monitoring system. (4) TIA Portal V13 Configuration Software, SIMATIC WinCC Flexible 2008 Configuration Software, King View 6.03 Configuration Software and Force Control Configuration Software were employed respectively to monitor steel rolling process. (5) Students are required to use Matlab/Stateflow to realize dynamic reproduction of automatic roughing mill rolling process, and to understand Petri net to establish model and simulation process of automatic roughing mill.

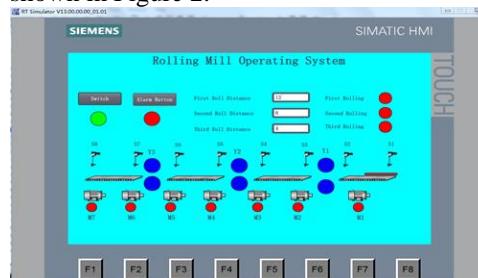
The enhanced requirements of engineering teaching case are as follows. After visiting metallurgical engineering virtual simulation experiment center and synthetical automation for process industries simulation center, students are required to design more complex Monitoring System for automatic rolling process, which is based on the one half strip hot continuous rolling lines, full continuous rolling line and tandem double rough stand rolling line presented by reference [10]. The teaching case will be combined with courses of PLC, sensor and detection technology and so on.

The analysis of knowledge points for engineering teaching case are as follows. It comes from application of automatic control fundamentals in

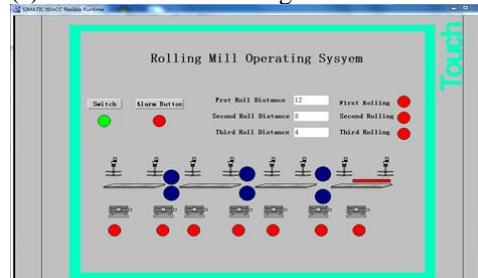
metallurgical industry, and embodies the integration of multi-courses in automation major, including two required courses and two selected courses. The required courses are “Programmable Logic Controller Principles and Applications” and “Principles and Applications of Sensors”, while the selected courses are “Configuration Software” and “Systems Engineering”. Engineering teaching case has different difficulty levels and can be adapted to students with levels. Meanwhile, it lays foundation for graduation projects and future works.

3. SIMULATION RESULTS OF CONFIGURATION SOFTWARE

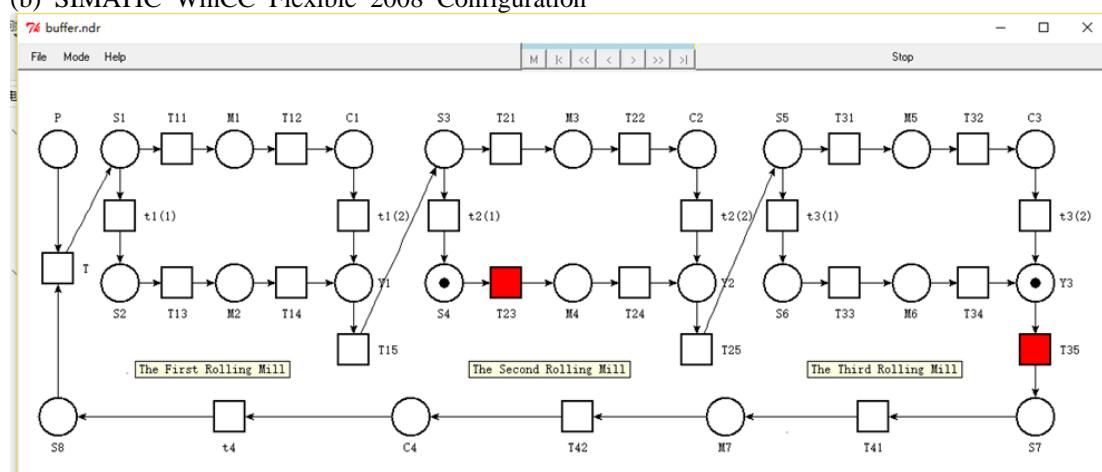
The steps of creating and running a project by configuration software is as follows. (1) Design GUI (Graphical User Interface) (Defining Animation); (2) Define external equipment; (3) Create a database (Defining variables); (4) Realize animation links; (5) Run simulation and debug [12]. The rolling mill operating system built by configuration software of TIA Portal V13, SIMATIC WinCC Flexible 2008, Force Control and King View 6.03 respectively is shown in Figure 2.



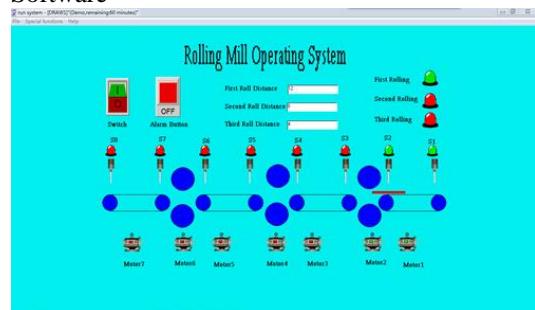
(a) TIA Portal V13 Configuration Software



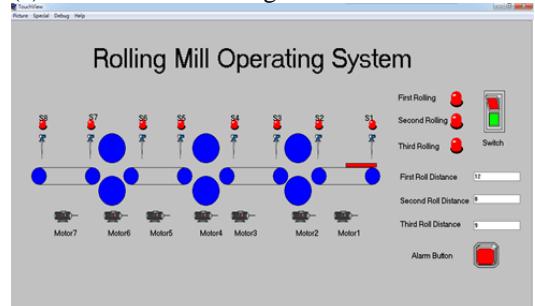
(b) SIMATIC WinCC Flexible 2008 Configuration



Software



(c) Force Control Configuration Software



(d) King View 6.03 Configuration Software

Figure 2. Rolling Mill Operating System Simulation
4. MODELLING AND SIMULATION BY PETRI NETS

Petri net is a formal modeling method based on graphics and mathematics, and has abundant system description and behavior analysis technology. It plays a very important role in the modeling and performance analysis of complex systems [13]. There are many simulation software for Petri nets, such as Visual Object Net ++, Tina Toolbox and CPNTools. As a well-known theory, Petri net is one of the teaching points of system engineering course. It is easy to learn and use, and easy to be understood by undergraduates. According to engineering teaching case introduced in Figure 1, Petri net model is built up and simulated by Tina Toolbox. The rolling mill operating system simulated by Tina Toolbox is shown in Figure 3 and Table 1 explains symbols.

Figure 3. Petri net model and its simulation with Tina Toolbox

Table 1. The explanation of symbol in Figure 3

Symbol	Explanation	Symbol	Explanation	Symbol	Explanation
P	Initialization, set stroke times	T	System begin to simulation	S8	Sensor: S8
S1	Sensor: S1	S3	Sensor: S3	S5	Sensor: S5
T11	S1 detects the arrival of steel, firing with no delay	T21	S3 detects the arrival of steel, firing with no delay	T31	S5 detects the arrival of steel, firing with no delay
M1	Motor M1	M3	Motor M3	M5	Motor M5
T12	M1 start up, firing with no delay	T22	M3 start up, firing with no delay	T32	M5 start up, firing with no delay
C1	Conveyor Belt C1	C2	Conveyor Belt C2	C3	Conveyor Belt C3
t1(1)	S1 turn to S2, firing with delay	t2(1)	S3 turn to S4, firing with delay	t3(1)	S5 turn to S6, firing with delay
t1(2)	C1 turn to steel, firing with delay	t2(2)	C2 turn to steel, firing with delay	t3(2)	C3 turn to steel, firing with delay
S2	Sensor: S2	S4	Sensor: S4	S6	Sensor: S6
T13	S2 detects the arrival of steel, firing with no delay	T23	S4 detects the arrival of steel, firing with no delay	T33	S6 detects the arrival of steel, firing with no delay
M2	Motor M2	M4	Motor M4	M6	Motor M6
T14	M2 start up, firing with no delay	T24	M4 start up, firing with no delay	T34	M6 start up, firing with no delay
Y1	Roughing rolling mill Y1	Y2	Roughing rolling mill Y2	Y3	Roughing rolling mill Y3
T15	Y1 screw down, firing with delay	T25	Y2 screw down, firing with delay	T35	Y3 screw down, firing with delay
S7	Sensor S7	T41	S7 detects the arrival of steel, firing with no delay	M7	Motor M7
T42	M7 start up, firing with no delay	C4	Conveyor Belt C4	t4	C4 turn to steel, firing with delay

5. MATLAB/STATEFLOW SIMULATION

Stateflow is a graphical design and development tool integrated in Matlab/Simulink, and is mainly used for modeling and simulation of complex control logic in control system [14]. Chart is the most common form in Stateflow, and its elements can be divided into two kinds: state and transition. States can have four different action types: entry, during, exit and on event_name, which respectively realize four actions: entry actions, during actions, exit actions and on event_name actions. The transition can consist of an event, a condition, a condition action, and/or a

transition action. The action types follow the label notation with this general format: event[condition]{condition_action}/transition_action [15]. A rectangular frame denotes state, while a line with an arrowhead indicates transition. According to engineering teaching case introduced in Figure 1, the rolling mill operating system simulated by Stateflow is shown in Figure 4. Notes: (1) circle describes junction linked between transitions; (2) Symbols in Figure 4 is same as Figure 1; (3) pause (10) is used to simulate transfer time of conveyor belt.

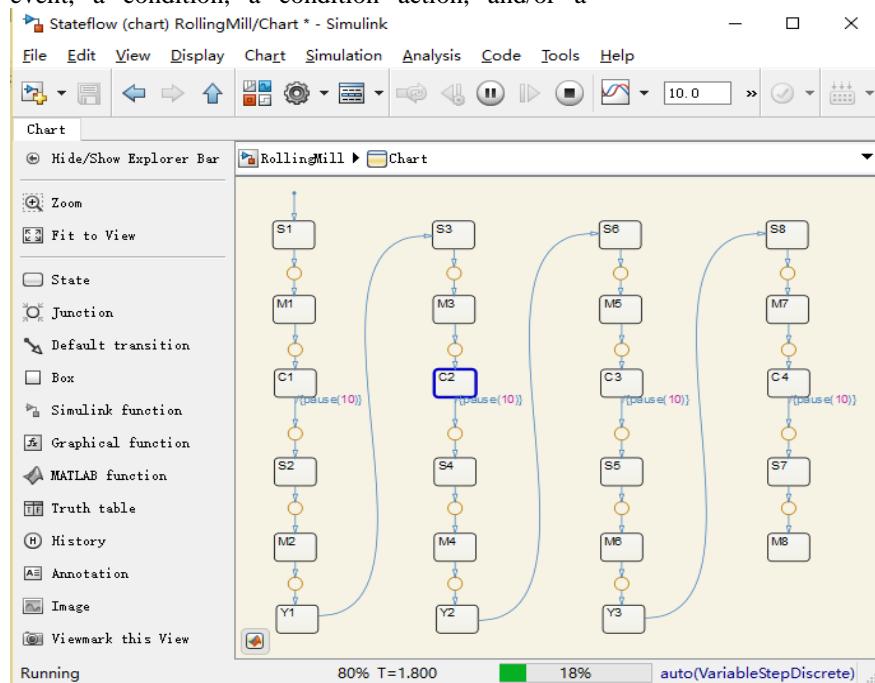


Figure 4. The rolling mill operating system simulated by Stateflow

6. PRACTICE TEACHING IN METALLURGICAL ENGINEERING VIRTUAL SIMULATION EXPERIMENT CENTER

Students learn to understand the process of steel rolling technology and main equipment through visiting metallurgical engineering virtual simulation experiment center. Figure 5 shows that the teacher in college of metallurgy and energy is explaining the production process of steel rolling for automation students from the point of view of technology.



Figure 5. Practice Teaching in Metallurgical Engineering Virtual Simulation Experiment Center

After understanding the main equipment and production process of steel rolling, students can truly understand the actual production of enterprises by combining with the pictures and videos in No.1 Steel Rolling Mill of HBIS Group Tang Steel Company. Figure 6 shows the pictures of hot rolling production line in No.1 Steel Rolling Mill of HBIS Group Tang Steel Company. In order to ensure the safe production of company, more and more high-risk workshops are closed to students' visiting and internship. By combining visiting the main equipment model of steel rolling with the hot rolling production site of Tangshan Iron and Steel Company, students can quickly develop an objective and rational understanding of the rolling production process and its automation, and establish a steel rolling workshop in their minds.

The picture of synthetical automation for process industries simulation center in college of electrical engineering is shown in Figure 7. The center researches the automatic control of hot continuous rolling process from tunnel furnace to high speed down coiler, which is based on real-time simulation system software. And the software are classified into five subsystems: hot continuous rolling real-time simulation system, process automatic control system, basic automatic control system, data acquisition and analysis system and hot continuous rolling 3-D virtual scene. Students can combine theoretical knowledge with engineering practice effectively by studying roughing mill model and its control theories in center.



(a) Slab enter into Vertical Rolling Mill



(b) Roughing Mill (Hot Continuous Rolling Mill)

Figure 6. The pictures of hot rolling production line in No.1 Steel Rolling Mill of HBIS Group Tang Steel Company



Figure 7. Synthetical Automation for Process Industries Simulation Center

7. CONCLUSION

The department of Automation of NCUST is under the pilot plan of "Training Outstanding Engineers" in ministry of education. In order to cultivate engineering talents, many reforms and explorations of the courses were carried out, including control system simulation. There are 40-class hours in our teaching, while the other universities have 32-class hours. Among the 40 hours, 32 class hours are guaranteed to complete the traditional teaching content, while 8 class hours are used to explore rolling mill teaching case. Under the "Elite plan"

program, the main mission of Application-oriented university, backed up with its own strong speciality, is to train high quality talents in this industry, to help local economic development. Relying on rolling mill process in Tangshan Iron Group as the model and test bed, this paper has developed a simulation mode, featured by its multi-discipline, multi-software, and multi-methods nature. The results has been adopted as the classic study case in NCUST.

ACKNOWLEDGEMENTS

This work was financially supported by Tangshan Technology R & D Program (15110202a), and Doctoral Scientific Research Foundation of North China University of Science and Technology, Research and Practice of Teaching Reform in Education of North China University of Science and Technology (QZ-1536-09).

REFERENCES

- [1] Zhu Chaoqun, Liu Weirong, Wang Zhiwen, et al. Exploration on Automation Majors Enterprise Practice Teaching Based on Outstanding Engineers Plan. *Research and Exploration in laboratory*, 2017, 36(12): 243-246.
- [2] Peng Xiwei, Liao Xiaozhong, Dong Lei. Exploration and Practice of Teaching Reform of Automation Specialty Course. *China University Teaching*, 2016, (1): 72-74.
- [3] Wang Hongmei, Bian Dunxin, Xing Xuening. Teaching Research and Exploration for Control System Simulation Curriculum. *Journal of EEE*, 2015, 37(4): 48-50.
- [4] Yang Guoliang, Liang Liming. Software Programming of Control System Simulation Exploration based on MATLAB. *China Electric Power Education*, 2012, (2): 80-81.
- [5] Pan Feng, Xue Dingyu, Chen Dali, et al. On the Construction of National Excellent Resources Sharing Course for Control System Simulation and CAD. *Research and Exploration in laboratory*, 2013, 32(11): 286-289.
- [6] Lin Feng, Yao Wei, Chen Xin, et al. Construction of Inquiry Experiment Platform of Matlab and System Simulation Course. *Journal of EEE*, 2018, 40(1): 116-118.
- [7] Xia Jingping. Reform on Experiment Teaching of Automatic Control Principle Oriented by Training of Outstanding Engineers. *Research and Exploration in laboratory*, 2017, 36(12): 188-191.
- [8] Zhang Xinfeng, Chen Hui, Li Qi. Construction for Control System Simulation and Design Course. *Journal of EEE*, 2013, 35(6): 10-12.
- [9] Wang Shubin, Zuo Xin, Luo Xionglin, et al. Teaching Reform of the Postgraduate Course of Control Systems Simulation. *Journal of EEE*, 2011, 33(4): 21-22.
- [10] Ma Bo, Sun Shaohui, Zhao Huaguo. Comparative Analysis on Modification Solutions for Rough Mill of Narrow-Strip Hot Continuous Rolling Line. *CFHI Technology*, 2017, (4): 5-9.
- [11] Liu Baozhong, Zhang Yue, Zhang Yu. Multi-Simulation of Rolling Mill Machine Rolling Control. Beijing: DEStech Publications, Inc., 2017, 386-390.
- [12] Han Ying. The Application of PLC in Automatic Rolling Mill Monitoring System. *Journal of Luoyang Institute of Science and Technology (Natural Science Edition)*, 2012, 22(4): 73-75.
- [13] Mo Taiping, Zhao Peisi, Duan Renhang, et al. Modeling and performance analysis of manufacturing execution system based on Petri net. *Computer Integrated Manufacturing Systems*, 2015, 21(8): 2063-2071.
- [14] Zhang Wei. *Modeling of Stateflow Logic System*. XIDIAN University Press, 2007.
- [15] Chen Jianghong. *Hybrid Petri Nets Based Modeling of Hybrid Systems and its Application in industry*. Beijing University of Chemical Technology, 2004.

Study on Structured Description of the Equipment Support Decision-Making Demand

Kai Zhao, Lu Gao, Yu Jia
Shijiazhuang campus, AEU, Hebei Shijiazhuang 050003, China

Abstract: In view of the large amount of information required for decision-making, various data styles and types, and the difficulty for decision makers to select effective information quickly and effectively in the current equipment support decision-making process, a unified and reasonable demand description method is set up with the propose to support the decision-making process and it is easy to quickly retrieve the support mode corresponding to the demand, realize the rapid and accurate decision-making in wartime, and solve the visual description problem of the support demand when the support object puts forward the demand.

Keywords: equipment support decision-making; decision-making demand; structured description

1. INTRODUCTION

Structural description of equipment support decision-making demand means that the equipment support decision-making organs comprehensively analyze the demand of equipment support decision-making according to the characteristics and rules of equipment support of combat forces, and explore the description methods affecting equipment support decision-making demand, so as to provide support for the rapid formulation of more reasonable decision-making plans.

2. A GENERAL APPROACH TO STRUCTURED DESCRIPTION

The structural description method adopts the principle of structuralization, modularization and top-down to analyze the demand [1]. This method uses the data flow diagram as the core to extract the related attributes of demand, sort out and describe the processing functions, and realize the re-abstraction and re-organization of demand in a structured form, so as to realize the visual description of demand, facilitate the rapid retrieval of demand and ensure the rapid implementation of decision-making. In order to better describe demand, several common structural description methods are summarized in this paper:

2.1. Mind Mapping

Mind mapping, the meaning of which is that a center gives out to the surrounding and by using lines, symbols, words and images, the structural style of divergent type and the node type are formed, so cumbersome text messages can turn into well-bedded tree structure chart, is put forward by the British

scholar Tony Buzan in the 1960s. It can display some abstract, boring content in the form of images visually and have a strong sense of organization. It is characterized by networking and clear structure, and the advantages of it are good visual effect and obvious focus and hierarchy.

2.2. The UML

Unified modeling language (UML) is a kind of object-oriented modeling tools which describes the basic concept, symbols and terms of the objects in the form of unified graphical elements, making the information of object visual, structured, standardized and documented and provide consistent information organizing mode for the users, facilitating understanding and communication.

2.3. Petri Net

Proposed by Dr. C.A. Petri in 1962, Petri net is a powerful tool for asynchronous and concurrent system modeling and performance analysis. It has the ability of guiding graphic description, and can succinctly and intuitively describe the structure of the system in the form of network diagram and represent various relationships in the system. It is mainly used to describe the dynamic performance of the system. In combination with the above methods and based on the analysis of the equipment support decision-making demand of new type operational forces, a description method of “dimension tree” based on tree structure is proposed in this paper, which can more intuitively reflect the demand of different situations, different equipment and different support tasks.

3. STRUCTURED DESCRIPTION OF “DIMENSION TREE” DESIGN

Tree structure is composed of a root node and multiple subsequent nodes, which include the root node of multiple sub-trees and multiple leaf nodes. It is a description method based on hierarchical structure. The method to describe “dimension tree” is to describe things in different levels and different dimensions so as to form different levels of “grid”. A “grid” is corresponding to a specific content in this level. The previous level of “grid” has a specific description in the next level so that the complex relationships in internal matters can be implied in a concise and exact way, which will analyse a complex problem step by step to facilitate analysis and operation. The structure of the “dimension tree” method is shown in Figure 1.

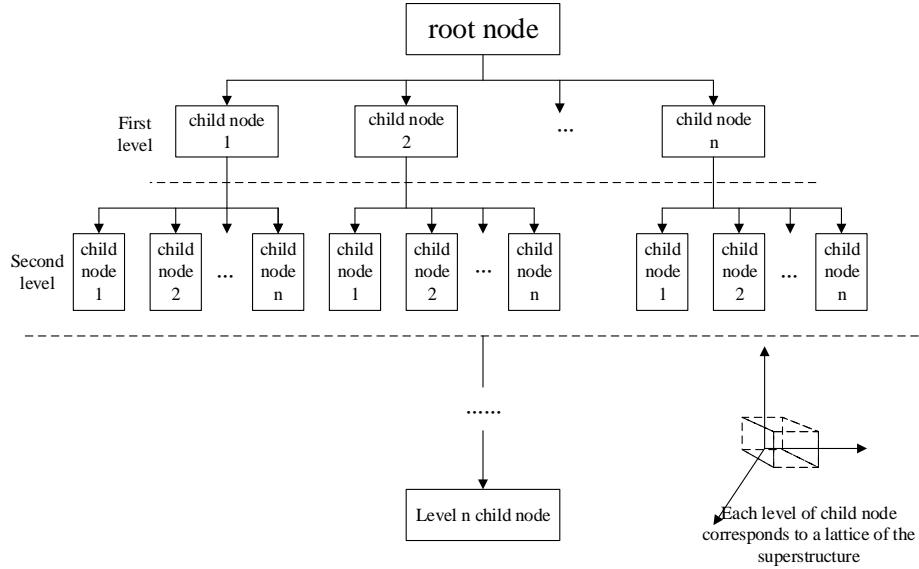


Figure 1. The Basic Structure of the Description Approach of the “Dimension Tree”

4. STRUCTURED DESCRIPTION PROCESS OF EQUIPMENT SUPPORT DECISION-MAKING DEMAND

Structured description of equipment support decision-making demand is to take a structured description method to describe the equipment support decision-making demand of this level, and decompose the general support demand into specific demand step by step. How to decompose and to which level can be determined according to the specific situation.

Different levels of demand reflect different content of equipment decision-making elements. Demand is the core of structural description. On the basis of a clear demand, we should analyse the corresponding data, equipment status, demand structure, equipment support operations and equipment support plan, etc. with demand, and further refine specific elements of content according to the specific tasks of equipment support. The description of the specific process is shown in Figure 2.

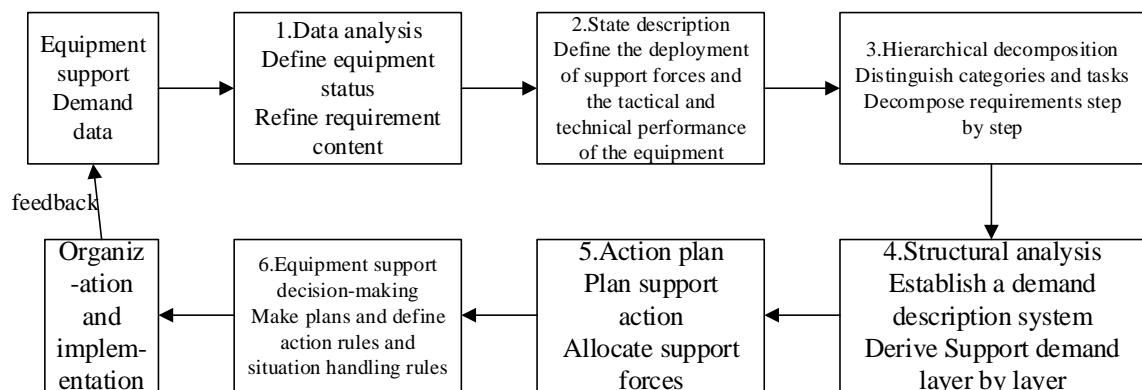


Figure 2. Structural Description Process of Equipment Support Decision-making Demand

According to the process of equipment support decision-making and demand model, the figure above defines the content and mutual relationship of structured description of demand, which can be divided into several aspects:

(1) Data analysis. The equipment support data are numerous during wartime, and the required support information should be extracted from the massive data, including equipment status information, equipment model, quantity information, ammunition demand information, battlefield environment information, equipment damage rate, equipment location information, etc. so as to clarify the content of support demand.

(2) State description. For equipment support information, we should comb the status information of different operational phase of the combat entity, including gear motor performance, ammunition and oil remaining amount, living conditions, software and hardware technology, and analyse the deployment of various support forces, support material reserves, support strength mobility, support department (sub) team maintenance support capability in correspond with demand.

(3) Hierarchical decomposition. The corresponding relations of multiple levels and different demands are established with the information of equipment support demand, support force and battlefield

environment (weather information, terrain and landform, etc.), and the support contents are decomposed step by step to make the support contents specific.

(4) Structural analysis. In the process of demand decomposition, the demands for equipment support at specific levels are determined according to the actual situation, and the time limit, location, material and personnel needs of the support are defined.

(5) Action planning. According to the analysis of demand and support capability, we should make advanced design and arrangement for support action, coordinate support strength and support resources and make plans for the support equipment name, function area, start time, duration, support requirements and effect, which mainly include equipment support force formed, equipment support deployment, equipment technical support, equipment management of battlefield, equipment support power use, etc.

(6) Action decision. We should choose the optimal program in the formulation of the program, coordinate the superior, deploy the action of the support force at the corresponding level, continue to do a good job tracking effectiveness, timely find and solve problems and constantly adjust the program so as to complete the support task.

5. REALIZATION PROCESS OF STRUCTURED DESCRIPTION OF EQUIPMENT SUPPORT DECISION-MAKING DEMAND

Equipment support decision-making needs are mainly obtained from battlefield situation, equipment status, support tasks and support forces [2]. The main tasks are as follows: First, fully understand and master the situation of the enemy and ourselves, the battlefield environment and operational objectives related to equipment support, as well as support tasks that should be completed in order to achieve operational objectives. Second, analyze and judge the favorable and unfavorable factors and the gap between support demand and possibility for completing support task, and find out the key problems of support. The third is to predict the possible problems and development trend of equipment support. Fourthly, the objective conditions needed to solve the key problems are compared with the realistic conditions, and the limits of the decision-making objectives are preliminarily determined.

5.1. Battlefield Conditions

The conditions mainly include enemy situation, our situation and battlefield environment, as shown in Figure 3. Equipment support is the appeared situation that the operational effectiveness is unable to play when our combat forces fighting the enemy and the organization of the activities are under enemy threat all the time. So necessary support that aims at keeping fighting capacity in the process of our equipment being attacked by enemy or confronting with the enemy as well as the threat that the enemy activities generate to our equipment support activities

must be taken into account when making equipment support decision-making. As for the situation of the enemy classes, we mainly design the following four elements: “the enemy attempts”, “the enemy troops”, “the enemy major combat operations” and “enemy operational capability analysis”. Our relevant information is the necessary basis for planning, organizing and implementing equipment maintenance support. We mainly design five elements, namely, “quantity of equipment involved in combat”, “our combat intentions”, “major combat operations”, “our main equipment involved in combat” and “intensity of use of weapons and equipment”. The battlefield environment has a great influence and restriction on the equipment maintenance and support activities, mainly involving the “natural geographical environment of the war zone”, “social situation of the war zone”, “civil situation of the war zone” and other three elements.

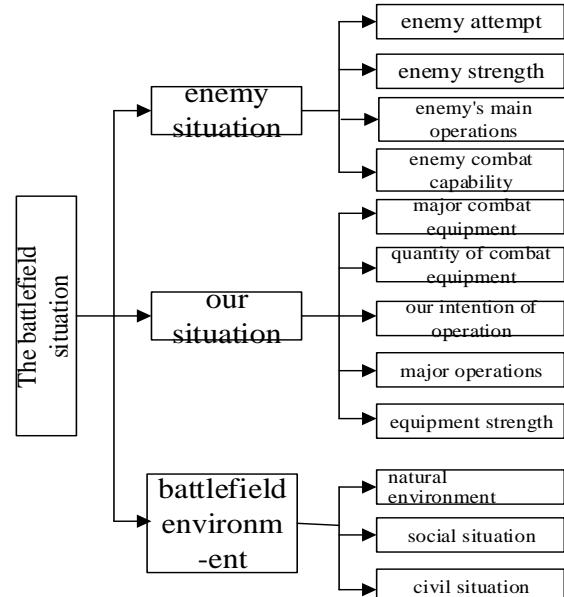


Figure 3. A Structured Description of the Battlefield Situation Demand

5.2. The Situation of Equipment

The arrangement of all the equipment support activities in the equipment support plan is based on the reality of the existing equipment, which is the basis of formulating the equipment support plan and implementing the equipment support activities. The situation of equipment must be considered when describing equipment support decision-making demand, including equipment model, the type of equipment, the status of equipment, the hierarchy of equipment, specific tasks that equipment takes on in combat, implementation of equipment support based on the priority of different equipment and the position of the equipment. Finding out the actual situation of equipment can accurately determine the demand of equipment support, defining equipment support

priorities can carry out accurate support under the condition of the limited resources, and maintaining the fighting capacity of the main combat equipment

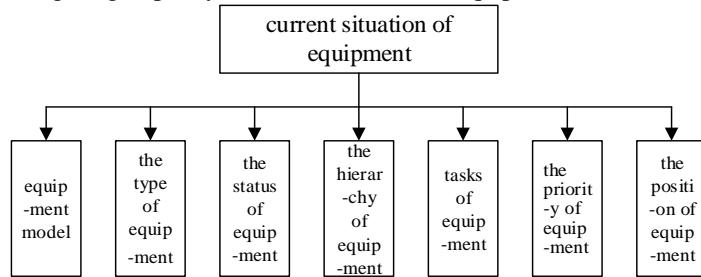


Figure 4. Description of Equipment Status

5.3. Equipment Support Forces

Equipment support forces are the main part of equipment maintenance support activities [3]. The current situation is the basis and premise of planning and arranging equipment maintenance support activities. The changes of combat situation must be taken into consideration in the aspect of the configuration of equipment support forces, equipment reserve, support mode and support action to achieve flexible and timely equipment support.

In the future high-tech local war, battlefield space is expanding, and information attack may affect the support team of mobile and search capabilities in regional [4]. Complex battlefield environment is not conducive to the deployment of equipment support forces. Precision strike will cause transport difficulties and loss on the way to equipment, ammunition and other supplies. The defense capacity of support strength affects the support capability. Mainly including: (1) Support personnel elements. Determine the professional matching rate, competent degree and full rate of support personnel. (2) Maintenance equipment elements. Determine the type and quantity of equipment required for each level of

can make the equipment support play their effectiveness. See Figure 4 for details.

maintenance and study their financing, distribution and supply. (3) Training support elements. Determine the training plan, subject setting, training method and training equipment required for the training. (4) Technical data elements. Determine various engineering and technical information (both written and electronic) documents required for equipment support. (5) Elements of supporting facilities and equipment. Determine the matching rate and completion rate of supporting facilities and equipment. (6) Informationalized resource elements. Computer, network equipment and other hardware required for informationalized support and professional management software for support and required electronic documents and data information.

5.4. Equipment Support Tasks

The equipment support task is to determine the target of the equipment support activities, which is the traction of the equipment support program [5]. Without the equipment support mission, the equipment support activities will lose their targets and there will be no implementation of equipment support. See Figure 5.

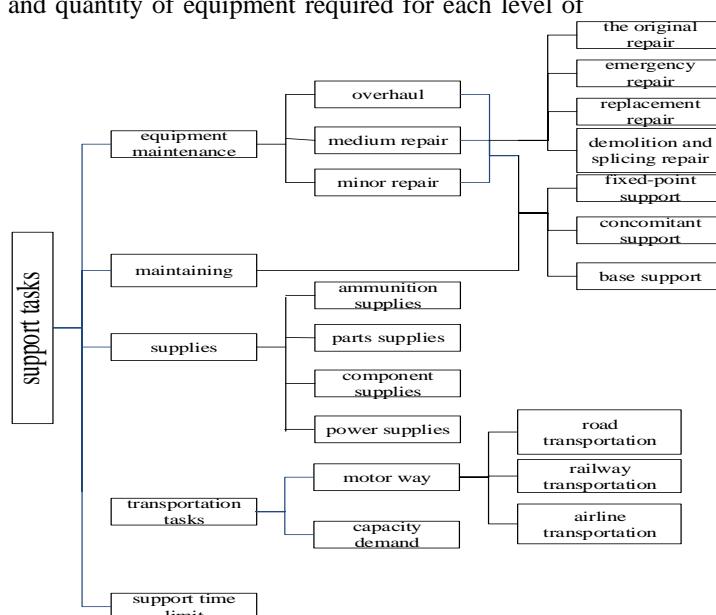


Figure 5. Description of Equipment Support Mission

6. CONCLUSION

The description method of equipment support decision-making demand is detailedly been stated in the aspects of the general method of structured description, structured description of “dimension tree” design, structured process of equipment support decision-making demand, structured description method of equipment support decision-making demand and other aspects in this paper, which provides a certain reference for policymakers reasonably and quickly making decisions and has made certain achievements in the aspect of visual description of support demand. However, as the equipment support decision-making is a huge system engineering, the research on its decision-making demand needs to be further deepened, and the description of decision-making demand needs to be further explored in the next step.

REFERENCES

- [1] Zheng Lizhen, Gao Lu, Yu Tonggang. Research on decision-making modeling method of equipment support command. Ordnance Industry Press, 2016
- [2] Guo Qisheng, Wang Kang, et al. Analysis method of weapon and equipment requirements. Journal of Academy of Armoured Force Engineering, 2013, 27(5): 8-11.
- [3] Shen Yaode, Du Xiaoming, et al. Research on the decision-making model of equipment support command based on rules. Computer measurement and control, 2012, 20(1): 135-137.
- [4] Zhao Wukui. Equipment support science. Beijing: PLA press, 2003.
- [5] He Guoliang, Fan Yanping, Guo Jie. Requirements analysis method for equipment combat capability. Journal of Academy of Armoured Forces Engineering, 2016, 30(2): 1-3.

Value of Traditional Chinese and Western Medicine Nursing in Children's Viral Myocarditis Nursing

Yan Zhu

Department of Paediatrics, Jingzhou Central Hospital, The Second Clinical Medical College, Yangtze University, Jingzhou, Hubei 434020, China

Abstract: Objective: To explore then method and value of traditional Chinese and western medicine nursing in children's viral myocarditis (VMC) nursing. Method: 100 children with VMC from August 2016 to August 2018 were classified into control group (conventional nursing) (50 cases) and observation group (traditional Chinese medicine nursing on the basis of control group) (50 cases) at random. The effects of nursing intervention of two groups were compared. Result: After nursing intervention for 7 days, the total effective rate of observation group was 92.00%, higher than that of control group (76.00%), $p<0.05$. The total duration of hospital stay of observation group was (9.6 ± 1.2) days, shorter than that of control group (13.7 ± 2.6) days, $p<0.05$. Conclusion: Combined traditional Chinese and western medicine nursing intervention contributes to improving therapeutic effect and facilitating recovery for VMC children, so it deserves to be promoted.

Keywords: VMC; children; combined traditional Chinese and western medicine nursing; nursing effect

1. INTRODUCTION

The pathogenesis of VMC is infection caused by virus invasion. The common pathogeny includes spirochete, rickettsia, fungus and virus [1]. The research has proven that the morbidity of VMC continues to rise under life style changes and living environment changes [2]. Cyclic adenosine monophosphate, ATP, coenzyme Q10, vitamin C and antiviral therapy are often used to treat VMC. After treatment, effective nursing intervention contributes to promoting recovery and improving treatment effect [3]. In this study, the nursing value of combined traditional Chinese and western medicine nursing for VMC children was discussed.

2. DATA AND METHOD

2.1. General Data

After the Ethics Committee approved, 100 VMC children who were received and treated in our department from August 2016 to August 2018 were chosen. After their parents approved, they allowed their children to participate in the study. The random number table was used to classify them into observation group (50 cases) and control group (50 cases). There were 26 male cases and 24 female cases

in the observation group, and the age was 3-13 years old, with the average age of 8.6 ± 1.2 . There were 28 male cases and 22 female cases in the observation group, and the age was 3-14 years old, with the average age of 8.4 ± 1.3 . General data comparison of both groups $p>0.05$.

Inclusion criteria: diagnosed with VMC in laboratory examination, imaging evidence; age: below 15 years old.

Exclusion criterial: incomplete clinical data; combined with important organ diseases; unconsciousness, blurred mind.

2.2. Method

2.2.1. Control group

The patients in both groups received conventional treatment. On this basis, the observation group received conventional western medicine nursing. (1) The electrocardiogram was monitored in real time. The nursing personnel paid close attention to electrocardiogram changes, vital sign changes and disease control of VMC children, and evaluated whether there was exacerbation trend. In case of any abnormality, the nursing personnel reported to the physician and did the ancillary work [4,5]. (2) Life nursing: the nursing personnel created favorable environment to promote recovery and guaranteed good ventilation, quiet and clean environment in the ward. The sufficient rest time was ensured for the VMC children, and the clothes increased or decreased in accordance with temperature changes. (3) Visit limit: the accompanying persons and visitors were limited. When the VMC children indeed needed to be accompanied, the accompanying person should prohibit smoking and liquor drinking [6]. (4) Diet nursing: the vegetables and fruits rich in vitamins and fibers as well as the food easy to digest were provided, and spicy and greasy food was prohibited [7].

2.2.2. Observation group

The observation group received traditional Chinese medicine nursing intervention while receiving the nursing intervention of control group. (1) Emotional nursing of traditional Chinese medicine: the nursing personnel gave the children emotional support, stabilized their emotions, encouraged them to express their dissatisfaction and eased their pessimistic and anxious emotions through relaxing nursing method. (2) Traditional Chinese medicine massage: 1) reflection

region massaging: the children's joints, gall bladder, liver, duodenum, pancreas and stomach for 15min every time, once/day; 2) comfortable position massaging: the children's ear reflection region, upper part of ear back, hear reflection region (central depression of cavity of auricular concha) and cardiac area (heart point and heart Shu), and the two ears were massaged alternately, 15min/time, twice/day. (3) Dialectical nursing: for the exogenous type, the nursing principle of tranquilizing mind by nourishing the heart and eliminating heat was adopted. The favorable recovery environment was created, and the emotional nursing was given. The fresh air was kept in the room. Fermented soya beans, mung bean, fresh ginger and other food were provided to enhance the effect of detoxication. For the spleen and stomach type, the principle of calming the heart and tranquilizing the mind, harmonizing stomach, removing stasis, eliminating heat and removing humidity was used. The mentality was adjusted, and greasy, raw, cold, phlegm-induced and humidity-induced food was prohibited. Endothelium corneum gigeriae galli, hawthorn and radish were eaten often to help invigorate spleen, promote digestion, eliminate phlegm and remove humidity.

2.3. Observation Indexes and Evaluation Criteria

(1) The 7 days therapeutic effects for both groups

Table 1. Total effective rate of both groups (n, %)

Group	n	Ineffective	Effective	Significant effect	Total effective rate
Observation group	50	4 (8.00)	19 (38.00)	27 (54.00)	46 (92.00)
Control group	50	12 (24.00)	20 (40.00)	18 (36.00)	38 (76.00)
χ^2	-	-	-	-	4.762
p	-	-	-	-	0.03

3.2 Duration of hospital stay

The duration of hospital stay of observation group was (9.6 ± 1.2) days, shorter than that of control group (13.7 ± 2.6) days, $t = 10.124, p < 0.01$.

4. DISCUSSION

VMC is a common disease among children. Its pathogenesis is virus infection. Since the immunity of children is not strong, they may be easily infected, and cardiac muscle tissue impairment results in the disease. The main manifestations include chest distress and palpitation, often accompanied with insomnia, lack of appetite and lack of strength. Clinic treatment mostly adopts symptomatic treatment. After treatment, nursing intervention measures are taken to promote recovery and improve therapeutic effect [8].

In the theory of traditional Chinese medicine, VMC results from wind-heat invasion of lung and heart impairment. The characteristics of this disease include "wind-heat and humid heat" and "pericardium attack". In *Huangdi Neijing*, "wind is the source of various diseases", so "harmful wind should be avoided" [9]. Hence, in the process of traditional Chinese and western medicine nursing intervention of VMC, it is required to guarantee

were observed. Electrocardiographic examination result, sign and symptoms improvement were combined for the evaluation. Ineffective: after treatment and nursing intervention, ST segment in the children's electrocardiogram failed to return to normal; the signs did not improve and the symptoms did not change. Effective: ST segment in the children's electrocardiogram improved obviously; the signs and the symptoms improved significantly; significant effect: the children's electrocardiogram returned to normal, and the signs and symptoms disappeared. Total effective rate = (total number - ineffective number)/total number $\times 100\%$.

(2) Total duration of hospital stay of both groups was observed.

2.4. Statistical Processing

The data were processed with SPSS19.0. The measurement data ($\bar{x} \pm s$) were tested with t test, and the enumeration data (5) were tested with chi-square test. $p < 0.05$ means the difference has statistical significance.

3. RESULTS

3.1. 7 days Treatment Effect

After treatment and nursing intervention for 7 days, the total effective rate of observation group was higher than that of control group, $p < 0.05$, as shown in Table 1.

reasonable diet and avoid harmful wind so as to facilitate recovery.

In this study, based on conventional western medicine nursing, traditional Chinese medicine nursing was provided for VMC children. Acupoint massage has the effect of regulating channels, activating collaterals and coordinating viscera and contributes to enhancing effective circulation of lymph and blood and improving vital energy and blood. Besides, it has promotion effect on myocardial cell metabolism and plays a role in improving immunity. Based on conventional diet nursing intervention, dialectical diet nursing intervention in traditional Chinese medicine is applied, and medicine effect is enhanced by diet so as to improve therapeutic effect. VMC is an infectious disease, so visit is limited to avoid spreading. However, since VMC children are still young, visit limit will cause them lack sense of security. It is hard to solve their anxiety and depression, thus leading to the increase of nursing difficulty. So, emotional nursing in traditional Chinese medicine is given to eliminate their negative moods, enhance treatment and nursing obedience, improve their psychological state and then promote recovery [10].

In this study, the total effective rate of VMC children

after receiving combined traditional Chinese and western medicine nursing for 7 days was higher than that of VMC children after receiving western medicine nursing intervention, indicating that combined traditional Chinese and western medicine nursing contributes to improving therapeutic effect. The duration of hospital stay of VMC children receiving combined traditional Chinese and western medicine nursing was shorter than that of VMC children receiving western medicine nursing, indicating that combined traditional Chinese and western medicine nursing can facilitate recovery of VMC children. Thus, this study holds that the application of combined traditional Chinese and western medicine nursing contributes to improving therapeutic effect and promoting recovery, and the nursing effect is better than that of conventional western medicine nursing. So, it owns high promotional value.

In conclusion, combined traditional Chinese and western medicine nursing intervention contributes to improving therapeutic effect and facilitating recovery for VMC children, so it deserves to be promoted.

REFERENCES

- [1] Rose, Noel R. Viral myocarditis. *Current opinion in rheumatology*, 2016, 28(4): 383-389.
- [2] Ioannis N. Mammas, Maria Theodoridou. Paediatric Virology: A rapidly increasing educational challenge. *Exp. Ther. Med.*, 2017, 13(2): 364–377.
- [3] Guo Yubo. Effects and related mechanism of overexpression of human thioredoxin on the inflammatory response in mice with viral myocarditis. *China Medical Abstracts (Internal Medicine)*, 2018, 35(03): 141.
- [4] Li Zhong. Protective effect of berberine on viral myocarditis via Toll-like receptor 4/nuclear factor- κ B signal pathway in mice. *China Medical Abstracts (Internal Medicine)*, 2017, 34(02): 98.
- [5] Sharma Minalini, Mishra Baijayantimala, Saikia Uma Nahar, Bahl Ajay, Ratho R.K. Inhibition of coxsackievirus infection in cardiomyocytes by small dsRNA targeting its cognate coxsackievirus adenovirus receptor. *The Indian journal of medical research*, 2017, 146(4).
- [6] Xingmei Qi. Spontaneous C-cleavage of a truncated intein as fusion tag to produce tag-free VP1 inclusion body nanoparticle vaccine against CVB3-induced viral myocarditis by the oral route.
- [7] Min Li. Kruppel-like factor 10 protects against acute viral myocarditis by negatively regulating cardiac MCP-1 expression to decrease inflammatory monocytes infiltration.
- [8] Zhaolan Liu, Zhijun Liu. Herbal medicines for viral myocarditis, *Cochrane Database. Syst. Rev.*, 2010, (7): CD003711.
- [9] Ming-Shyan Lin, Yu-Hsiang Tseng, Mei-Yen Chen. N-Hospital and Post-Discharge Outcomes of Pediatric Acute Myocarditis Underwent After High-Dose Steroid or Intravenous Immunoglobulin Therapy. *BMC Cardiovasc Disord*, 2019, 19: 10.
- [10] N. Spanakis, E.N. Manolis, A. Tsakris. Coxsackievirus B3 sequences in the myocardium of fatal cases in a cluster of acute myocarditis in Greece. *J. Clin. Pathol.*, 2005, 58(4): 357–360.

Research on Hot Spot Knowledge of Equipment Support in China-A Visualized Study Based on CNKI Data with Citespace

Zhang Jing Yu^{1,*}, Liu Wan Yi¹, Ma Zhou², Li Xing Ming¹

¹Shijiazhuang Campus, Army Engineering University, Shijiazhuang, Hebei, 050000, China

²Institution of Chemical Defense, Beijing, 10000, China

Abstract: In this paper, the author draws a map of the main research achievements of equipment support in Chinese army in the past 20 years through the key words of relevant literature and the author's research institutions. The author analyses and displays the hot issues and development trend of equipment support. Finally, the conclusion is drawn to provide ideas for improving the development of Chinese army equipment support activities.

Keywords: equipment support; visualized map; hot spots and trend

1. INTRODUCTION

With the rapid development of science and technology, the speed of weapon update and the technical content contained are also increasing day by day, which puts forward more stringent requirements for the equipment support of Chinese army. Nowadays, all the armies in the world take the improvement of equipment support capacity as an important factor affecting the combat effectiveness of the army, which is of great significance for winning the battle. The research on the hot spot issues of China's military equipment support can not only analyze the key tasks of China's military equipment support in different stages in the context of the big era, but also discuss its future trend, which is conducive to improving the military and economic benefits of equipment maintenance support.

2. MATERIAL AND METHOD

2.1. Data Sources

The data in this paper comes from CNKI. The advantage of CNKI lies in its complete collection of literature and reasonable and scientific retrieval method. Therefore, CNKI is selected as the statistical source of this data. In addition, "equipment support" was selected as the topic and key words, and the literature scope was "all journals". In each literature, the information included authors, title, institution, and other information. At the same time, in order to avoid the phenomenon of repeated selection and deviation from the research topic due to the improper naming of keywords. The author has merged the literatures with similar words, finally, according to the research content, some terms that are not related to the object of this study or not in the field, such as "management of civil meteorological satellite equipment" and so on

are deleted. After screening invalid data such as preface, introduction of personal academic achievements, book review, 382 literatures are finally obtained as the research object.

2.2. Research Methods

This paper uses citespace as a research and analysis tool, citespace is a literature data mining and visualization software developed by Chen Chao Mei team, it is a blend of clustering analysis, social network analysis and other methods and it can analyze the basic knowledge and research frontier of a certain field through the analysis of literature co-citation and coupling, scientific research cooperation network, theme and domain contribution, etc., it can also detect subject research features and evolution trend, as well as the intersection of different subjects, interaction, at last it would demonstrate them through a map. Since citespace presents the structure, law and distribution of scientific knowledge by means of visualization, the visualized mappings obtained by such methods are also called "science knowledge mapping".

3. RESEARCH ON HOT SPOT AND EVOLUTION TREND OF EQUIPMENT SUPPORT

First of all, the search conditions are set up on CNKI for a period of 1998-2018, with the theme: "subject = military equipment support" or "title = military equipment support", and the data base is selected as an academic journal. By using the visualization analysis of CNKI (Figure 1), it can be concluded that the number of documents on equipment support of China's army has fluctuated, and the overall annual volume of articles is on a rise. At the same time, the fluctuation trend indicates that in the past 20 years, equipment support has always been a hot spot for researching in China's army, and its research level keeps on deepening and the research results are rapidly increasing.

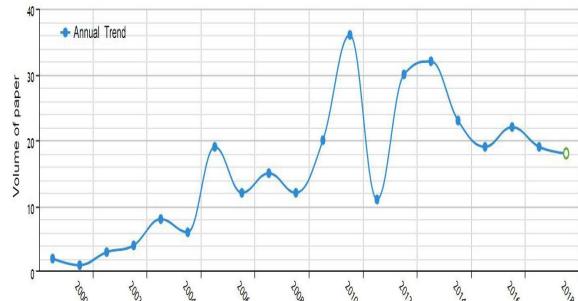


Figure 1. The trend of military equipment support documents in China's army

3.1. Test Result and Analysis on Hot Spot Issues

We attach all the literatures in Citespace and set “Top N” in Selection Criteria as 50. In the “Time Slicing” we set up the time span from 1998 to 2018 and “Years Per Slice” as 1. In Term Type, we do the “Burst Terms”. We do “Term Keyword” in “Node Types”, the thresholding (c, cc, ccv) are set to (4.3.20), (4.3.20), (4.3.20), respectively, we tick pathfinder in “Pruning Column” which is used to simplify and merge the graph. Finally 393 literatures have been shieived as object, the following mapping could be achieved. There are 62 nodes and 125 connections between nodes in this atlas. Nodes represent the frequency of keyword references. The size of the node font represents centrality and the larger the font, the stronger the centrality, and the higher the frequency of its appearance. The connection between a node and a node represents a co-occurrence relationship between the two. Its color represents the time when it first appeared. The thicker the line between the two nodes, the closer the connection between them.



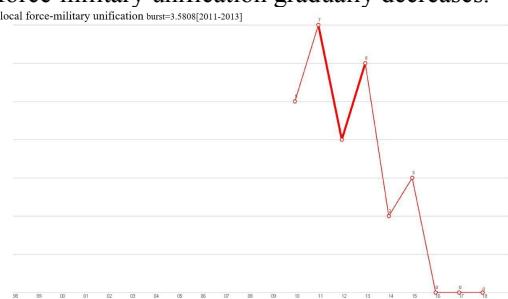
Figure 2. The mapping of co-occurrence literatures
Citespace can clearly and intuitively present the mapping of co-occurrence of key words in a certain topic, which can be used to study its related hot issues and analyze hot issues in a certain field from multiple perspectives. Combined with Figure 2, it can be concluded that in the topic of equipment support, the key words with higher statistical frequency and stronger psychological quality are: equipment support, military civilian integration and local force-military unification and army. These key words represent the

hot issues studied during this period. The emergent point of the periphery is the new subject about the hot words. As can be seen from the figure, the emerging disciplines of equipment support in recent years are equipment-support informatization.

Through the secondary literature analysis, the scholars talks about equipment support from the point of military civilian integration, mainly because the purpose of making army equipment support in military and civilian integration equipment safeguard is the requirement of the national development strategy, also the intrinsic attributes required need military civilian integration model. Equipment support will be integrated into the overall layout of national social and economic development and national defense science and technology development. With the help of talents and technical forces of national defense and military industry enterprises, we should expand the way of military-civilian integration technology guarantee, try to use local logistics strength to carry out equipment supply support in specific links and occasions, and construct a supply support network of global coverage and the combination of peacetime and war. In order to enhance the army equipment supply support capabilities and benefits.

Local force-military unification relative to complete military formation. At present, our common saying is socialization. Socialization refers to the use of market economy conditions and means by the army, organize social forces to undertake some work that can be done by society. The essence of socialization is marketization [1]. That is to say, the equipment maintenance support is integrated into the socialization environment. Therefore, the equipment maintenance support can also be said to implement the socialization of part of the equipment maintenance support.

On the basis of analyzing the differences between military civilian integration and local force-military unification and compared with different pictures in figure 3, the author thinks that military civilian integration is a high-level form of local force-military unification, which is developed on the basis of local force-military unification. It can also be found that the military civilian integration appears after the local force-military. When the military civilian integration increases rapidly, the frequency of the local force-military unification gradually decreases.



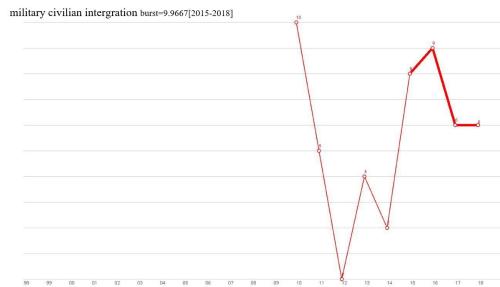


Figure 3. The analysis of trend for different hot spots
3.2. Test Result and Analysis on Evolution Trend of Equipment Support



Figure 4. Evolutionary path of key words in the field of equipment support

According to the key words at node in time, we can sort out the evolution process and trend of the research field of "Army equipment support".

The socialization of logistics support of China's army began in the early 1990s. It was fully launched in 2000. As far as the US military is concerned, the socialized development of our equipment support will lag behind. Therefore, in the study of equipment support in the past few years, the words "US military" and "contractor" appeared to a higher degree, which was intended to compare the similarities and differences in social support between China and the United States in various aspects, analyzed the successful experience and existing problems of the US military, put forward the enlightenment to the military-civilian integration equipment support construction of China's army, gradually formed a socialized guarantee road based on China national conditions.

Since 2010, Chinese army has gradually integrated equipment support into the era of military-civilian integration. During this period, new hot spots have gradually been formed, including military industry enterprises, joint support, and so on. This is due to the new situation. The national development strategy of military-civilian integration requires army equipment support to adapt to the new situation. The

In order to study the evolution process and trend of equipment support research, the set citation number, co-citation frequency, co-citation coefficient three-level threshold and corresponding time setting remain unchanged. By using the time-line function of citespace, the sequence mapping of key words shown in Figure 4 can be obtained: at the top of the mapping is the year in which the keywords appear, and the same color node ring represents the words associated with the high-frequency keywords on the right side of the graph. The density and area of the node ring are proportional to the frequency of occurrence; the time sequence of the occurrence of keywords indicates the evolutionary path of the study in this field.

development of military industry and national defense science and technology industry is not only related to the economic interests of the country, but also to the international status of our country. It is an important part of the comprehensive strength of the country and has naturally become the focus of research.

In particular, by 2017, President Xi stressed: "Reform is the right thing to do to promote the transformation and construction of the armed force, and it is also the fundamental driving force and the way out" [2]. In particular, after the 18th National Congress of the Communist Party of China (CPC) put forward the "path of military-civilian integration with Chinese characteristics, and insisted on the unification of rich country military-civilian integration has become a national strategy", and President Xi important instructions on the transformation of the army construction. This paper points out the development direction for equipment construction. It is under this background that the military-civilian integration literature accumulates and rises and changes suddenly.

From the analysis of the burst of key words, it can be clearly concluded that the development direction of our military equipment support is to follow the development path of military-civilian integration change from the original military independent support

mode and change to military-civilian integration, gradually push this support mode to each field of equipment support. This is not only the need of national development strategy, but also the inevitable choice of equipment support development.

The key words immediately followed are joint operations, which is the main situation in the future information battlefield. Looking at several local wars in recent years, the equipment support in joint operations also shows some unique characteristics compared with the traditional support. Therefore, the concept of “accurate support”, which is the biggest feature of joint operations, has also become a hot term in the same period [3].

Finally, at the time of the readjustment and reform of Chinese military, the Central military Commission put forward a series of instructive spirits such as “able to fight, win a battle”, “adhere to the fundamental traction of operational needs, and make use of actual combat”. Raise equipment support capability to the level of equal importance of combat effectiveness. In order to improve the equipment maintenance support capacity and guarantee the quality benefit under the information condition. In accordance with the requirements of integration, regionalization and integration, it is necessary to focus on the implementation of the two-level maintenance and support operation system, adjust it to the base level and the troop level, and construct a regional support system adapted to the two-level operation system, and replace the repair mode of the parts. Guarantee resource allocation and operation management mechanism. Therefore, “put the interests of the whole above everything else, take actual combat as the basic requirement”, this principle is the foothold of the army equipment support construction ,meanwhile, strengthen the thought of “main Construction for war” and “adapt to the requirement of actual Combat training” [4], set up the idea that “both maintenance and repair should be based on actual combat”, adapt to the development of equipment technology, adjust the maintenance system reasonably, and coordinate the relationship between peacetime construction and wartime use. As a result of the above point of view, since 2017, maintenance and combat training at the base level have gradually increased to high-frequency terms. This is not only the trend of adapting to equipment support, but also the objective requirement of equipment support construction.

3.3. Test Result and Analysis for the Content of Accumulation Emergence of the Author Co-Operation

Generally speaking, in the same scientific research field, the relationship between the number of researchers and the number of research institutions can reflect the content of knowledge in this field [5]. Leave the research parameters unchanged, setting “node type” to “author” only, and setting the threshold to 5, which means that only the authors with

more than five posts are displayed: the nodes represent the number of authors of the literature collected by CNKI, and the connections between them represent the cooperative relationship. As can be seen from Figure 5, there are 59 nodes and 39 connections. There is basically no connection between some key nodes, which shows that the current research status is that the researchers in the relevant field are in the state of individual research, and the cooperation objects between the authors are relatively fixed, and the communication between them is more limited. The larger the node, the more productive it is, but the cooperation relationship is not close. It shows that at this stage, the research on equipment support is still in a single state of study. The larger nodes in the mapping are Li Fu Sheng, Zhou Hui Zhen, Guo Shi Zhen, Zhang Cheng, etc. The phenomenon of regional cooperation among productive authors is obvious, the scope of cooperation is relatively limited, only within institutions and colleges and universities, lack of cross-regional cooperation. Therefore, we should advocate cross-regional cooperation, establish the necessary cooperation platform, exchange and optimize expertise in the same field.

4. CONCLUSION

The construction and development trend of army equipment support is, in the final analysis, inseparable from a specific historical and international environment [6]. In order to meet the needs of present and future operations, the government should coordinate the strength construction and development trend in all links from the strategic overall perspective, strengthen the innovation of safeguard means and methods, perfect the policies, regulations and standards; construct the supporting operation mechanism, and continuously improve the efficiency and efficiency of the guarantee. In order to meet the needs of all equipment maintenance and support, to meet the needs of carrying out maintenance support within and outside the combat area, and to be able to adapt to the needs of the transition of peace and war in time of war, the overall combat capability and support capability of the equipment should be improved in an all-round way.

At the same time, we should also pay attention to the fact that in the field of research, which need break regional and regional restrictions, enhance academic exchanges between scientific research institutions and professional institutions, build platforms conducive to inter-regional academic exchanges and share research results, focus on solving structural contradictions, institutional barriers and bottleneck problems that restrict the army equipment supply support and accelerate innovation in equipment maintenance and support.

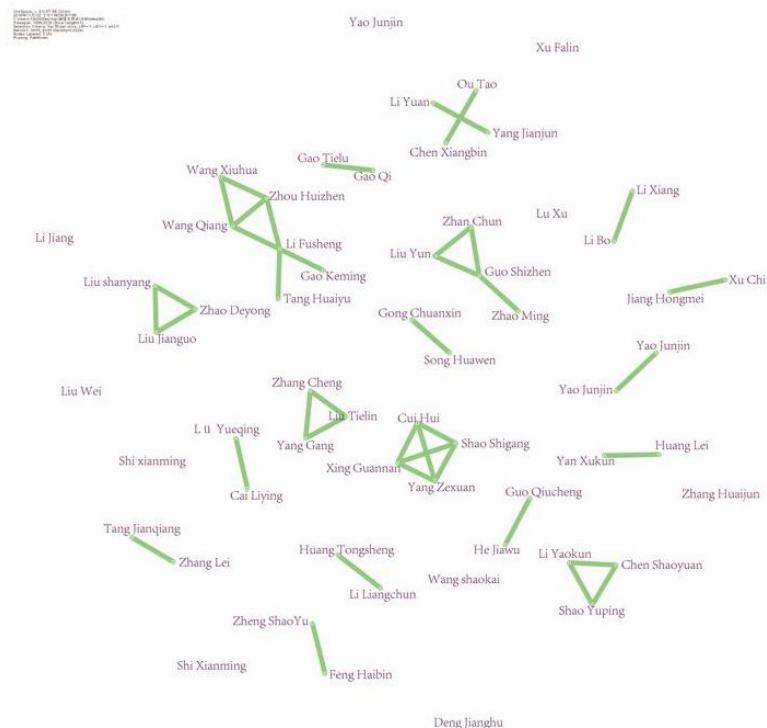


Figure 5. Co-occurrence mapping of authors related

REFERENCES

- [1] Zhai M.M., Zhao Y.M., et al. Analysis on maintenance support of local-force military unification's equipment. *Journal of the Institute of equipment Command and Technology*, 2015, (4): 32-34.
- [2] Lv B., Li X.S., Ji P.H. Research on the road of military civilian integration in western countries. *Defense Industry Press*, 2015.
- [3] Qin M., Li Y.P. Ways and methods to strengthen research on military-civilian integration and sharing technology. *Dual-use Technologies and Products*, 2015, 8(15): 50-52.
- [4] Li L. *Equation of modern war*. People Publishing House, 2015, pp. 407-409.
- [5] Han G.Y., Kong L.K., et al. Research progress and future trend of military civilian integration, based on CNKI data. *Defense Science and Technology*, 2017, (8): 94-103.
- [6] Liu T.L., Zhang C., Wang T. Non-war and war military operations equipment support capability integration and transformation ideas. *Journal of the Academy of Armored Forces Engineering*, 2013, (6): 10-12.