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Information Disclosure of Foreign Public Organizations： Status, Media and Practice -- A Research Review

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***Abstract*—Information disclosure is one of the core contents of public organizations which provide public services, the research results of information disclosure and transparency in the international academic community. It is an important significance to grasp the current research focus, features and trends in this field. Firstly, this study summarized the status quo of the number of articles of foreign public organizations, prolific authors and countries in the recent ten years (2002 -2012), and portrayed the evolution trend of cutting-edge research in the field. On this basis, the study explored how the foreign public organizations use information and communication technologies, e-government and emerging social networks to improve organizational transparency and reduce corruption so as to promote information disclosure and enhance public trust. Finally, the study took the Open Government Directive in the U.S., Information Assets Registration System of the Public Organizations in the UK and New Zealand Government Open Access and Open Authorization Framework as cases to analyze and summarize the initiatives to promote information disclosure practices in the U.S., UK and New Zealand. The study summarized the research features and trends of information disclosure in foreign public organizations and put forward the enlightenment and outlook of the information disclosure research in China, aiming to provide references for the Chinese government and related public organizations.**

***Index Terms*—public organizations; information disclosure; information and communication technology; e-government; social network websites**

I. Introduction

As early as in 1685, the British scholar Locke pointed out in "Two Treatises of Civil Government" that "the power must be implemented through clear and public laws; only the public law can ensure the ruler not to be wanton". Along with the vigorous development of modern democracy and information society, more and more countries have begun to pay close attention to the openness problems of information in recent decades; however, transparency and the right to access to government information are the recognized root of modern democratic institutions operation by international societies (Cullier and Pitroowski, 2009) [1]. Some scholars pointed out that the reason why information disclosure was important was largely based on the following three reasons: (1) the vigorous development of the trust and loyalty enables people to have the right to access to information; (2) patriotism comes from people's own beliefs, which mainly depends on full information of each problem in all levels, rather than the propaganda of the government itself; (3) the government power supported by the informed citizen is indestructible, because through the fully utilization of information, the government and individuals establish a partnership relationship, which depends on the government's respect for the individual's right to know [2]. In addition, with the popular development of the "New Public Management Movement (NPM)" in the world, governments have generally realized that in order to realize the "good governance" concept of public administration, it is necessary to conduct transparency and public accountability system reform (Bonson et al., 2006), which requires the notion of government administration should be transformed from negative administration to the positive one. Therefore, the significance of information disclosure is not rigidly in the political level; it also affects the daily life of every citizen, concerning the practical problems of people's livelihood.

Today, the global computer network connects and collects the computer technology revolution, communication technology revolution and the results of the digital revolutions, making the global delivery and instant sharing of the information really possible, forming an information society. Many countries take e-government construction based on information and communication technologies (ICTs) as a policy tool to improve the transparency of government and reduce corruptions; and some countries from the Americas, Asia and Europe have confirmed the information and communication technologies (ICTs) can indeed succeed

in reducing corruption (Lord, 2006; Shim and Ecom, 2008)[3][4], reducing the costs of information collection, dissemination and acquisition of government agencies. The rapid development of information technology has become the booster of media reform, and more and more electronic government affairs have been focusing on the application of social media, such as: Microblogging, Facebook and Twitter in the information disclosure of public organizations.

The purpose of this study was to review the relevant literature of information disclosure of foreign public organizations, and discuss the enlightenment of literature on China. This study was conducted mainly from the following four aspects:

- it discussed the current situation and the trend of information disclosure of foreign public organizations in the recent 10 years;
- starting from the point of view of information dissemination and media channels, the study introduced how the foreign public organizations used information and communication technologies and social network sites to conduct information disclosure;
- the study explored the practical measures in terms of government information disclosure electronization in developed countries, taking USA, UK and New Zealand as examples;
- based on the current research on information disclosure of the foreign academic community, the study summed up the development features of information disclosure in foreign public organizations, and put forward the enlightenment and outlook of the information disclosure in China, aiming to provide references for the information disclosure in the Chinese public organizations including governments.

II. Current Situation and Trend of Information Disclosure of Foreign Public Organizations (2002-2012)

With the development of modern democratic system and the information society, western countries have established the government information publicity system in succession, to improve the transparency of government operation, to guarantee a citizen's right to know, to promote economic development, and to maintain social stability. Since 2009, when President Obama implemented and carried forward the '*Open Government Directive'*, and incorporated "Transparency" and "Participation", "Collaboration" into the government reform agenda, the government information publicity has gradually developed into a global hot topic and a trend. At present, there are a total of more than 70 countries and regions all over the world establishing the government information publicity system, so the theoretical research on the government information publicity is increasingly overheating, and a number of research productions have been made.

In this paper, relevant literature is used from the Science Citation Database of the Institute for Scientific Information, the scientific measurement method is used to analyze the current situation and trend of information disclosure of foreign public organizations and the scientific mapping knowledge domains are used to draw the evolution of research trends. As shown in Figure 1, the results show that from 2002 to 2012, internationally, 486 pieces of literatures were concerned in terms of information disclosure of public organizations, reflecting the research status and popularity in this field to some extent.

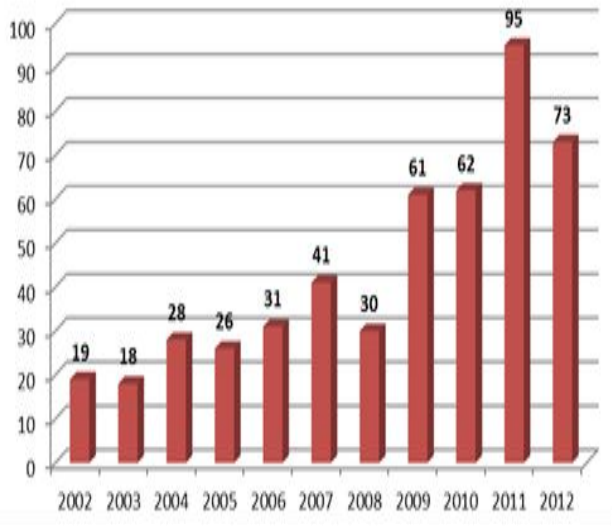

Figure 1. Research literature's year distribution and quantity

It can be seen from Fig. 1, the quantity of published papers relevant to information disclosure of foreign public organizations showed a tendency of ups and downs over the last decade. In 2007, the quantity of research literatures was up to 41, which was the first minor peak over the past decade. In 2008, the quantity of research literatures decreased (only 30). From 2009 to 2011, the published papers surged again, the literature quantity rose from 61 in 2009 to 95 in 2011, and the average number of published papers is as 2.5-3 times as that over the past seven years (2002-2008). This phase is also "the most glorious period" of the research on information disclosure of foreign public organization over the past decade. On balance, in recent years, foreign scholars have changed their research perspectives of information disclosure from the original traditional e-government, gradually evolving to use modern information and communication technology as well as social media, such as microblogging, blog, Facebook and Twitter, to launch the practical activities of information disclosure. In addition, there are abundant research paradigms, research methods and research tools and so on [5].

Specifically, Table I shows us top 10 international scholars in terms of the number of published papers in the research field of information disclosure of public organizations. The authors respectively ranking No. 1, 4 and 5(BOLIVAR, GALERA and HERNANDEZ) are from the Economic and Business Research Department

of the Universidad de Granada. They mainly probed into relevant problems of online disclosing government financial information from the perspective of the Internet and e-government [6]. The authors respectively ranking No. 2 and 7 (TORRES and PINA V) are a research team. From the Accounting and Finance Department of the Universidad de Zaragoza, they adopted the method of empirical research to verify the forefront and development trend in terms of transparency, openness and accountability of e-government, and determined to what extent the Internet can promote the government more transparent and accountable. In addition, the implementation of information and communication technology, the number of local residents as well as the public management style have also affected the development of urban e-government [7]. The authors respectively ranking No. 3, 8 and 9 (FOX J, PIOTROWSKI SJ and RELLY JE), moreover, are scholars from the U.S., respectively from University of California at Santa Barbara, Rutgers University and University of Arizona. Among them, PIOTROWSKI SJ from Rutgers University, as one of the initiators of the international projects of government transparency, put forward four channels to generate the government transparency: 1. Positive dissemination by the government; 2. Related materials published by the government; 3. Public meetings, and...; 4. Exposure by the prosecutors (Piotrowski, 2007) [8]. In general, the authors with the largest number of literatures are from Spain, showing that the Spanish teams have some ground-breaking in the research field of information disclosure.

TABLE I. TOP 10 AUTHORS PUBLISHING THE MOST ARTICLES

Rank	Author	Quantity	Rank	Author	Quantity
1	BOLIVAR MPR	6	6	LUNA-REYES LF	3
2	TORRES L	4	7	PINA V	3
3	FOX J	3	8	PIOTROWSKI SJ	3
4	GALERA AN	3	9	RELLY JE	3
5	HERNANDEZ AML	3	10	STASAVAGE D	3

TABLE II. TOP 10 COUNTRIES PUBLISHING THE MOST ARTICLES

Rank	Country	Quantity	Rank	Country	Quantity
1	U.S.A	131	6	Australia	18
2	England	43	7	Netherlands	17
3	P.R. China	40	8	India	13
4	Spain	35	9	Romania	12
5	Canada	21	10	Germany	10

Table II shows us that, from the regions (countries) of publishing organizations, the United States, Britain and China are the countries with the largest number of published papers; but from the publishing organizations, scientific research institutions in the United States and Spain have published the largest number of literatures. It shows that the United States is the second to none in the number of published papers in the research field of information disclosure of international public organizations. Compared with the United States, however, Britain and China have more researchers, but the research orientation is relatively dispersed, and the Spanish research team is stable, with a high degree of cooperation and a unified research orientation.

Furthermore, through the word frequency analysis, it can be seen that the highest frequency keywords with the highest frequency are “Transparency” and “E-Government” in the research literature over the past decade, showing that foreign scholars focused on the use of e-government to improve the transparency and promote information disclosure of public organizations over the past decade. Followed by the keywords such as “Accountability” and “Internet”, it shows that with the rapid development of information technology, network accountability and online information disclosure have become the mainstream and hot spots in the current research. In addition, “Corruption”, “Participation”, “Democracy”, “Trust” and “Open government” are also hot words, reflecting the implementation way and ultimate purpose of government information disclosure is to establish an open government through strengthening democratic participation, so as to reduce corruption and increase the public’s trust in government. Finally, “Politics”, “Technology”, “Model”, “Perspective” and other words have also become research hotspots in the field of information disclosure of public organizations, showing that the research in the field is involved in relevant theories and research methods of the politics, as well as in the use of technological tools to construct the mathematical model. In brief, scholars have conducted detailed and in-depth studies of information disclosure of public organizations from different perspectives [5].

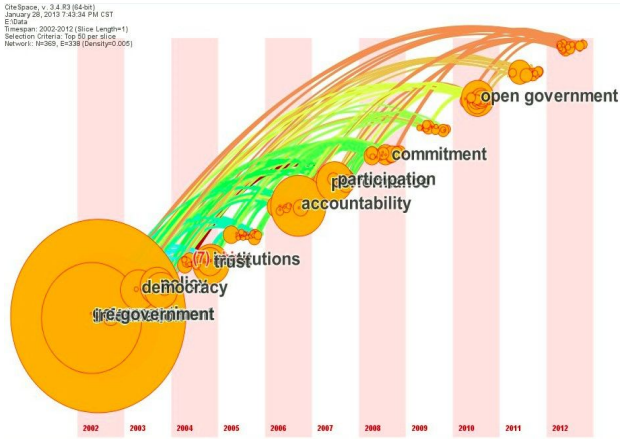

Figure 2. Evolution Trend of Research Fronts

In addition, Fig. 2 also depicts the evolutionary trend of the research on information disclosure of foreign public organization over the past decade. According to the mutation rate, the keywords are sorted from high to low, as follows: E-government, Democracy, Accountability, Trust and Commitment and Open government. These keywords reflect the information disclosure of public organizations has achieved a big leap over the past decade, from development of e-government to establishment of open government, national governments build up e-government widely, strengthen the democratic participation, unceasingly improve the public accountability system and fulfill the governments' commitment to the public, so as to promote the mutual trust between the government and the public, eventually, to realize the goal and vision of establishing an open government and gradually [5].

III. Medium Channels for Information Disclosure of Foreign Public Organizations: ICTs, E-Government and SNWs

With the development and popularization of information technology, more and more public organizations have turned their attention to the application of the Internet, internet-based information and communication technologies (ICTs), e-government, etc., and have set out to use it as a policy tool to increase government transparency and reduce corruption, probed into the problem, namely, whether the information disclosure plays a significant role in improving organization transparency, curbing corruption and promoting the citizen's political participation. The researches of some scholars shows that (see table III), in addition to the United States, Australia and other developed countries, many developing countries, such as Pakistan, Philippines, Chile, etc., have also set up and improve the e-government network system unceasingly, and have made remarkable achievements (e.g. Bhatnagar, 2003; World Bank, 2004; Anderson, 2009; Shim and Eom, 2008; Pathak et al., 2009) [9-10].

TABLE III. Introduction to the Construction of E-government Network System by Some Countries

Literature Sources	Country(city)	Theme	Purpose or Achievement
Anderson,2009; Heeks, 2005; Shim and Eom, 2008	Chile Philippines	E-procurement system	The public is allowed to actively supervise the process of governmental invitation for bids and signing contract, to prevent corruption in the process of contract-issuing and contract-awarding
Cho and Choi, 2004; Kim et al., 2009	Seoul, South Korea	Citizens' online participation in the construction of OPEN Portal	By reducing the direct contact of government officials and the public, the public is allowed to supervise the process in which government officials handle their (the public's) application
Anderson, 2009	Pakistan	Tax system and overall restructuring of departments	By reducing the direct contact of the public and revenue officer, such behaviors as bribery and accepting the bribes are reduced
White House, 2009	The United States	Creating the website which is allowed to access to the government fiscal expenditure data	In order to promote the public to supervise the government expenditure, to quickly identify and eliminate waste items, many state governments have created this type of website
Chen Bing, Zhang Bin, et al., 2012	Australia	Government 2.0	By changing public policies, an open and transparent culture is created; a number of sensitive information is disclosed as national information resources

Gurmeet (2010) and other scholars analyzed and evaluated the e-government potential of three countries, i.e. India, Ethiopia and Fiji, and further explored the e-government role in reducing corruption in the public sector. The significant research findings are as below: there is a significant positive correlation between the e-government, the government-citizen relationship and reducing corruption [11]. Mohammad (2010), from the research perspective of Bangladesh, pointed out that the use of information and communication technologies (ICTs) can help the government improve the service efficiency and transparency, and further put forward that the "right to know" and the "e-government" are two important strategies which can be adopted to improve the transparency and accountability system of a country [12]. Different from the research results of Gurmeet and Mahammad, however, Vicente (2010) et al. Found, after the empirical research, that the practice of ICTs and e-

government is difficult to work for the governance of the public sector in a short time.

In terms of the ICTs improving information disclosure, Juan (2011) verified the role of the Internet for the improvement of accountability and transparency in non-profit organizations. Based on the previous empirical researches, the author took it into account that the Internet can promote the diffusion of voluntary information in non-profit organizations, and created an inform disclosure mode for Span Non-governmental Organizations Development Institution (NGODs), as their guide to improve the transparency and accountability. It has been found after investigation that Spain NGODs websites only mainly play a decorative role, evolving to be more informative and relative, so that the stakeholders can get relevant information, such as ongoing work and use of funds, and an organization can be regulated. In the study, the author also found that the degree of information disclosure is associated with the contributions received by the organization in the future [13].

Under the background of rapid development of emerging media, Monika (2010) et al. reviewed the social network (SNWs), based on the interrelation of information exchange (IE) and information disclosure (ID), trust plays an intermediary role. With 131 students of B School as samples, information exchange type as an independent variable, trust as a moderator variable and information disclosure as a dependent variable, after exploratory researches, it has been found that trust has a significant mediating effect between information exchange type and information disclosure. This is because the similarity is the basis for the formation of a community, when the members of the community trust each other, they will not release false information, but real message depends on the extent (range) of information disclosure. Different from the previous research results, the author proposes that information exchange type and trust have resulted in the increase of information disclosure [14].

George and other scholars, from the perspectives of channels of information dissemination and quality of information provided by websites and ICTs, expounded the specific measures which the governments of the United States, Spain, Japan and other countries take to realize the internetization, electronization and legalization of information disclosure, for example, improving the IT usage of government departments, the use of information record management mode, the development of various network channels and etc. In addition, to solve all sorts of problems in the implementation process, such as improper information transmission and storage, insufficient public participation, lack of effective supervision mechanism, etc., they put forward the corresponding countermeasures from the perspective of policy implementation and evaluation [15] [16] [17].

Some scholars put forward that two most basic modes of establishing a trust bridge with the public are to provide organization information and disclose organization operation (Saxton &Guo, 2011; Waters, 2011) [18] [19]. As a popular social network, "Facebook" is changing the nature of privacy and the consequences of information disclosure. Emily (2009) and other scholars, through the online survey, probed into information disclosure and information control of 343 college undergraduates on the "Facebook", as well as personality factors affecting information disclosure and information control level. The research results show that the participants release their private information on the "Facebook", but they deemed that information control and privacy are also very important for them. After further studies, it has been found that there is no significant negative correlation between information disclosure and information control, through multiple regression analysis, it shows us that information disclosure can be predicted according to the public's demands. Trust level and self-esteem can be used to predict information control, and both of them (disclosure and control) are two different processes, which depends on the influence of different personality traits [20].

As a popular micro-blogging and social service network, "Twitter" sets up a new platform to improve information communication and interaction between public organization and the public. In recent researches, some scholars pointed out that 100 large non-profit organizations in the U.S. have already started to use "Twitter" for interactive dialogue and community construction [21]. Other scholars interviewed some non-profit organization staff (such as the Red Cross) on the "Twitter", and found that "Twitter" plays an important role in cultivating and strengthening the relationship between public organization and the public [22]. With the rise and rapid development of "Twitter" in the society, some scholars began to focus on the application of "Twitter" in government departments. Jennifer (2010) et al. conducted the research on the usage of "Twitter" for communication and information exchange by the United States Congress. After analyzing the usage of "Twitter" by more than 6000 different positions from the Congress, the author found that Congress staff mainly use "Twitter" to release and link with news, articles, blog posts and information reports related to their daily activities, which does not help greatly to perfect the legislative process and to improve government transparency, and "Twitter" is only their means of self-promotion. With regard to these existing problems, the author proposes some policy suggestions on how to use "Twitter" from the angle of a legislator [23].

IV. Practical Measures of Information Disclosure of Foreign Public Organizations: Taking the Cases of U.S., UK and New Zealand

Currently, there are many countries taking into consideration or having implemented Creative Commons licenses in public organizations information, which are usually Version 2.5 and Version 3.0. Other countries, for example, UK is using or planning to use customized government licenses to interact with publics. All those above-mentioned practical measures have a wide range

of applications. Countries such as U.S., UK, Australia, New Zealand, Norway and Mexico have already built government portal websites with information disclosure [24].

A. U.S. Open Government Directive Plan

Open Government Directive Publications in the United States Federal Government are in the public domain; therefore, the federal government focuses on active publication of public organizations information in available mode. Obama administration released "Open Government Directive" on December 2009 (Figure 3) guiding administrative department and head of agency to take action to achieve three principles of open government, which is Transparency Participation and Collaboration. The three principles have already been listed in the memorandum of open, transparency government established by the President. Specifically speaking, Open Government Directive demands the federal departments and organizations to expand acquisition of information through online public mode and compels all organizations to at least release three data sets which don't exist before or can't be downloaded. Meanwhile, they need to register on government's official website (www.data.gov) and create a website of open government with public feedbacks about quality of information distribution and emphasis of publication by making use of mechanisms. Any information data acquired from government's official website (www.data.gov) has no restriction in purpose while concerning to quality of information, organizations get command of versions of data set [25].

Figure 3. Open Government Directive from official website of White House

B. Information Asset Register of UK public organizations

UK has officially implemented the Re-use of Public Organizations Information Regulations formulated according to Directives of European Union on July 1st 2005 (Figure 4). In addition, the government also published a number of projects concerning open government. British government considered unpublished government information as a vital part of national assets; therefore, the Public Organization Information Management subordinate to UK National Archives inform the public of information resources possessed by government by creating Information Asset Register. Its emphasis is to supervise the unpublished government information resources for people and provide the use of it [26]. IRA is a collection of catalog concerning unpublished or informally published government information resources in British government departments, which is a centralized retrieval system launched by British government according to the Consultation on the Future Management of Crown Copyright in 1999, aiming at covering information resources from all the British government departments and organizations, including data set, set of files, recent electronic records, statistical data set and research projects and so on. In order to carefully manage these possible "grey literature", every government department has its responsibility to maintain its own IRA in their websites. And on this basis, the central government works on IAR of all the government departments in the aspect of complete subject index and integration of hyperlink, then the public can retrieve required government information resources through IAR Information Service System(www.uk-legislation.hmso.gov.uk/iar /index). Now IAR has already been a vital way for government information disclosure under the frame of the Freedom of Information Act [27].

Figure 4. Re-use of Information in Public Organization Regulations of UK

C. Framework Program of Open Access and Open Authorization from New Zealand

On August 2010, New Zealand government launched Framework Program of Open Access and Open Authorization from New Zealand (NZGOAL) (Figure 5) which will be used by National Service Agency as the government guide document. When these National Service Agencies launch and provide resources of copyrighted and non-copyrighted works for use by the third party， this guide principle of framework program needs to be observed[28]. Framework Program of Open Access and Open Authorization from New Zealand

(NZGOAL) make a clear standard when works whose copyright held by the government need to be authorized by Creative Commons Licenses. The program also encourages National Service Agency to mark non-copyrighted resources as "not having known rights". Most scholars think that reuse of those above-mentioned resources (copyrighted and non-copyrighted works) will benefit New Zealand a lot in the aspect of innovation and economy. NZGOAL itself can only be suitable for data set published anonymously with personal information filtered which will be complied with instructions of NZGOAL to be licensed or published to the public, but information and works concerning other sensitive information. According to regulations of NZGOAL Framework Program, New Zealand governmental service agency ought to publish copyrighted works they have;people may be interested in or people urgently need on the Internet by license agreement with the highest degree of open (Creative Commons Attribution License) unless there are special reasons. Similarly, the above-mentioned agency should also publish resources of non-copyrighted works to the public through Internet and declare "not having known rights". Decisions about copyrighted and non-copyrighted works made by NZGOAL comprise issues such as open access, authorization, creation, novelty, open formats and charge and so on, notes are listed before agency publish resources on the data website of New Zealand government by questions and answers[29].

Figure 5. Frame of Open Access and Open Authorization from New Zealand

V. CONCLUSION

To sum up, the features of practices of information disclosure in foreign public organizations are as followed: first, knowledge foundation in the area of information disclosure of the public organizations is dominated by government to make some relevant practice of government information disclosure and transparency from the perspective of information technology, e-government affairs and formulation and implementation process of public policy. In this way, the government actively publishes information of public organizations and interacts with the public. Second, the hot issues of foreign information disclosure practice are relevant to transparency, e-government affairs, accountability, Internet, corruption, participation and democracy and so on, laying emphasis on public feedback, for example, establishing specialized public government websites concerning the quality of published information and public feedback of the key publication. Third, stressing communication and coordination of the government at all levels and relevant departments fully indicates that the irresistible trend of information disclosure of government departments with "transparency", "participation", and "cooperation" put forward by President Obama.

Compared with the western developed countries, China did not officially implement "Regulations on the Disclosure of Government Information of PRC" until 2008. It has been more than 4 years since its implementation; there's been a fierce debate and discussion about relevant issues of government information disclosure in the academic community and social public, and the bone of contention mainly focuses on the aspects of domestic public management and the theory of information management. A large number of scholars have conducted in-depth researches on government information disclosure from different perspectives of institutional construction, theoretical significance, construction of agencies; organization and utilization of information. Especially since 2008, the research results of government information disclosure have been greatly achieved. Thus it can be seen that government information disclosure of our country is and will be a hot social issue, a common concern of scholars and the public. Therefore, domestic scholars should reasonably draw lessons from foreign advanced experience, broaden academic vision and strengthen the awareness of the question, and improve the targeted research on the government information disclosure as well. In addition, it is necessary to carry out empirical researches, figure out domestic objective status and promote the diversity of the researches on government information disclosure by enforcing the interaction and communication between disciplines [30].

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Learning Objects Management Using Topic Maps Technology

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***Abstract*—Learning objects, defined in this study as ‘‘interactive web-based tools that support learning by enhancing, amplifying, and guiding the cognitive processes of learners”, have been analyzed from numerous perspectives. The Learning objects have become thoroughly integrated in the today’s learning. When the Learning objects used in Web environment some disadvantages have emerged, such as knowledge representation, knowledge reorganization, knowledge clustering, knowledge retrieval. This paper proposes that use Topic Maps to reform the information organization of Learning objects based on the information of Learning Objects and thesaurus, which organizes the information in a hierarchical and multi-granular model. It is applied to realize semantic association and intelligent classification of the Learning objects and support the implement of different kinds of learning style.**

***Index Terms*—Learning objects, knowledge organization, knowledge representation**

I. INTRODUCTION

The educational use of information and communication technologies (ICT) for different purposes in higher education is increasing. Despite the numerous advantages, the adoption and integration of ICT in higher education is progressing relatively slowly in many cases, due to several concerns und barriers on institutional, pedagogical and individual levels [1]. On an individual level, a successful implementation strategy for educational (technological) innovations needs to consider Learning Objects Management. The Internet and other digital technologies have become thoroughly integrated in the today’s learning. Technology holds an important place in human life in a large variety of con-texts from science to education, agriculture to commerce, transportation to communication and facilitates life and continues to develop. The Internet and other digital technologies have become thoroughly integrated in the lives of today’s college student. Online learning management systems (LMS) such as Blackboard, Moodle, or Sakai are nearly ubiquitous on colleges and universities, and wireless Internet access permeates most college classrooms.[2]

Traditional knowledge organization systems (classification systems, thesauri subject headings, etc.) act as an important part to traditional literature organization. When they are used in Web environment, some disadvantages have emerged such as machine dis-understandable, machine unprocessable, slow renewal and poor retrieval function.[3]The explosive growth of the World Wide Web is fueling the need for a new generation of technologies for managing information flow, data, and knowledge. It is necessary for them to transform in content and structure so as to reconstruct net worked knowledge organization systems which can support knowledge organization and content-based information retrieval. The purpose of reconstruction is to make the systems easy to use, machine-understandable, machine process able, support automatic renewal classification and automatic indexing, and support interoperability.

There is a problem when these organizations require an integrated view of their heterogeneous in-formation systems. It is necessary to query/exploit every data source, but the access to each information system is different. In this situation, there is a need for an approach that extracts the information from those resources and fuses it. Usually this is achieved either by extracting data and loading it into a central repository that does the integration before analysis, or by merging the information extracted separately from each resource into a central knowledge base.[4]

ISO provides a standardized notation for interchangeably representing information about the structure of information resources used to define topics, and the relationships between topics. Topic Maps is an ISO standard for knowledge representation and interchange with an emphasis on navigation and retrieval of information. As defined by the standard, Topic Maps can be used to represent content contained in information objects as topics, enabling the creation of navigational tools, linking of these topics together to enable navigation between them and filtering an information set to create user and purpose-specific views. Thus Topic Maps are becoming an emerging technology for content navigation, metadata and knowledge management.

Topic Maps date back to 1991 and have gone a long way since then. The article “Perspective on the Quest for Global Knowledge Interchange” by Steve Newcomb gives a historical overview. In the last years, the Topic Maps Data Model was developed and standardized by

ISO in 2006, together with a XML-based serialization format, XTM 2. Later, the Compact Topic Maps Notation followed which is more suited for manual editing.

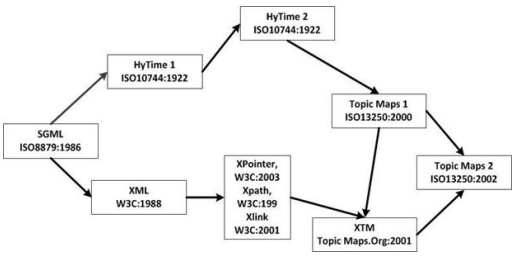

Figure 1. The development history of Topic Maps

Additionally, a query language and a modeling language are currently in the progress of standardization. Many different Topic Maps engines exist and free to choose from most of them (i.e. they are Open Source and using permissive licenses). Others are available commercially and may offer increased value for their specialized use cases.

- Ontopia: Open source tools for building, maintaining and deploying Topic Maps-based applications. This long-time commercial application is now available as Open Source at the Ontopia Google Code repository.
- Major To M: The MaJor To M (Merging Topic Maps Engine) project was founded to develop a lightweight, merging and flexible Topic Maps engine satisfying different business use cases. The engine provides a couple of new features above to other engines based on the Topic Maps API version 2.0.
- Networked Planet's Web 3.0: The Networked Planet Web3 Platform is a complete solution for creating, organizing and publishing structured semantic data. The Web3 platform stores and manages data in a schema less data store, allowing complete flexibility of the shape of the data stored.
- Ruby Topic Maps: Ruby Topic Maps (RTM) is a Topic Maps Engine for the Ruby programming language. It can be used alone or together with other frameworks like Ruby on Rails.
- tinyTiM — The tiny Topic Maps engine: A very small and easy to use in memory Topic Map engine, implementing the TMAPI interfaces.

Effectively managing the data stored in web is not an easy task, especially when it comes to ensuring efficient information retrieval, discovery and auditing; the challenge is to extract meaningful in-formation from the large amount of data available. [5]Search engines are not of much help for these documents either. Current customization methodology is also more geared towards providing syntactic operability rather than addressing any of the semantic aspects.

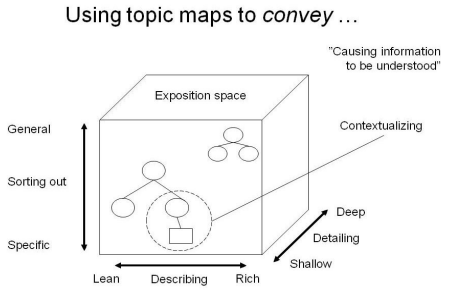

Figure 2. The flexible model provided by Topic Maps

II. METHODOLOGY

To create the topic map document means to design the structure of interconnected topics and to link all accessible information resources to this structure. The technical route is first to identify the Learning Objects thesaurus, describe the relationship between the topics, then uses the theme graph grammar standardization of description, on the basis of the use of the Ontopia engines as thematic map processor, link resources and to organize these resources, finally to provide navigation type online learning. Topics maps software enables searching and querying maps using standard predefined queries or queries defined by user, customizing visualization of maps according to individual preferences etc. Basic elements of topic maps are (1) topics, (2) occurrences of topics (either statements about topics, or links to relevant external resources about topics) and (3) associations that connect topics into the network structure. To create the topic map document means to design the structure of interconnected topics and to link all accessible information resources to this structure.

A. Determine thesaurus in the Learning Objects knowledge fields

Resources, available to students of these courses, were disseminated in numerous locations, e.g. WebCT e-courses, university library; digital library of the faculty and other subscribed digital libraries, website of the university, personal websites of teachers and students, study agenda information system, scheduling information system etc. Take the Learning Objects of learning sciences as an example, the Learning Objects covers the information content is given priority to, within the scope of the captioned with keywords learning sciences as the center, select eight relevant keywords and alternative word for the correlation analysis, sum up the relationship between the words.

B. According to the XTM (XML Topic Maps specification) grammar to write code

We use the Omnigator engines which developed by Ontopia company to make the thematic map. Figure 2 shows the education information processing "Learning Objects topic vocabulary, subject of relevance, relevance between in the role of guidance, and resources of the category. For the user to search for key words showed as the center of knowledge structure, for individual learning

and adaptive learning flow applications to provide a kind of knowledge organization solutions.

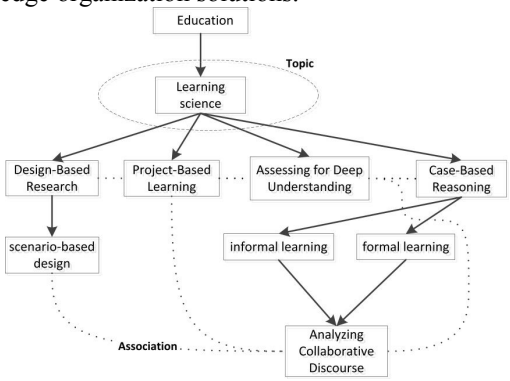

Figure 3. An integrated topic map for the partial ordering process

III. Results

Topic maps started life as a way of representing the knowledge structures inherent in traditional back of book indexes, in order to solve the information management problems involved in creating, maintaining and processing indexes for complex documentation. As the model evolved, their scope was broadened to encompass other kinds of navigational aid, such as glossaries, thesauri and cross references. The ability to encode arbitrarily complex knowledge structures and link them to information assets indicates a major role for topic maps in the realm of knowledge management: Topic maps can be used to represent the interrelation of roles, products, procedures, etc. that constitutes corporate memory, and links them to the corresponding documentation.[6] Many interesting possibilities presented themselves when we considered ways of extending our Topic Maps knowledge base. One such possibility requires considering the structure of our Topic Map as a directed graph with nodes representing processes and arcs as is related to associations (with the direction capturing the role of each process as ancestor or descendant) giving us the ability to rank the results of queries based on the analysis of clusters formed by the result nodes.

Ⅳ. Conclusions

In this article it has been demonstrated and exemplified how Learning Objects knowledge may be built into topic maps in order to make them even more flexible for information and knowledge representation purposes. In more general terms, an attempt has been made to suggest how Topic Maps may function as a means of extending “information architecture” into what might be called “discourse architecture”.

Discourse architecture may be construed as a kind of hybrid between traditional organizational schemes like a tree or a network classifying, describing and relating entities and their properties and running text in which situations are unfolded, contextualized and evaluated. Defined in this way, discourse architecture, and “discourse topic maps”, may be seen as an effort to enhance find ability as well as intelligibility using a common approach or model. Other areas might include, as already indicated above, Web 2.0 and Web 3.0 scenarios where the focus is on user-generated content and/or automated processing. It goes without saying, of course, that more research is needed to explore and evaluate how topic maps may be designed, developed and applied in traditional information architecture projects and approaches and, more narrowly, what forms of knowledge might be relevant and valuable for what types of information architecture or domains.

Acknowledgment

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Select the Best College Coaching Based on Data Mining: A Case Study

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***Abstract*—In order to find the best all time college coach in the last century, this paper builds two models. In Model One, we introduce a simple method of evaluating coach through analytic hierarchy process (AHP). In Model Two, we have obtained the specific data from the authentic website and have a series of processing to it through the given indicators so that we can get the ranking of college coaches of the sports that the problem demands, finally, we find the best college coach. Then, we analyze the effect of different time lines, which also means the different processing of evaluation indicators in different time lines to make our models have a wider range of application. Meanwhile, we make some improvements so that it can be applied to both genders and all possible areas. So our models have reached a satisfactory degree. At the request of problem, we choose three sports and list the top five coaches in each sport. We also point out the strengths and weaknesses of our models and some prospects thinking for the future study. An article for sports illustrated in the end of this paper can make sports fans understand our research. What's more, since the opinions of players and fans about the evaluation indicators and their importance may be different, we attached a questionnaire to this article. In this way we can perfect our study through the opinions of players and fans.**

***Index Terms*—Data Mining, Analytical hierarchy process, Fuzzy comprehensive analysis**

I. INTRODUCTION

Sports Illustrated is an American sports media franchise owned by media conglomerate Time Warner. The scouting reports, including a World Series Preview and New Year's Day bowl game round-up, enhanced the viewing of games on television. [1]Now, Sports Illustrated holds an activity to find the people called the best coach in college sports in the last century. This paper uses mathematical models to make solutions to find the best all time college coach in the last century and lists the top five college sports coaches in the three different sports.

A coach is the most important figure in a sports team. We know a coach's ideas will decide whether a team will win or not.[2] There were many excellent coaches in the last century. But who would be the best? Are there any indicators that can judge a coach is excellent or not? What's more, does it make a difference in time line horizon, different genders or sports? This paper solves all these problems. Besides, according to the requirements of the problem, we will study such sports such as college hockey, football, basketball, baseball to choose the best college coach for the previous century in this paper.

A brilliant college coach must qualify himself to have many excellent abilities of various aspects such as the team's winning rate, the time of teaching and so on. We must find out and analyze these elements, measure their importance, give the weights and finally get the formula to calculate the overall performance score that represent coaches' excellence degree. According to the final analysis of the overall performance score, we can know whether a coach is good or not and his ranking.

During the previous century's development of college P.E, there were several important time line horizons. For example, after World War I, people gradually attached the importance to college physical culture, and the need of college coach began to expand. As to World War II, the college physical culture developed faster and the university sports coaches' demand was in short supply. In the 1960s, the needs of college tended to balance.

When it comes to 20th century while feminism was on the wane, people thought that women couldn't organize and train a team like men especially in baseball and football where women were in obvious inferior strength. So the rate of women college coaches is very low in the previous century. Today however, feminism caught the attention of people and the rate began to be higher.

II. PROBLEM ANALYSES

According to our life experience and the materials we've collected, we've found out a series of indicators to measure whether a coach is good or not, when we work out all the weights of all the indicators through the mathematical model, we can build a function based in all the indicators. [3]And then, we can take all the indicators that we've collected into the function to get the final score. It will be the final grade of each coach which represents the level of a coach's excellence. Finally, by comparing the scores, we can get the ranks and pick up the best coach in the previous century.

The analytic hierarchy method is a kind of solution which can decide analysis to the complex problem of

multi-objective that combine of qualitative and quantitative, it is put forward by the United States home T.L. denier at the 1970s. There are many evaluation standards and different standards have different degrees of influence on the evaluation results. So, this model combines qualitative and quantitative data to get a simplified evaluation method.

According to the requirements of the problem, we picked up 3 sports first and then found the top 5 coaches in each different sports according to the model. Actually, this requirement's aimed at testing the model. In other words, we should compare the 15 coaches we find with the real data to see the degree of compliance and guarantee its reliability.

We make some assumptions about the problem we solved in this paper:

- We assume the coach's gender does not affect the evaluation indicators in this model for the time being.
- We assume the range of time does not affect the evaluation indexes in this model for the time being.
- We assume the sports do not affect the evaluation indexes in this model for the time being.

III. METHODOLOGY

We choose four sports: baseball, football, and basketball and college hockey in this model.

Let's take football for example, first, we look for the specific information of the most distinguished 10 college football coaches including the number of games that they guided, the number of games in which the team they guided wins, losses, and sites, and the probability of win.[4] Then, we can get the level of the coaching skills of the coaches through sorting their games by some certain indicators. Last, we get the rank of the 10 coaches by the fuzzy comprehensive evaluation to their works.

We can also use this method to get the rank of the 10 coaches by the fuzzy comprehensive evaluation to their works at baseball, basketball and soccer.

About the background of the fuzzy comprehensive evaluation, we know the professor L.A. Zadeh created the fuzzy mathematics at 1965, at the same time the application of it in the two aspects of theory and practice has achieved great results.

- Pct.: Win-Loss percentage
- R: The evaluation matrixes of 10 coaches.
- W: The weights set of the four indicators {Win-Loss, Pct, Years}.
- S: The fuzzy judgment set.
- μ : The evaluation result.

(1) Calculate the maximum eigenvalue λ by the method of give the weight of vector.

(2) Calculate the consistency index CI=(λ -n)/(n-1). n is the number of coaches who are compared and here n=4.

(3) Calculate the consistency rate CR=CI/RI.

(4) Judge whether it is consistent. If CR < = 0.89(the consistency indicators can be seeing schedule 1), the judgment matrix can be accepted, that means the characteristic vector we get is efficient. If not, we think the consistency of matrix is poor, and we should obtain the judgment matrix. We can use this method to judge the rationality of the former judgment matrix which means the corresponding eigenvectors are effective.

We make the evaluation set is {Win-Loss, Pct, Years}, and the weight set is W= {0.5, 0.3, 0.2}.

The evaluation matrixes of 10 coaches are:

$$R_1 = \begin{bmatrix} 0.6651 & 0.0004 & 0.3345 \\ 0.0000 & 0.3074 & 0.6926 \\ 0.0000 & 0.8700 & 0.1300 \end{bmatrix}$$

$$R_2 = \begin{bmatrix} 0.6805 & 0.0033 & 0.3162 \\ 0.0000 & 0.4815 & 0.5185 \\ 0.0000 & 0.4815 & 0.5185 \end{bmatrix}$$

$$R_3 = \begin{bmatrix} 0.7306 & 0.0012 & 0.2682 \\ 0.0000 & 1.0000 & 0.0000 \\ 1.0000 & 0.0000 & 0.0000 \end{bmatrix}$$

$$R_4 = \begin{bmatrix} 0.7422 & 0.0017 & 0.2561 \\ 0.0000 & 1.0000 & 0.0000 \\ 0.0000 & 1.0000 & 0.0000 \end{bmatrix}$$

$$R_5 = \begin{bmatrix} 0.7979 & 0.0009 & 0.2012 \\ 0.0000 & 1.0000 & 0.0000 \\ 1.0000 & 0.0000 & 0.0000 \end{bmatrix}$$

$$R_6 = \begin{bmatrix} 0.6357 & 0.0017 & 0.3626 \\ 0.0000 & 0.0000 & 1.0000 \\ 0.0000 & 0.5460 & 0.4540 \end{bmatrix}$$

$$R_7 = \begin{bmatrix} 0.6548 & 0.0031 & 0.3421 \\ 0.0000 & 0.0000 & 1.0000 \\ 1.0000 & 0.0000 & 0.0000 \end{bmatrix}$$

$$R_8 = \begin{bmatrix} 0.6367 & 0.0035 & 0.3598 \\ 0.0000 & 0.0000 & 1.0000 \\ 0.0000 & 0.6878 & 0.3122 \end{bmatrix}$$

$$R_9 = \begin{bmatrix} 0.8083 & 0.0073 & 0.1844 \\ 1.0000 & 0.0000 & 0.0000 \\ 1.0000 & 0.0000 & 0.0000 \end{bmatrix}$$

$$R_{10} = \begin{bmatrix} 0.7919 & 0.0011 & 0.2070 \\ 0.0000 & 1.0000 & 0.0000 \\ 0.0000 & 1.0000 & 0.0000 \end{bmatrix}$$

We can take the operator and make sure the fuzzy judgment set S, then we can judge by the principle of maximum membership degree.

IV. RESULTS

The traditional evaluation standard to the college coaches is too single, and the level of coaches in different years can't be regarded as the same. The result of the evaluation to coaches are affected by the professional quality of the coach, sports equipment, the popularity of sports culture, the support that comes from schools and institutions and other factors. So we should regard this factor as the indicator of the evaluation to coaches.[5]

Because different sports have different difficulty coefficient, so, the degree of difficulty of the coach's guiding is also different. So when we find the best all time college coach, the tapes of sports will also have certain influence to the activity.

So, we can make model extend to all possible areas by modifying indicators and weights of them.

We can add sport types in the evaluation indicators set and get the difficulty coefficient of different sports through a large number of data analysis and information to get the weights. This method is similar to the above the discussion of gender, so, we will not repeat.

If 70% of the coaches that ranked by the analytic hierarchy process (AHP) are the latter half of last century, we can take the way two. Otherwise, we can take the way one.

The way one: if the effect isn't too big, we can mention the coaching time in the indicators of evaluation and consider it, we can do some adjustment to the weight by the characteristics of different sports.

The way two: if the effect is too big or can't be controlled, we should do the overall adjustment to the coaching time on the result. The adjustment is: dividing the whole century to different extents respectively and divided them by the corresponding proportion (such as the 60s-80s, we can make the result divided by 0.85, but after the 2000, we can make the result divided by 0.95).

Considering the factors, the evaluation indicators of coach identified as: the game's winning or losing, the safety of the players, the coaching time, communication to players, organization and management ability, sports skills and tactics.

Here we describe a modified fuzzy comprehensive evaluation process:

(1) We make the evaluation factors set

$\mu = \{\mu_1, ..., \mu_6\}$ = {the game's winning or losing, the safety of the players, the coaching time, Communication to players, Organization and management ability, Sports skills and tactics}

(2) We make the level set

V ={ V_1, V_2, V_3 } = {Good, So So, Poor}

(3) We can calculate the weight vector of each first indicator and assume the weight vector A = (0.202, 0.156, 0.156, 0.202, 0.156, 0.166)

V. CONCLUSIONS

(1) We establish the two models by respectively using the analytic hierarchy process (AHP) and fuzzy comprehensive evaluation, and we choose the best all time college coach in the last century is a basketball coach whose name is Adolph Rupp through calculate the certain data in the model.

(2) We explain the different time line horizons have effect to the result, and we give the solution through the analytic hierarchy process (AHP).

(3) We discuss how the model can be extended to both genders and all possible sport fields, and then we modified the indicators of the model and get the solution through the fuzzy comprehensive evaluation method.

(4) We choose three different sports and show the top five coaches of the model. The followed table is the result.

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Application of Computational Thinking in the basic computer courses in Agronomy Specialty

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***Abstract*—The basic course of university computer teaching should be aimed at the students of different levels and different majors, has different lectures. Teaching content should be closely combined with students' major. In the process of teaching we should cultivate their ability to analyze and solve problems with computer technology. Based on analysis of common problems in computer basic course in university put forward the corresponding measures of teaching reform of agronomy students. The new measures can cultivate students' ability of computational thinking, which closely combining the student's major. The method can not only improve the level of students' computer operations, but also enable them to be proficient in the use of computer technology to solve practical problems in learning and life. Practical teaching results show that relevant measures reasonably and effectively and to reach the anticipated goal.**

***Index Terms*—Computer courses; Agronomy Specialty; Combination of professional teaching; Computational thinking**

I. INTRODUCTION

The rapid development of computer technology prompted the industry to practitioners of information literacy of the increasingly high demand, also makes the computer operating skills of university graduates with high expectations from the society. University computer basic course is one of the compulsory courses in Colleges and universities of non-computer professional; its purpose is to improve the computer operation skills to the students as well as the application of computer technology to the actual live and work beyond the capacity of. In 2003, the Ministry of education according to the need of social development, introduced the "on the further strengthening of suggestions" computer basic teaching in Colleges and universities, and its main content is to put forward the target and the construction of explicit opinions on the curriculum reform of basic university computer. In the suggestion, clearly pointed out those general undergraduate students to learn two foreign computer courses, one is the basic computer knowledge; the two is the programming language. The former mainly includes office automation, computer network and other content; while the latter mainly train the students to use computer programming language is the ability to solve practical problems.

At present, put forward a series of solutions in the proposal based on the various colleges and universities, each university has its own specific circumstances and not unified model. The training level of different students and students' differences, so for all colleges and universities should formulate to adapt the reform of teaching methods. Based on the analysis of the actual situation in their own university, with 10 years of teaching experience, combined with the specific circumstances of the agronomy specialty, puts forward a set of the reasonable reform program. The new method has been implemented over three years, significant effect, obtain the ideal teaching effect.

II. PROBLEM

According to the guidance of Ministry of education, the school students mainly take two basic computer courses; one is "computer foundation," and two is "Visual FoxPro program design." The former is the popularity of computer knowledge about the students; the latter is to enable students to have the program design ideas. Findings from two courses teaching, mainly has such several questions.

A. Students of different level of computer skills

With the popularization of computer technology, the majority of primary and middle schools throughout our country have set up computer basic course. Because the degree of economic development in different areas, different students' computer level is different, the general is in the eastern region is higher than the level as the students. With the decline as the cost of computer hardware, most of the students have a personal computer, is conducive to enhancing the students' computer level. However, the rural students' family computer ownership is much lower than the city student's family. Therefore, city students' computer level is much higher than the rural students. Table I is the author's school in 2012 entrance basic computer skills test table; the data into the

table reflects the general situation of the national university.

TABLE I. STUDENTS OF COMPUTER PROFICIENCY TEST TABLE

Test Content	The students of eastern part(%)		The students of western part(%)	
	City Student	Rural Student	City Student	Rural Student
Chinese Characters Input	100	100	100	98
Word	97	90	92	74
Excel	90	82	84	40
PowerPoint	70	61	67	21
Flash	36	14	28	9
Virus Prevention	72	67	70	57
Computer Repair and Maintenance	24	11	18	5
Packaging of Computer	12	7	8	2
Webpage Design	21	17	19	6

B. Teaching contents

It pointed out that the Ministry of education's proposal, University computer foundation curriculum should include six aspects, namely: the basic knowledge of computer, computer programming, computer hardware, database technology, multimedia technology and application and network technology and application. In the teaching hour arrangement, streamlining but teaching content unchanged or even increased number of hours for most school computer courses, cause the teacher to ensure the teaching schedule and skip some important knowledge point. The rapid development of information technology, all kinds of new technology emerge in an endless stream, more and more knowledge to teach students, but the teaching hours (especially the experimental class) to reduce the contradiction between the increasingly prominent.

C. Teaching content update slows

Computer science-related knowledge updated soon, different students of teaching content are different, but the textbooks and teaching material publication needed a time period. When publishing fresh material added fresh content, these elements were out of date or face elimination, are no longer used for practical work. For example: the basis of the materials in the Office updated to version 2007; most of the office platform has been updated to 2010 platform; designs of teaching materials are still using Visual FoxPro 6. This language has basically been eliminated. Microsoft will stop supporting the technology.

D. Practices are weak

The main training the students' ability to use computers to solve practical problems of computer courses, the training is mainly composed of practice courses to complete. The actual process of teaching, courses are mainly in theory, supplemented by the experiment of. My school is in the form of a 1.5:1 distribution theory and practice during the course, so is the consequence of the students passed the exam, but to solve practical problems in learning will be at a loss what to do, and even many of the students in writing graduation thesis even when the word directory operations will not.

E. Practices of curriculum design and specialized combination is not tight

Computer teaching goal during the course is to help students use computer tools to solve specific problems in learning, to improve the efficiency of work and study. However, in the actual teaching process, no matter what kind of professional, what level as the students are using the same materials and syllabus, and even electronic teaching plan, courseware and other teaching resources are the same. Students do not understand the auxiliary function of computer courses on their own profession, cannot understand how to flexibly use the computer technology into their professional knowledge, and therefore, cannot achieve the expected teaching goal.

F. Students lack the ability of Computational Thinking

Computational thinking is the basic concepts of computer science to solve the problem design the system and understand human behavior. Computational thinking is a kind of recursive thinking, is a kind of parallel processing mechanism. Computational thinking can to solve the complicated task or design a system. Computational Thinking by using heuristic reasoning to solve a problem, is planning, in the uncertain case study and scheduling.

The cultivation of the computational thinking ability has the very important function for the students. It can help students to establish a rational analytical ability; I can guide the students to establish a complex problem solving way of thinking. However, at this stage, China's University Students in teaching computer basic not involved in this area.

G. Assessment methods need to be improved

At the present stage of computer courses, mainly consists of two parts, one is the theory test. Two is a hands-on examination of. Examination of the theory focuses on the students' basic knowledge to grasp the situation, operating mainly inspects the student to the commonly used software operation ability. However, these two kinds of inspection methods not closely, not all knowledge of computer courses of comprehensive. The ideal way of evaluation should combine theory and practice evaluation combined. Therefore, the existing assessment methods need to be further reform.

III. TEACHING REFORM

Aiming at the problems in university computer courses teaching at the present stage, combined with the actual situation in the Rongchang campus of Southwestern University, the author of more than 10

years of teaching experience, puts forward the following proposals for reform.

A. Students' basic level, teach students in accordance with their aptitude

Computer basic level test for all freshmen, according to the different test results are differentiated teaching. In the design into a test system mainly considers testing integrity, diversity, scientific and objective. The test system should be based on the open network, and to the students, the results are some specific analysis and screening, to determine the different levels of students should strengthen training from which aspect, the students assigned to the same computer skills for teaching in the same class, this can teach students in accordance with their aptitude.

B. Reasonable use of extra-curricular teaching time

Because the total number of students teaching hours of continuous reduction in, so the computer courses teaching hours also showed the trend of decreasing year by year. At present, want to raise the number of hours of computer basic curriculum may not. Therefore, in order to make the students master the relevant skills and application of computer, the need to develop students' extracurricular time. Create the computer interest group or to assign students using computer technology to solve problems in the student's practice task. The assignment, to provide students with experimental place and equipment and to give on-the-spot guidance, so can make up for the shortage of teaching hours, but also improve the students' practical ability.

C. According to the actual situation, adjust the teaching outline

The rapid development of computer technology, the teaching process cannot update the teaching materials, and experiment guide book, but there are plans to update the teaching outline. According to the development within the computer field, regularly updated syllabus. The teacher according to the updated program, add new knowledge and new technology in teaching, to enable students to master the knowledge of computer science.

D. And the agronomy specialty closely, emphasis on practical abilit.

The traditional teaching method is to first theory teaching, and then practice, but the teaching effect is not ideal. In some of the content, can be in the computer room, the teacher while combined agronomy knowledge teaching, students while operating. In the teaching of something (such as EXCEL), can put the agronomy specialty students generally considered more difficult course "biometrics" closely combined, let students use EXCEL to simplify the "certain difficulties in Biostatistics." Students through this study, can understand the auxiliary effect of computer technology on the professional, but also can stimulate student's interest in learning computer knowledge.

E. Designs the teaching contents, which are combined closely with professional

Computer knowledge learning is to enable students to use computers to solve a variety of problems during the process of learning, so the design of teaching content according to the different professional. According to the agronomy specialty students, sorting and comparison study of data processing can be taught DNA; learning management system can be taught a variety of RFID management information system in modern farming enterprises; learning the database knowledge, can guide students to design and implement a small pig or cow field feed invoicing software.

F. students computational thinking ability, improve the practical skills

The main purpose of calculative thinking training students, let them learn to think like a computer scientist problem, analyze and solve problems, make the most of the students in the calculation to meet a strange problem which can reasonable design and calculation model of science, cultivate this thinking ability will make the students benefit from the life of. Computational Thinking Education through computer basic course of the University, it is not down to the teaching mode of computer basic course to the original again, but need to content the training objectives and teaching the existing basis, from computational thinking ability training, organization optimization of teaching contents, prominent core, at the same time, through the reformation of teaching method, strengthen thinking method of training.

G. adjust course

Examination is an important link of teaching work, through the form of test paper in general to test. However, for the computer this strong practical course, the traditional test has been unable to meet the teaching requirements, the paperless examination system basically can solve this problem.

Paperless examination is performed on computer by computer test, the random question. Students answer directly on the computer, corresponding to the operation, after the examination, by the computer automatic scoring and score. Paperless examination the advantages are mainly embodied in two aspects, one is the combination of theory and practice, enhance the students' practical application level. Two is to improve the efficiency and reliability of the examination. Paperless examination simplifies the traditional examination preparation for the exam, no printing papers, only need to load the database in the computer. The system can automatically test and test. Students can take the test at any time. In addition, the machines automatically selected questions, one of a set of questions, and effectively prevent the students' cheating, and also stop the leakage of exam questions, test the real level as the students, ensure fairness and reliability test.

IV. TEACHING REFORM RESULTS AND DISCUSSION

Teaching reform carried out in Southwestern University Rongchang campus. The campus is in agronomy characteristics of the main campus, the student 60%-80% are pasturage, aquatic products such as agronomy specialty. The effect is obvious in the agriculture-related majors, after implementation of the program, the students master the knowledge of a computer increase, the students' practical ability to improve, students' learning enthusiasm greatly computer knowledge is excited, the extracurricular practice guidance teachers. Students can use computer knowledge to solve the problem of part of the professional learning.

TABLE II. THE THROUGH RATE AND AVERAGE SCORE OF FIRST LEVEL IN NCRE

Year	Through Rate	Average Score	Teaching Reform
2007	67.12%	74.32	No
2008	69.36%	75.16	No
2009	64.57%	72.35	No
2010	78.39%	80.17	Yes
2011	79.58%	80.69	Yes
2012	80.14%	82.34	Yes

Change the teaching reform of three years is larger, table II and table III data over the years the students to participate in the National Computer Rank Examination (NCRE) level and level two level tables.

TABLE III. THE THROUGH RATE AND AVERAGE SCORE OF SECOND LEVEL IN NCRE

Year	Through Rate	Average Score	Teaching Reform
2007	73.25%	64.72	No
2008	73.10%	65.18	No
2009	72.22%	63.29	No
2010	83.64%	72.58	Yes
2011	87.18%	73.49	Yes
2012	86.98%	75.98	Yes

In Table II and table III data can be seen obvious achievements of teaching reform, the comparison with the data results can be sure teaching reform. However, the computer technology is by far the most a technology rapidly, the knowledge and technology updates fast hitherto unknown. To cultivate students' information quality, we must update the teaching idea, science curriculum, reasonable arrangement of the teaching plan, the use of modern teaching methods, update and integration in the aspects of teaching content, teaching methods, in order to adapt to the new training needs.

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Design of Light Wave Receiver and Its Application in Fuse System

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***Abstract*—Current trigger fuse signal receiving system is given priority to with the passive situation, to eliminate physical field to a small number, to ensure that the action reliability of fuse, the paper designs and implements the waves are not trigger fuse sensing signal receiving system actively, through the sensor under low SNR signal amplifying, filtering, detection, automatic gain control and so on, analyzing the principle of fuse receiver and parameter setting, with double op-amp LM358 receiver design, using S3529 and S3528 level even form a 16th order band-pass filter, available band-pass and band stop filter with different width. Based on modular design principles test the circuit, test results show that when the input signal receiver of the locus of control in 0.1 mV, effective signal range of 0 ~ 5 mV, amplification, the measured magnification of 44300 times; Band-pass filter, the measured passband is 87-2215 Hz; AGC link, the locus of control in 0.1 mV, dynamic range is 34 db. Test performance stability, meet the design requirements, can be effectively applied.**

***Index Terms*—Light wave receiver, fuse system, circuit design, sensing signal**

I. INTRODUCTION

With the continuous development and the progress of optoelectronic information industry, reviews the development of optoelectronic technology and electronic industry in recent years, it is exclamation its brilliant achievements, especially in combination with the development of computer information technology, the progress of intelligent processing chip, electronic products have been towards the direction of intelligence, integration and integration. The Detection, reception and collection of light signal is implemented by the electronic circuit device. Effective optical signals [1-2] is of great fundamental significance on light signal acquisition and processing.

When it is to point to attack from within a certain distance through, it can not contact with the target body and it is a kind of automatic device which can automatically charge explosion, that is no trigger fuse. It is one of the main components of modern homing weapon, and it belongs to weapon fuse of a proximity fuse, Light waves field of the ship will be eliminated to a small number because of their own protection requirements to ensure that the action reliability of fuse. The development of active fuse is better than the passive fuse. This paper designs and realizes a kind of light waves of trigger fuse sensing signal receiving system actively, and be used to light the trigger fuse system effectively.

II. OPTICAL SYSTEM DESIGN PRINCIPLE

A. fuse optical principle

The fluctuating signal from the sensor The purpose of circuit is amplified, frequency selection and automatic gain processed, in order to make the amplitude of output signal stability to 5 v. Because the amplitude of input signal is only 100 μV or higher, thus the overall magnification factor should be 50000 [3-5]. However the signal through the filter suffers from attenuation [6], therefore the magnification of optical amplifier should be greater than 50000 times. Due to the fuse of the waves of effective signal is 100-2000 hz frequency range, so the filter passband inside should be designed for 100-2000 hz. Because the fluctuation of input signal is bigger, hence the output signal is likely beyond the range of 5 v. So it is necessary to add AGC, whose dynamic range in the circuit is greater than or equal to 25 db [7-9].

Finally the principle block diagram of light sensor signals designed is shown in "Fig 1."

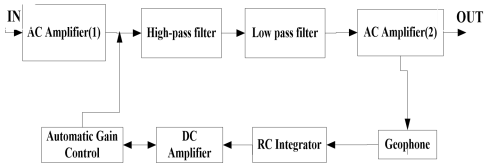

Figure 1. light receiver principle block diagram

The ac amplifier module of light wave consists of two ac amplifiers. The total magnification of these is 50000 times; The cutoff frequency of high-pass filter is 100 Hz, while that of low-pass filter is 2000 Hz. This is because the frequency range of fuse waves is 100-2000 Hz. AGC consist of four parts: the detector, RC integrator, DC amplifier and automatic gain control.

B. the main parameters designed

In the actual light system, both the effective signal and noise are through frequency selective filter processing. that is, only the spectrum component of the system passband can pass the filter. The effective signal of input from receiver is a narrowband signal. The mainly important role to fuse light waves is amplification and narrowband filter. The main parameters of fuse light waves are light sensitivity (voltage), passband and AC magnification, etc.

III. THE FILTER CIRCUIT OF LIGHT WAVE

Because the effective frequency range of the sensing signal of the waves from the original system is 100 ~ 2000 hz, we must design a band-pass filter to realize the function of the frequency selective. In order to reach the technical indicators of fuse light wave, we need design a filter for at least 16 order. However, the filter are most 8th order, using two band pass filter for 8 order level even to form 16th order band-pass filter. In this case, we use S3529 and S3528 level even form a 16th order band pass filter, available band pass and band stop filter with different width.

A switch capacitor low-pass filter, whose footprint is dual inline-pin package, is low pass filter of light wave based on CMOS manufacturing process. Therefore the advantages of switch capacitor low-pass filter is convenient. The schematic diagram of low pass filter is shown in “Fig 2”. The arrangement of its corresponding dual inline-pin package as shown in “Fig 3”. It is composed of four parts: I/O operation amplifier, internal ROM, latch, programmable frequency divider and low pass filter, etc.

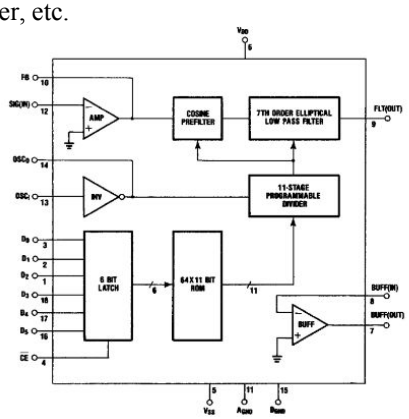

Figure 2. light S3528 internal structure diagram

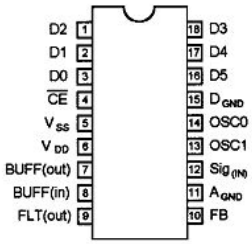

Figure 3. light S3528 pin sketch

The cutoff frequency code words of low pass filter are $D_5 \sim D_0$, which can be directly connected to both a fixed level and the microcomputer bus, completing cut-off frequency point Settings or rising along the input data latch. The output control with ROM can be implemented.

IV. THE SYSTEM OF FUSE LIGHT WAVE

Aimed at the above basic circuit application in light wave fuse system, not only use low-pass or high-pass filter, but also adopt band pass and band stop filter. Using S3529 and S3528 level even form a 16th order band pass filter, reasonable setting S3528 and S3529 again, available band pass and band stop filter with different width can be obtained. The band-pass filter circuit for light wave fuse system is shown in “Fig 4.”

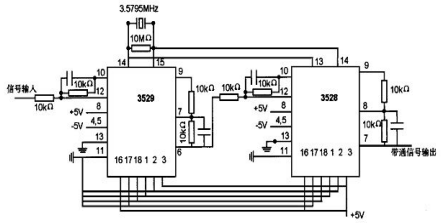

Figure 4. fight receiver fuse system band-pass filter circuit

The fuse system also includes detector, RC integrator, DC amplifier, automatic gain control, Here is no longer introduced in detail.

For component attachment convenience, it is necessary to convert from the schematic diagram to PCB diagram. The rules of routing are as follows: the power and ground wires are thick, because the current is larger; Don't cross the strong and weak signal in order to avoid interference; Elements should be aligned as far as possible to keep beautiful. Because the elements are more, it is difficult to go with single panel line. Therefor we chose the double-sided wiring. The PCB layout of light receiver circuit is shown in “Fig 5,” and the 3D view of computer simulation is shown in “Fig 6.”

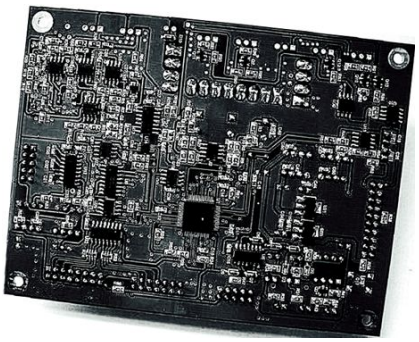

Figure 5. light receiver circuit PCB figure

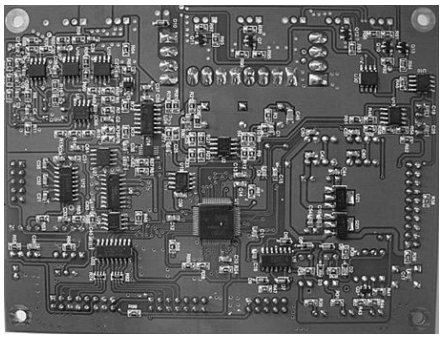

Figure 6. a light receiver circuit 3 d view

V THE TEST RESULTS

Finally, we test the filter system combined with the light wave system. The control points are controlled by dc level of dc amplifier. when the input signal V_i

is 100μV , the output of dc amplifier must be in the location where the volt-ampere characteristics of diode change the fastest so as to reach the control point located in 100μV .

Debugging of filter.The debug method of high-pass filter is the same as that of low-pass amplifier. If the input of the filter (V_i) is a sinusoidal signal whose frequency is variable, and then measure the output signal of amplifier Vo; If the frequency o Vi fall within the passband filter, then the output signal Vo should be equal to the input signal Vi; If the frequency of the Vi fall within the stop band filters, thus the output signal Vo should be approximately equal to zero; Otherwise, the filter will not work properly. The input signal is peak-to-peak value to 2 v, which is a variable frequency sinusoidal signal. The test data of the output signal is shown in table 1.

TABLE I. LIGHT RECEIVER PERFORMANCE TEST DATA

Frequency	Vopp2	Vopp2/Vipp2
0	2.00	1.00
1	2.00	1.00
2	2.00	1.00
2.1	2.00	1.00
2.15	1.90	0.95
2.2	1.54	0.77
2.215	1.41	0.705
2.25	1.08	0.54
2.3	0.66	0.33
2.35	0.43	0.215
2.4	0.28	0.14
2.45	0.18	0.09

If the module is working properly, we need to connect various modules together and then the overall circuit is debugged. For the whole light circuit, AGC need to play a significant role, because the value of input signal must be 100μV . Therefore our overall debugging difficulty is how to control this point.The control points are controlled by dc level of dc amplifier. when the input signal V_i is 100μV , the output of dc amplifier must be in the location where the volt-ampere characteristics of diode change the fastest so as to reach the control point located in 100μV .

When the input signal V_i is 100μV , the input signal of amplifier is a constate that the volt-ampere characteristics of diode change the fastest. We need to adjust R19 to make it suitable for requirements. the control point for the receiver is 0.1 *mv* , and the range of effective signal is 0 ~ 5 *mv* .

VI CONCLUSION

Aimed to design a light signal and effectively used to light the trigger fuse system, we study the module circuit and analyze in detail the principle and the module. we test the filter system combined with the light wave system. The test results indicate that When the input signal V_i is 100μV , the input signal of amplifier is a constate that the volt-ampere characteristics of diode change the fastest. We need to adjust R19 to make it suitable for requirements. the control point for the receiver is 0.1 *mv* , and the range of effective signal is 0 ~ 5 *mv* . Finally, light wave has the following links and indicators: amplification, The measured magnification is 44300 times; band-pass filter based on S3529 and S3528, the measured passband is 87-2215 Hz; AGC, the locus of control is 0.1 mV and the dynamic range is 34 db. Test performance is stability and it meet the design requirements, thus it can be effectively applied to the trigger fuse in the light of engineering practice.

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Numerical simulation study on commonly used main girder sections' aerostatic stability

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***Abstract*—For the study of commonly used main girder section's aerostatic stability in bridge engineering, using fluid dynamics software Fluent to simulate the numerical wind tunnel and get the wind force coefficients.A program based on ANSYS is developed,which used the modified increment and inner-outer iteration method.With the help of the wind force coefficients and the ANSYS program,we can get the critical wind velocity of main girder section.then every main girder section's aerostatic stability can be used to analyze and compare.**

***Index Terms*—main girder section; aerostatic stability; non-linear; wind force coefficients.**

I. Introduction

With the span and height of bridges increasing, the wind-resistant behavior of bridges is drawing the attention of people gradually. Now it is necessary to make a study on the commonly used main girder section's aerostatic stability.it can help people know more information about the sections' wind-resistant behavior. Also ,it can suppose an important reference when people choose a girder section. In order to study the aerostatic stability, we should find the sections' wind force coefficients. In the past, the wind force coefficients can only get in the wind tunnel test. But rencent years, with the improvement of fluid dynamics software, wind engineer has found a way of numerical simulation[1]. It has been proved correct[2]. To study the aerostatic stability, is to solve the critical wind velocity in the mean wind load case. Now it can be well solve considering geometry nonlinear, material nonlinear and load nonlinear[3]. This paper will apply these new technology to study the girder sections' aerostatic stability.

II. Main girder section

By collecting the main girder section's information most commonly used in bridge engineering,it can be easily found that,T-section gieder and box-sectiong girder are usually used in girder bridges,and suspension bridges are always built with truss girder and box-section girder. And in arch bridges ,T-section,box-section and tuss girder can be used to bulid. while except these sections, double-girder section is also can be seen in the cable stayed bridges.So there are four kinds of girders are commonly used in the bridge engineering.they are T-section girder,box-section girder,tuss girder and double-girder section. These sections all can satisfied with the requirements of bending resistance,shearing resistance and torsion resistance. for further study of the main girder section's performance in wind load case,this paper will research the four section's aerostatic stability.

For contrast, this paper intended the four section's size similar. According to the width of most highway is 12m, so the sections' size are intended as follow:

1) T-section girder. The main girder is composed with five T-section girder, which has 2.5m hight, 12m width and 2% two-way cross slope. In the top.

2) Box-section girder. The main girder is box-section with fairing. The section has 2.5m hight, 12m width and 2% two-way cross slope. In the top.

3) tuss girder. The tuss girder has 2.5m hight, 12m width and 2% two-way cross slope. In the top.

4) double-girder. The double-girder has 2.5m hight, 12m width and 2% two-way cross slope. In the top.

III. The wind force coefficients of the sections.

This paper uses fluid dynamics software Fluent and simulate the numerical wind tunnel to test the four different section's wind force coefficients.

The determination of wind forces on a bluff-body is quite difficult because they are dependent on a number of variables related to the geometry of the body and to the upwind flow characteristics. Therefore, geometrically scaled models are often used in practice to obtain pressure (or force) coefficients through wind tunnel tests, and these force coefficients are then applied to full-scale prototype structures. The pressure or force coefficients are non-dimensional quantities. For a bridge deck section, three non-dimensional mean wind force coefficients, which are seen as the functions of an angle a of attack, are usually defined as follows equation(1)[4][5]:

$$\left.\begin{aligned} F_D &= \frac{1}{2}\rho U^2 C_H D \\ F_L &= \frac{1}{2}\rho U^2 C_V B \\ M_T &= \frac{1}{2}\rho U^2 C_M B^2 \end{aligned}\right\} \quad (1)$$

where: C_D , C_L and C_M are the drag, lift and moment coefficients, respectively; U is the incoming wind flow velocity; D is the hight of girder section. B is the width of girder section.

This paper made 40 fluid dynamics models like that according to the wind angle of attack from -5°to 5°. Then we can get the wind force coefficients, which show in fig1 to.fig4.

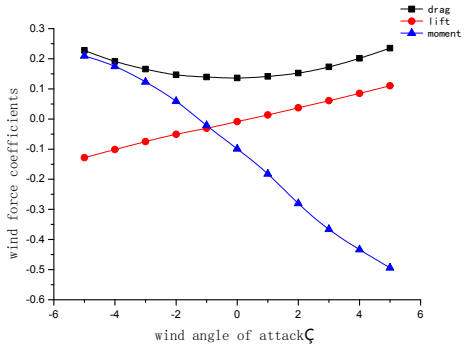

Figure 1. T-section's wind force coefficients

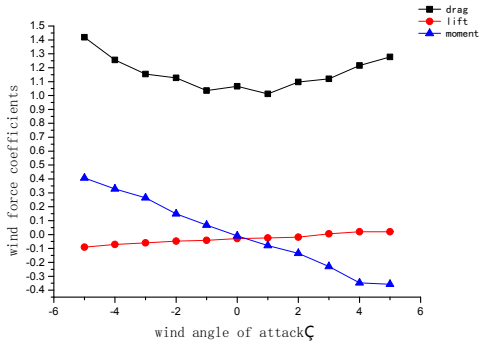

Figure 2. box-section's wind force coefficients

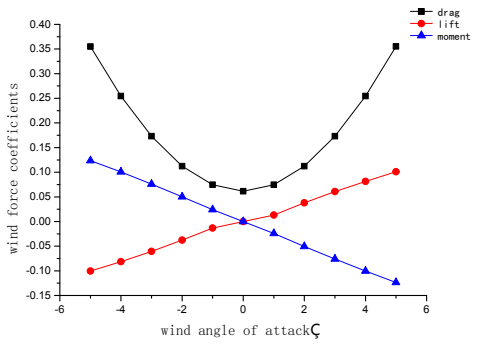

Figure 3. tuss's wind force coefficients

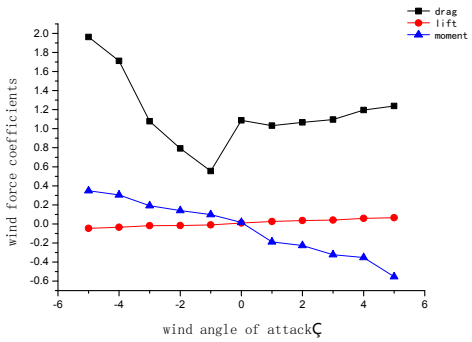

Figure 4. double-girder's wind force coefficients

According to the wind force coefficients we got, we can acquire the drag, lift and moment in the bridge which was influenced by the wind load. And through these information, we can further analysis the stress and displacement of the bridge in the wind load case. Finally analysis the aerostatic stability of the four girder sections.

IV. ANALYSIS OF THE NON-LINEAR AEROSTATIC STABILITY

In general, aerostatic instability analysis is all about forming and solving the following equation(2):

$$\left[K(\delta)\right]\{\delta\} = \{\Delta P(\delta)\} \quad (2)$$

where: $\left[K(\delta)\right]$ is the total structural stiffness matrix in which both linear stiffness and geometric stiffness are included; $\{\delta\}$ is the displacement vector of the bridge structure; $\{\Delta P(\delta)\}$ is the wind force vector acting on the bridge structure.

The Euclidean norm of the aerostatic coefficients of lift, drag and pitch moment is taken as convergence criterion, which can be expressed as equation(3):

$$\left\{\frac{\sum_{j=1}^{Na}\left[C_k(\alpha_j) - C_k(\alpha_{j-1})\right]^2}{\sum_{j=1}^{Na}\left[C_k(\alpha_{j-1})\right]^2}\right\} \le eps_k \quad (k = D, \mathrm{L}, \mathrm{M}) \quad (3)$$

Where: N_a is the total node number;

$C_K(\mathrm{k} = D, L, M)$ are the aerodynamic force coefficients; eps_k is the allowable tolerance.

The modified increment and inner-outer iteration method of a 3-D aerostatic instability analysis can be summarized as follows[4]:

1). Assume an initial wind velocity U_0 , an initial wind angle of attack α_0 , an initial displacement vector $\{\delta_0\}$, and decide a wind speed increment ΔU .

2). Calculate the total stiffness matrix using the initial displacement vector $\{\delta\}$ and decide wind forces on

the bridge using the initial wind speed U with the initial wind angle of attack α .

3). Solve the global equilibrium equation (3) to obtain the displacement vector $\{\delta\}$ using a numerical method such as the Newton-Raphson method.

4). Obtain the torsional angles of bridge deck elements from the displacement vector $\{\delta\}$.

5). Calculate the effective angle of attack α for each element.

6). Check if the Euclidean norm of Equation (3) is less than the prescribed tolerance.

7). If Equation (3) is not satisfied, then go to step (2) with the new effective angle of attack and the new displacement vector.

8). If Equation (3) is satisfied, increase wind speed by ΔU and go to step (2).

9). Keep the iteration of steps (2) to (8) until the solution of Equation (2) at step (3) becomes divergent.

10). Return to step (8) using a slightly small wind speed increment ΔU .

11). Keep the iteration of steps (2) to (10) until the difference of wind speed increment ΔU between the previous and current steps is less than the preset threshold. The final wind speed is then the critical wind speed for 3-D aerostatic instability of a long-span bridge.

An ANSYS program was developed as above method. With the help of that program, the critical wind velocity of the foue girder sections is listed as TABLE 1.

TABLE I. THE CRITICAL WIND VELOCITY OF THE FOUR SECTION GIRDERS(M/S)

main girder section	T-section	box-section	tuss	double-girder
the critical wind velocity	90	145	855	105

V. CONCLUSION

1) this paper use fluid dynamics software Fluent to simulate the numerical wind tunnel and get the wind force coefficients. The wind force coefficients completely accords with the theoretical law.

2) From the wind force coefficients those were got from fig5 to fig8, it can be concluded that, the four girders have similar result,while the wind force coefficients of tuss was lower than other sections. Although the box-section has a high value of Cd , it has low value of Cl and Cm

3) from TABLE 2,it shown us the tuss girder has a faster critical wind velocity, which will have a best performance in the wind load case.while the T-section girder has a worst wind-resistant ability.

4) this paper can prove that, among the commonly used main girder section, tuss girder has the best aerostatic stability. because mean wind load case, the tuss girder has a smaller windward area. It will recive smaller load. So the tuss girder has the best aerostatic stability.

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Based on the Modal Analysis of Composite Laminated Plate Equivalent Elastic Modulus Calculation and Experimental Study

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***Abstract*—Sandwich plate with its abundant mechanics properties is widely used in various engineering fields. It makes statics and dynamics research of Sandwich plate become focus for its complex constitutive relationship. In this paper, a new analysis method that uses the combination of modal analysis and finite element analysis to integrally and systematically analyze the equivalent elastic modulus of sandwich plate is developed. Its natural vibration mode and natural frequency of each order are measured with INV 1601B type vibration test instrument teaching and INV1601 DASP software to analyze mechanical properties of sandwich plate , and its equivalent elastic modulus is calculated by adjusting parameters via the general finite element software ANSYS . The real reflect of the dynamic mechanical properties of sandwich plate can be got in the numerical simulation of dynamic simulation.**

***Index Terms*—sandwich plate; modal analysis; equivalent elastic modulus**

I. INTRODUCTION

Sandwich plate, which originated in the World War II aviation industry, can replace steel members are widely used in aviation, spaceflight, locomotives, ships, cars and buildings, and other fields, and sandwich plate got rapid development and application, due to light weight, high specific strength, bigger than rigidity, good stability, heat insulation, sound insulation and other advantages. At present, when people evaluate the performance of the sandwich plate, the most people use numerical analytical method, experimental method or finite element method. The common calculation methods have Sandwich laminated plate theory, the equivalent plate theory and the theory of the honeycomb panel[1]. However, there are big differenc-es between different ways of equivalent in terms of computational complexity, accuracy and applicability[2]. Abroad, j. Dai[3] did fatigue test; W.G. James[4] did a bending test; F. Aviles[5] did peel test and made specific re-search to the different properties of the sandwich plate; Gibson[6]made the research of the elastic modulus of the honeycomb material based on the Euler beam theory. At home, people mainly focused on the honeycomb sand-wich plate theory. Fu Minghui and Yin Jiuren[7] did the research about equivalent parameters of honeycomb sandwich plate by considering the skin effect on sand-wich and thinking skin expansion deformation should not be neglected. Hao Hongyan and Huang Zhiliang[8] did the research about the dynamic characteristics of actual struc-ture of honeycomb sandwich plate with finite element dynamic simulation.

The constitutive relations of composite sandwich plate structure are complex and each part of which is discontinuous, so it is difficult to calculate the experimental data. Therefore, analysis and calculation of statics and dynamics of the sandwich plate structure become a major focus in the research at home and abroad. In this paper, when we are going to surface and sandwich panel structure as a whole, we can put forward to test the equivalent elastic modulus of honeycomb panel by using the method of dynamics, and then we systematically calculate the data of the constitutive relation of the structure. Its natural vibration mode and natural frequency are measured with INV1601B type vibration test instrument teaching and INV1601 DASP software to analyze mechanical properties of sandwich plate , and its equivalent elastic modulus is calculated by adjusting parameters via the general finite element software ANSYS.

II. THE FEASIBILITY STUDY AND DISCUSSION

The experimental modal analysis is a kind of analysis method of the system identification. In the process of this study, we adopt INV1601B vibration teaching type tester and INV1601 DASP software in order to process and analyze the mechanical properties of sandwich plate, and seek its modal parameters, which include modal vibration mode, the modal frequency and damping ratio[9]. We use the simply supported beam to verify the feasibility of the new method. The first three order natural frequency of the beam can be measured with the tester, and then we also can calculate the natural frequency of the beam by entering the elastic modulus of the aluminum plate in the

ANSYS and compare with before data obtained by experimental method. It illustrates the feasibility of the proposed method has certain that the experimental and calculated results error is less than 5% as shown in table 1. In order to validate the experimental method, we has carried on the experimental analysis of aluminum disc, and got the same results, so we come to the conclusion that it is certain feasible to use modal analysis method to measure elastic modulus of material.

TABLE I. EXPERIMENTAL AND CALCULATED RESULTS ANALYSIS OF THE SIMPLY SUPPORTED BEAM

Frequency order	Theoretical value(Hz)	Measured value(Hz)	Error (%)
1	42.691	43.640	2.17
2	160.280	164.938	2.91
3	367.677	363.999	1.000

III. RESEARCH AND ANALYSIS OF SANDWICH PLATE

A. *Sandwich plate modal experiment*

Sandwich plate three point bending test by Electronic tensile machine .

Figure 1. Three point bending of sandwich plate

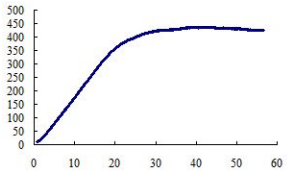


Figure 2. Sandwich plate bending test curve

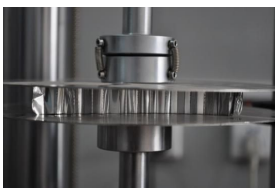


Figure 3. Compression of sandwich plate

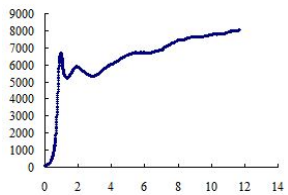


Figure 4. Compression curve of sandwich plate

We adopt INV1601B vibration teaching type tester and INV1601 DASP software in order to do model analysis of sandwich plate. In the process of analysis, we test sandwich plate by adopting the experimental methods that is the multipoint excitation and taking a single point in free constraint conditions. Sandwich plate used in the experiment uses the $300\times200\times19$ mm^3 aluminum film lam-inated plate, whose stationing way use 4×5 units, a total of 30 points, table board and sandwich connected by gluing way, and freedom constraint condition using 4 Angle underlay the soft, like sponge etc , simulation, as shown in “Fig.5”.

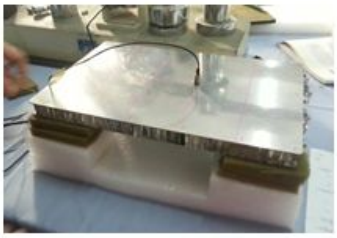


Figure 5. Sandwich plate experiment chart.

In the process of experiment, we knock the sandwich plate samples by using the hammer to stimulate its vibration, thus we obtain the modal data by modal experiment. Modal parameters are shown in Table 2 and modal vibration mode as shown in “Fig.6”. There are the unsmoothed places in “Fig.6” due to the strength in the process of tapping is uneven and the numbers we divide are discontinuous.

TABLE II. SANDWICH PLATE SAMPLE MODAL ANALYSIS RESULTS

Modal order time	Natural frequency (Hz)	Damping ratio /%
1	68.278	19.534
2	170.161	2.204
3	291.913	3.307
4	384.533	1.946

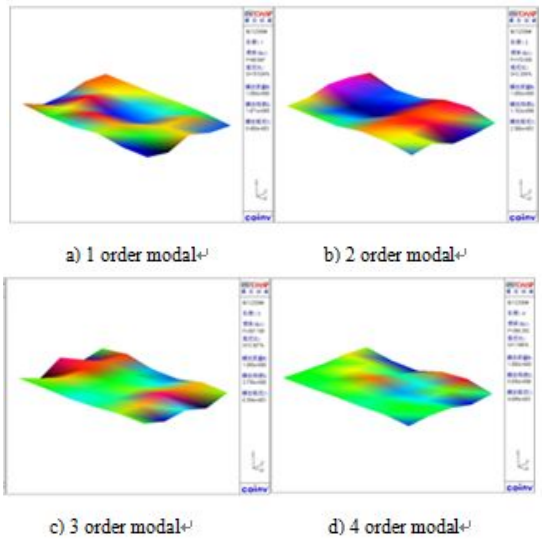


Figure 6. 4-order sandwich plate before experimental modal

B. *Sandwich plate calculation and analysis*

In order to calculate sandwich plate analysis, we first studied the parameter equation equivalent plate for Hoff theory, according to research zhang tieliang[10] formula shown in Table 3.

TABLE III. EQUIVALENT PLATE PARAMETERS FORMULA

	Reissner	Hoff theory
Equivalent thickness	$t_{eq} = \sqrt{3}(h_f + h_c)$	$t_{eq} = \sqrt{h_f^2 + 3(h_c + h_f)^2}$
Equivalent elastic modulus	$E_{eq} = \frac{2E_f h_f}{t_{eq}}$	$E_{eq} = \frac{2E_f h_f}{t_{eq}}$
Equivalent Poisson's ratio	$\mu_{eq} = \mu_f$	$\mu_{eq} = \mu_f$
Equivalent density	$\rho_{eq} = \frac{\rho_c h_c + 2\rho_f h_f}{t_{eq}} k$	$\rho_{eq} = \frac{\rho_c h_c + 2\rho_f h_f}{t_{eq}} k$

The properties of sandwich plate is mainly characterized by elastic constants. Sandwich panels of complex structure , Which is difficult to obtain by analytical methods. This paper describes a method for the mechanical properties equivalent sandwich plate finite element-based elastic range, the application of this analysis method is equivalent to the sandwich plate elastic solid single board

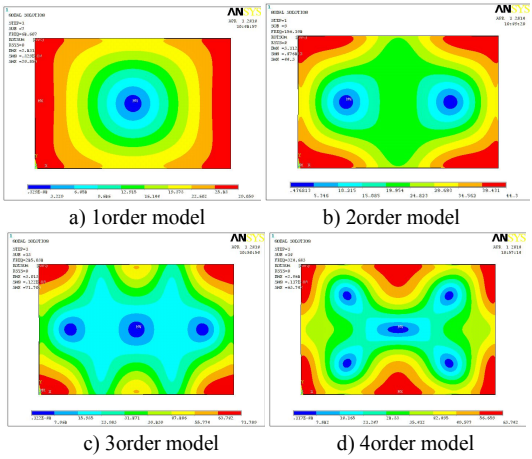
Sandwich plate model is established with ANSYS, and the table plate and sandwich is equivalent to the same material of monolayer plate at the same time, then it is calculated by using shell91 unit, finally we carry out the modal analysis of sandwich plate by adjusting the parameters and setting up the equivalent elastic modulus of sandwich plate in a free constraint condition. After many tuning parameter, makes the modal frequency and modal vibration mode that are calculated by the finite element method are generally consistent with the experimental data, thus the equivalent value of the equivalent elastic modulus of sandwich plate we get is 95 MPa . Under the equivalent modulus of elasticity $E = 95\,\text{MPa}$, the error in comparing the natural frequency of the modal analysis of sandwich plate by the finite element method with the experiment's before you got is shown in Table 4, vibration mode diagram is shown in "Fig.7".

TABLE IV. SANDWICH PLATE FINITE ELEMENT MODAL ANALYSIS AND COMPARISON RESULTS

Modal order time	Natural frequency (Hz)	Error /%
1	68.607	0.48
2	156.20	8.20
3	285.04	2.35
4	384.16	15.58

IV. CONCLUSION

In this paper, the method of modal analysis we adopt to calculate the equivalent elastic modulus of composite sandwich plate can reflect actual structure dynamic characteristics of sandwich plate in the dynamic analysis. Through the frequency characteristics of sandwich plate which had been gained by experiment modal analysis, The adjustable parameter method presented in this paper by ANSYS 5.7, the equivalent modulus of elasticity $E = 95\,\text{MPa}$,then through the three point bending of sandwich plate experiment ,the elasticity modulus of sandwich plate is 105MPa.In order to further verify the experimental method, almost the same experimental results are obtained when we use different materials and uniform thickness of sandwich plate, so we make sure in the case of uniform thickness using the proposed method to determine the equivalent elastic modulus of sandwich panel are true and correct. However, we didn't discuss r the different thickness of the sandwich plate.



a) 1order model b) 2order model

c) 3order model d) 4order model

Figure 7. 4-order sandwich plate before calculating modal

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Thematic Analysis of Meteorology Bachelor's Degree Thesis and Research Hot Spots -- Exemplified by Chengdu University of Information Technology

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***Abstract*—With degree theses of undergraduate students from College of Atmospheric Science, Chengdu University of Information Technology during 2008–2013 as the research object, this paper makes statistical analysis of themes and word frequency of keywords in an attempt to find out the research characteristics of meteorology bachelor's degree thesis and put forward relevant recommendations, in order to further enhance the education level of undergraduate students of meteorology major and promote the meteorology discipline construction in China.**

***Index Terms*—University, Meteorology, Bachelor's degree thesis, Thematic analysis, Word frequency analysis**

1 Introduction

Dissertation for Academic Degree (DAD) is a product of academic degree system, and a summary of scientific research conducted by a degree applicant under the instruction of the research tutor [1]. Academic degree theses are very valuable information resource for building literature resource of universities and research institutes, implying fully creative mentality and achievement, which reflect forefront dynamic and the latest development in respective discipline field, so they have high reference value [2]. Nowadays, most of the published theses are doctorate dissertations or master's theses; however, the author argued that the research on bachelor's degree theses of undergraduate students, especially those in popular university majors, should not be ignored. Research on bachelor's theses of undergraduate students in a popular major can drive sustainable development of the popular discipline, and can stimulate the development and construction of the discipline nationwide.

Meteorology is an ancient discipline with profound connotation; it takes the atmosphere as the object of study, describing atmospheric characteristics qualitatively and quantitatively, and intensively studies atmospheric weather situation and variation laws and weather forecast [3]. Meteorology major is a time-honored popular major of Chengdu University of Information Technology. Nowadays, Chinese universities which have meteorology major bachelor degree conferring program include Nanjing University of Information Science & Technology, Chengdu University of Information Technology, Peking University, Nanjing University, China Agricultural University, Shenyang Agricultural University, and Lanzhou University. This paper takes Chengdu University of Information Technology (CUIT) as the example, studying degree theses of undergraduate students from College of Atmospheric Science of CUIT during 2008–2013 from the aspects of the theme and keyword, and attempts to find the current status of meteorology major bachelor's thesis. This paper has certain coverage and representativeness in spite of certain limitation in the samples selected.

II. Samples of Study

In collaboration with Hangzhou Metadata Co., Ltd., Chengdu University of Information Technology adopted the developed "Digital Integration Management System for Academic Degree Theses" to implement digital integration management of undergraduate students' degree theses in the whole university in June, 2005[4] .Nowadays, has collected about 29,100 bachelor's degree theses up to now. As there are few collected theses during 2005–2007, they are not listed into the scope of study; Therefore, for the sake of accuracy of this study, it was decided to choose 1,138 bachelor's degree theses in total from College of Atmospheric Science in six consecutive years from 2008 to 2013 as the samples of study. Figure 1 presents the distribution of degree theses as a function of years. As can be seen from the data given in the figure, the number of meteorology theses increase progressively year by year, indicating that the team of meteorology major is constantly growing.

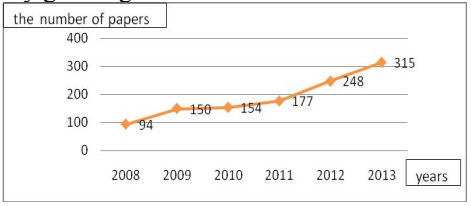

Figure 1. Number of meteorology degree theses versus year Unit: pcs

III. RESEARCH THEMES

Classification method is a tool to reveal and organize intelligence information, and the classification numbers derived from classification method reveal the literature theme content through discipline knowledge classification system [5]. Therefore, this study investigates the distribution of degree thesis themes through statistic of classification numbers, so as to reveal the general trends and dynamic of meteorology research.

A. Distribution of themes

Statistic of themes of the samples shows that, fundamental research of meteorology still dominates the degree theses, and the themes of 340 theses focus on P42 (Basic Meteorological Element, Atmospheric Phenomenon), accounting for 29.9% of the whole samples, a great amount of studies are on this theme every year. Besides, a considerable part of theses are on P45 (Weather Forecast) and P46 (Climatology), accounting for 16% and 22% of the total number of samples respectively. Some theses are related to P40 (General Theories and Methods), P41 [Atmospheric Sounding (Meteorological Observation)], P43 (Dynamic Meteorology), P44 (Synoptic Meteorology), and P49 (Applied Meteorology). And a minor percentage of the theses are on P22 (Geodesy), P31 [Earth (Rock Systems) Physics (Solid Earth Geophysics)], P33 [Hydrological Science (Physics of Aquatic Systems)], P47 (Marine Meteorology), P48 (Weather Modification), and P7 (Oceanography). The statistic of thesis themes specific to every year is shown in Table 1. In addition, extremely few theses involve interdisciplinary study of meteorology and F-type (Economics), of meteorology and Q-type (Biological Science), of meteorology and S-type (Agricultural Science), of meteorology and TK-type (Energy and Power Engineering), of meteorology and TP-type (Automation Technology, Computer Technology), of meteorology and TV-type (Hydraulic Engineering), of meteorology and V-type (Aeronautics and Astronautics) or X-type (Environmental Science, Safety Science). Among which, the number of theses involving interdisciplinary study of meteorology and F-type accounts for 0.1% of the total number of samples; the number of theses involving interdisciplinary study of meteorology and Q-type accounts for 0.5% of the total number of samples; the number of theses involving interdisciplinary study of meteorology and S-type accounts for 3.0% of the total number of samples; the number of theses involving interdisciplinary study of meteorology and TK-type accounts for 0.1% of the total number of samples; the number of theses involving interdisciplinary study of meteorology and TP-type accounts for 0.1% of the total number of samples; the number of theses involving interdisciplinary study of meteorology and TV-type accounts for 0.1% of the total number of samples; the number of theses involving interdisciplinary study of meteorology and V-type accounts for 0.1% of the total number of samples; and the number of theses involving interdisciplinary study of meteorology and X-type accounts for 0.9% of the total number of samples. This indicates that, as information spreads worldwide, academic research is no longer in a single discipline, interdisciplinary penetration is being reinforced, too. Meteorology is no exception, although theses on its interdisciplinary research are few these years, its overall trend is extending gradually to various discipline fields.

TABLE I. NUMBER OF DEGREE THESES CLASSIFIED BY THEME DURING 2008–2013 UNIT: PCS

Year / Theme	2008	2009	2010	2011	2012	2013	Total
P22 (Geodesy)	1(1.1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (0.1%)
P31 [Earth (Rock Systems) Physics (Solid Earth Geophysics)]	0 (0%)	1 (0.7%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (0.1%)
P33 [Hydrological Science (Physics of Aquatic Systems)]	0 (0%)	0 (0%)	0 (0%)	0 (0%)	4 (1.6%)	4 (1.3%)	8 (0.7%)
P40 (General Theories and Methods)	5 (5.3%)	10 (6.7%)	16 (10.4%)	6 (3.3%)	11 (4.4%)	3 (1.0%)	53 (4.7%)
P41 [Atmospheric Sounding (Meteorological Observation)]	2 (2.1%)	5 (3.3%)	5 (3.2%)	13 (7.3%)	10 (4.0%)	10 (3.2%)	45 (4.0%)
P42 (Basic Meteorological Element, Atmospheric Phenomenon)	31 (33.0%)	39 (26.0%)	53 (34.4%)	54 (30.5%)	80 (32.3%)	85 (27.0%)	340 (29.9%)
P43 (Dynamic Meteorology)	2 (2.1%)	8 (5.3%)	7 (4.5%)	10 (5.6%)	11 (4.4%)	14 (4.4%)	54 (4.7%)
P44 (Synoptic Meteorology)	8 (8.5%)	13 (8.7%)	6 (3.9%)	17 (9.6%)	6 (2.4%)	15 (4.8%)	65 (5.7%)
P45 (Weather Forecast)	10 (10.6%)	29 (19.3%)	32 (20.8%)	20 (11.3%)	39 (15.7%)	47 (14.9%)	177 (15.6%)
P46 (Climatology)	18 (19.1%)	30 (20.0%)	23 (14.9%)	39 (22.0%)	54 (21.8%)	94 (29.8%)	256 (22.5%)
P47 (Marine Meteorology)	0 (0%)	2 (1.3%)	4 (2.6%)	1 (0.6%)	0 (0%)	0 (0%)	7 (0.6%)
P48 (Weather Modification)	1 (1.1%)	0 (0%)	0 (0%)	1 (0.6%)	0 (0%)	0 (0%)	2 (0.2%)
P49 (Applied Meteorology)	12 (12.8%)	7 (4.7%)	0 (0%)	9 (5.1%)	15 (6.0%)	31 (9.8%)	74 (6.5%)
P7 (Oceanography)	0 (0%)	0 (0%)	2 (1.3%)	0 (0%)	0 (0%)	0 (0%)	2 (0.2%)
Miscellaneous	4 (4.3%)	6 (4.0%)	6 (3.9%)	7 (3.9%)	18 (7.3%)	12 (3.8%)	53 (4.7%)
Total	94	150	154	177	248	315	1138

(Note: All interdisciplinary research theses involving P-type and other disciplines with classification numbers not attributed to P-type are ascribed to the Miscellaneous; the bracketed numbers are the percentages of number of theses on a theme over the total number of theses that year.)

B. Analysis on the theme levels

Through statistical analysis of the sample themes, we

can find the sample distribution characteristics. However, for more in-depth understanding of the research theme fineness, this study makes statistical analysis of the quantity of sample levels (see Fig. 2). (Note: Since theses on interdisciplinary research are few relative to total number of samples, it was neglected in the analysis of sample fineness, and only the meteorology research theses were analyzed)

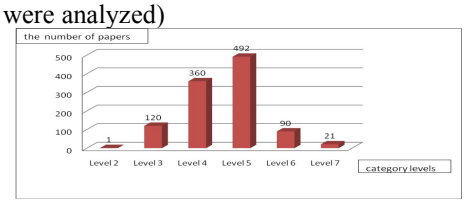

Figure 2. Number of samples classified by category levels Unit: pcs

As can be clearly seen in Fig. 2, category levels of the research samples concentrate on Levels 4 and 5, but there are 603 samples at or above Level 5, accounting for 53.0% of the total number of samples. Therefore, undergraduate students in meteorology major have good fineness in research, with intense and deep connotation.

IV. ANALYSIS ON THE WORD FREQUENCY OF KEYWORDS

A. Word frequency statistic

After thematic analysis of degree theses, this study summarizes the keywords of every thesis. The words with equal meaning were merged, for example, ENSO (El Nino Southern Oscillation), air temperature, climate change, meteorological factor, rainstorm, etc. The words with similar meaning were also merged, for example, Tibet and Tibetan plateau, EOF (empirical orthogonal function) analysis and EOF analysis method, V-3θ structural graph and V-3θ chart, satellite remote sensing and remote sensing, etc. and some keywords without independent retrieval significance were excluded, for example, the highest, related, trend, data, non-regular, etc. The keywords were analyzed with office software, and finally, there are totally 1,552 keywords. By ranking the keyword frequencies, we have obtained the high-frequency words, sub-high-frequency words, sub-low-frequency words and low-frequency words, which are defined as follows: high-frequency words refer to the words with word frequency higher than or equal to 10, sub-high-frequency words refer to the words with word frequency between 6–9, sub-low-frequency words refer to the words with word frequency between 3–5, and low-frequency words refer to the words with word frequency below 3 (see Table 2).

TABLE II. FREQUENCY DISTRIBUTION OF KEYWORDS IN METEOROLOGY BACHELOR'S DEGREE THESES

Frequency level		Keyword		Keyword
High-frequency	102	Precipitation amount	26	Water vapor transport
	87	Spatiotemporal distribution	25	Air velocity
	86	Rainstorm disaster	24	Atmospheric circulation
	68	Air temperature	21	Abrupt change; intense precipitation; Sichuan-Chongqing precipitation
	66	Qinghai-Tibetan Plateau	20	Strong convection weather; variational trend
	62	Sichuan area	19	Rice field; spatial and temporal variation
	58	Wavelet analysis	18	Hail
	46	Climate change	17	Characteristic analysis; latent heat flux
	39	Southwest China area	16	Southwest low vortex; temperature change
	36	Strong convection	15	Physical quantity characteristic; human comfort index; low vortex; wave-packet propagation diagnosis (WPD)
	35	Interdecadal change; circulation situation	14	Correlation analysis; soil humidity
	32	Drought	13	Xinjiang; South Asian High Pressure
	31	Trend change	12	Sunshine duration; climatic characteristic; tours climate; precipitable water; North China area; composite analysis; Doppler weather radar
	28	EOF	11	Mann-Kendall test; atmospheric heat source; comparative analysis; subtropical high; sensible heat flux; seasonal variation; precipitation anomaly; satellite cloud imagery
	27	Summer precipitation; Chengdu; variational characteristic	10	Cumulative temperature; intensity index; influence system; cross-equatorial flow; diagnosis analysis; FAO Penman-Monteith equation
Sub-high-frequency	9	GIS; M-K test; ultra-low temperature; West Sichuan plateau; ground-based GPS; cloud-to-ground lightning flash; Hebei Province; circulation features; precipitation anomaly; meteorological element; disturbance energy; sunshine; Northwest China area; coefficient of correlation; harmonic analysis; snow disaster; Chongqing City		
	8	BP neural network; East Asian summer monsoon; multiple regression; circulation anomaly; accumulated snow; thunderstorm; shear line; tropical easterly jet; temporal change; numerical prediction product; digitization; water vapor flux; total solar radiation; fog; Ya'an; early warning index; cloud cover; the Middle and Lower reaches of Yangtze River; weather factor, stepwise regression		
	7	MODIS; Beijing area; East Sichuan area; low-frequency oscillation; flood/drought variation; moving average; regression analysis; airport; extreme precipitation; the Yangtze and Huai River area; Jinta oasis; cold air; the immune evolutionary algorithm; evaluation model; spatiotemporal distribution features; numerical simulation; vorticity; Tibet; linear regression; relative humidity; correlation		
	6	Soybean; local meteorological factor; wind profiler radar; high-temperature weather; case study; Ruoergai grassland; South China; precipitation concentration period; precipitation characteristics; net radiation; blown-up theory; helicity; tourism; South China Sea monsoon; frozen disaster; stratosphere; plain; meteorological disaster; trend analysis; heat resource; microwave radiometer; pollution; physical quantity diagnosis analysis; period; the lowest air temperature		
Sub-low-frequency	5	Priestley-Taylor equation; Z index; specific humidity; variation analysis; snow disaster; reference crop evapotranspiration; convective parameter; convective cloud mass; El Nino; albedo; wind chill index; wind shear; wind direction; radiation flux; Ganzi Aba; Mount Gongga; Guizhou; flood disaster; extreme low temperature; precipitation days; radar echo; cold front; Liangshan area; brightness temperature; agricultural drought; rolling topography; climate; meteorological yield; zoning; heat island effect; artificial		

		neural network; Sanjiang Plain; sandstorm; humidity; time series; statistical analysis; soil temperature; Turpan; hazard; phenology; Xichang; West Pacific subtropical high; summer; correlation relationship; Indian monsoon; influence factor; rain season; reanalysis data; evapotranspiration; quality control; mesoscale convective system; principal component regression analysis
	4	ENSO; TOMS satellite data; dark pixel method; Bowen ratio energy balance method; difference correction; heavy fog; low-level jet; low cloud cover; ground surface temperature; terrain; east-west oscillation; winter; Dunhuang; distribution characteristic; icing; drought index; plateau shear line; sea surface temperature; cold wave; Henan; North China precipitation; environmental factor; circulation background; circulation type classification; extreme high temperature; polar vortex; precipitation intensity; the Jinsha River Basin; runoff feature; air pollution; Longquan area; filtering wave; area index; model simulation; inversion layer; Euclidean distance; Panzhihua; climate warming; climatic analysis; climate tendency rate; meteorological condition; tropical Indian Ocean; bilinear interpolation; Sichuan rainstorm; four seasons; velocity field; sounding data; synoptic analysis; weather system; projection; zonal wind; satellite remote sensing; satellite data; flood season; evolution; night rain; Indian Ocean; prediction; the maximum air velocity
	3	ERA-40 data analysis; GPS precipitable water; MICAPS; MM5 numerical prediction product; NCEP/NCAR reanalysis data; OLR; REOF; Banan District; boundary layer parameter; standardization; standardized precipitation index SPI; squall line; parameter estimation; yield forecast; urban heat island; ozone; first date; vertical velocity; atmospheric visibility; bandpass filter; conductor icing; low frequency circulation; low temperature rain or snow weather; low-value system; ground air velocity; geothermal inversion; earthquake; earthquake-stricken area; East China type; East Asia area; East Asian winter monsoon; reflectivity factor; non-regular information; nonlinear time series; classification evaluation; wind energy; risk assessment; high-altitude humidity; plateau; plateau airport; plateau monsoon; Normalized Difference Vegetation Index; sea surface temperature; sea surface temperature anomaly; the Heilongjiang River; Hengduan Mountains; East China area; the Yellow-River–Huai-River–Hai-River region; cumulus convective parameter scheme; extreme air temperature; precipitation distribution; precipitation trend; precipitation forecast; precipitation data; structured; decomposition through empirical orthogonal function; radial velocity; anomaly; flue--cured tobacco; spatial change; thunderstorm weather; thunderstorm; area rainfall; woody plant; Namuling County; energy distribution; fitting test; annual average air temperature; agriculture; agroclimate analysis; decision tree; Pearson Type III distribution; assessment test; climatic potential productivity; climatic resource; aerosol optical depth; aerosol index (AI); air temperature change; regional rainstorm; trend; tropical Pacific; Three-River Source Region; forest fire disaster; moist potential vorticity; adaptability; comfort index; data processing; water vapor; water vapor condition; direct solar radiation; sounding analysis; synoptic situation; statistical characteristic; abrupt change test; soil relative humidity; microphysical scheme; microclimate effect; Asian-African monsoon zone; Asian-African summer monsoon; Yibin; moving path; vulnerability evaluation; rain and snow weather; forecast equation; forecast factor; forecast index; cloud; marsh and wetland; Zhaoqing area; evaporation amount; vegetation; China; precipitation distribution over China; southern China; ending date; return period; periodic change; periodic feature; total cloud cover; the highest air temperature
Low-frequency	2	Totally 253 (omitted)
	1	Totally 917 (omitted)

As can be seen from the above table, the words such as precipitation amount, spatiotemporal distribution, rainstorm disaster, air temperature, Qinghai-Tibetan Plateau, Sichuan area, wavelet analysis, climate change, strong convection, interdecadal change, circulation situation, drought , etc. are high-frequency keywords of the samples, and research hot spots of degree theses. These hot spots are not isolated, instead, they are closely related, showing high attention to the basic meteorological elements and atmospheric phenomena. GIS, M-K test, ultra-low temperature, BP neural network, East Asian summer monsoon, accumulated snow, circulation anomaly, low-frequency oscillation, regression analysis, extreme precipitation, wind profiler radar, precipitation concentration period, blown-up theory, meteorological disaster, heat resource, etc. occur in relatively high frequency, indicating that the samples have studied much about weather forecast and climatology. Words such as snow disaster, evaporation amount, comfort index, sounding analysis, spatial change, standardized precipitation index SPI, non-regular information, sounding data, etc. occur in relatively lower frequency, indicating that a few samples are involved in atmospheric sounding.

B.Analysis on the research fields corresponding to the hot spots

This study further classifies high-frequency words in samples according to the corresponding research fields.

TABLE III. CLASSIFICATION OF HIGH-FREQUENCY WORDS BY RESEARCH FIELD

Type of research field	Keyword	Frequency	Keyword	Frequency
Theory type	Precipitation amount	102	Abrupt change	21
	Spatiotemporal distribution	87	Intense precipitation	21
	Rainstorm disaster	86	Strong convection weather	20
	Air temperature	68	Variational trend	20
	Climate change	46	Spatial and temporal variation	19
	Strong convection	36	Hail	18
	Interdecadal change	35	Characteristic analysis	17
	Circulation situation	35	Latent heat flux	17
	Drought	32	Temperature change	16
	Trend change	31	Physical quantity characteristic	15
	Summer precipitation	27	Human comfort index	15
	Variational characteristic	27	Low vortex	15
	Water vapor transport	26	Correlation analysis	14
	Air velocity	25	Soil humidity	14

	Atmospheric circulation	24	Sunshine duration	12
	Climatic characteristic	12	Tours climate	12
	Composite analysis	12	Precipitable water	12
	Atmospheric heat source	11	Comparative analysis	11
	Subtropical high	11	Sensible heat flux	11
	Seasonal variation	11	Precipitation anomaly	11
	Cumulative temperature	10	Intensity index	10
	Cross-equatorial flow	10	Diagnosis analysis	10
Total frequency	1095			
Application type	Qinghai-Tibetan Plateau	66	Sichuan-Chongqing precipitation	21
	Sichuan area	62	Rice field	19
	Wavelet analysis	58	Southwest low vortex	16
	Southwest China area	39	Xinjiang	13
	Chengdu	27	South Asian High	13
	North China area	12		
Total frequency	346			
Technology type	EOF	28	Wave-packet propagation diagnosis (WPD)	15
	Doppler weather radar	12	Mann-Kendall test	11
	Satellite cloud imagery	11	Influence system	10
	FAO Penman-Monteith equation	10		
Total frequency	97			

Out of the 62 high-frequency words, 44 fall within the theory type, accounting for 71.0% of the total number; 11 fall within the application type, accounting for 17.7% of the total number; and 7 fall within the technology type, accounting for 11.3% of the total number. This indicates that, by now, meteorology bachelor's degree theses focus on basic theory field, less theses are in application field, and technology field is slightly involved but the thesis quantity is obviously not enough. From one aspect, this also indicates that cultivation of meteorology undergraduate students for research on application and technology of atmospheric science is not so emphasized on and needs to be strengthened.

V. CONCLUSIONS

This study selects 1,138 bachelor's degree theses from College of Atmospheric Science, Chengdu University of Information Technology as the object of study, and makes statistical analysis of research theme and keyword respectively. It's found that the meteorology bachelor's theses have several major characteristics as follows:

(1) The sample research has good fineness, depth and targets. But most of the samples are based on basic meteorology theories, lacking the studies on technology and application aspects.

(2) The phenomenon of overlapping in selection of degree thesis topic remains popular. Every year, there are a lot of similar topics selected, such as analysis on rainfall in Sichuan area, study on atmospheric change in Qinghai-Tibetan Plateau, study on summer climate in Sichuan-Chongqing area, etc. the thesis topics selected are too monotonic, which should arouse the attention of the teachers of meteorology undergraduate students in China.

(3) The degree theses have fewer creative research achievements. It's found from sample survey that, the creativity of meteorology bachelor's degree theses has not been embodied so obviously, and both theoretical value and practical significance are quite implicit.

(4) There are fewer interdisciplinary studies, only individual topics selected involve economics, forest science, computer science, aeronautical technology, energy and power engineering, hydraulic engineering, and environmentology.

In summary, based on traditional basic research, meteorology is gradually incorporating comprehensive and interdisciplinary academic research, and its research field will be wider and more extensive in future; it is still an arduous task and a long way to go for education of meteorology undergraduate students and discipline construction of meteorology in China.

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Monitoring Monomer battery voltage of Series Batteries Online based on Voltage to Frequency Conversion Method

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***Abstract*—Monomer battery float charging voltage detection of series batteries is an important on-line monitoring object of EPS. This paper designs a microcontroller technology as the core, using V/F conversion methods to collect battery voltage data, through software programming for deal real-time data, then perform real-time monitoring and control. The technology of Optocoupler isolation and transformer isolation are used to solve the problem of data acquisition circuit and data processing circuit electrically isolated. The hardware architecture framework of logging devices is given. Logging devices are given hardware architecture framework, and V/F converter circuit, power inverter circuit and electrical isolation circuits are introduced in detail. Dual serial MCU is used to achieve meter display communication and remote data communication, a communication scheme is given.**

***Index Terms*—On-line monitoring, V/F conversion methods, Electrical isolation, Data communication**

I. INTRODUCTION

Emergency Power Supply (EPS) become an indispensable feature for modern industrial design and business. Its reliable operation has also become the main research direction in the field of power supply study. EPS used in series with the battery is as the main power system. If these systems are composed of single cells, generally use 24, 32 or 48 units consisting of lead-acid batteries cascade. As the main source of power battery of the inverter system the way it works is not regular. That is likely to require long-term means that the battery pack is in the floating state, leading to battery failure problem. That is also means that the battery may need to maintain the floating state for a long time, thereby bring the problem of battery failure. Often the failure of the battery pack from the failure of a single cell in a vicious cycle starts, especially for longer time use but not more than service life of the battery pack. Only rely on the daily maintenance of maintenance personnel is both time-consuming and inconvenient, also do not meet the need of modern management. Therefore, the operating parameters of a single cell in the online real-time monitoring, for data analysis of periodic testing, to detect the problem becomes extremely important. Monomer battery float charging voltage detection is one of the most basic performance indicators.

There are some technical difficulties in circuit design of monomer battery float charging voltage detection. Multiple selection mode measurements can be considered from the perspective of reducing costs, but its voltage range beyond the standard analog switches operating voltage range. The use of mechanical relays is not satisfactory in speed, service life and work reliability. To ensure measurement accuracy, the measurement cell in suspension. To consider the signal acquisition circuit and signal processing circuit to take effective electrical isolation in system design. Due to increase in the number of cells in series with the battery pack, power consumption measurement circuit is difficult to reduce. The country has a lot of battery voltage measurement method proposed.

First proposed extraction voltage resistor network structure, theoretical analysis of this approach is feasible, but for the presence of the battery pack accumulate errors and greatly reduce the measurement accuracy. So it was suggested that the passive isolation detection method [1]. Traditional testing methods use relay and large electrolytic capacitors treated in isolation which is more mature, but there are some defects in mechanical action slow and low service life. Practice has proved that the detection device according to this principle in speed, service life and work reliability are not satisfactory. In order to solve the above problems can replace mechanical relay by the coupler relay [2], so that the electrolytic capacitor without additional premise, while improving the reliability, speed and service life also will meet the requirements, but the relative costs to be greatly improved. It was also suggested the use of a differential amplifier [3] or operational amplifiers [4] [5] acquisition circuit, and also have achieved some success.

II. VOLTAGE TO FREQUENCY (V / F) CONVERTER NON-CONTACT VOLTAGE SAMPLING EXTRACTION PRINCIPLE

Although the V/F converter [6] non-contact sampling extraction voltage method has been proposed, but not yet

applied to solve the larger battery cell voltage measuring concatenation. In this paper, with the aid of V/F conversion method, considered the main technical difficulties raised in front of the cell voltage measuring circuit designs exist. This article has designed a battery cell voltage line detection hardware implementation.

A.Overall cell voltage measurement system implementation

This system is mainly completed the following functions. The overall realization is shown in Figure 1. Mainly compose by the sampling circuit, a voltage-frequency conversion circuit, electrically isolated from the circuit, an analog switch, CPU, and power supply etc.

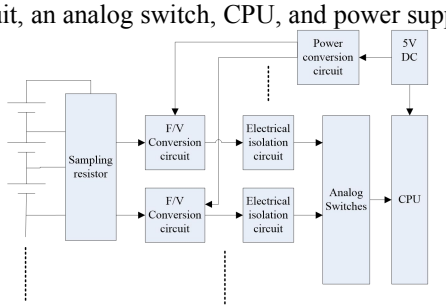

Figure 1. The circuit of inverter and the rectifier

B. The working principle

Signal acquisition using the F/V conversion methods. The battery voltage is sampled by suspension access point, the terminal voltage of the battery cell via the partial pressure (lower power consumption) as the F/V converter input. Divider resistors dispersion can be adjusted by F/V converter circuit. The output signal is converted to analog switches via optical isolation device. Processor collect frequency signal by control analog switches. Data acquisition and data processing circuit with optical isolation circuit and transformer isolation technology to achieve electrical isolation between the two circuits.

Machine design consider from mechanical shape and instrumentation, the structure of the circuit made a deal. Data acquisition and data processing circuit are designed separately. Each acquisition board can collect 8-way battery voltage signal, you can easily select the number of plate collected according to the number battery to be measured. Another design a motherboard, through the flat wire to each acquisition board connected to the motherboard, unified the collected signals are processed. Machine powered by DC 5V, switching power supply will convert 5V to 10V via DC/DC inverter module (described below). Due to the special design of the above circuit structure, the power of each acquisition board can be controlled, you can save the whole power consumption.

III.THE REALIZATION OF THE FUNCTION OF THE CIRCUIT

A. V/F convert circuit

To reduce the sampling circuit the battery power consumption, F/V converter signal taken from the sampling resistor. Only the battery voltage signal is gathered. V/F conversion using the integrated chip LM331, LM331 can be used as a precision voltage to frequency converter. LM331 with a new temperature compensated energy gap reference circuit, over the entire operating temperature range and low to the 4.0V supply voltage has a high precision, single-supply operation. Its wide dynamic range, good linearity, the largest non-linear distortion is less than 0.01%, it has a good linear when operating frequency lower to 0.1Hz. high conversion accuracy, digital resolution up to 12 bit. External circuit is simple, just access a few external components to facilitate constitute V / F converter circuit, and is easy to maintain accuracy. V/F converter circuit is shown in Figure 2.

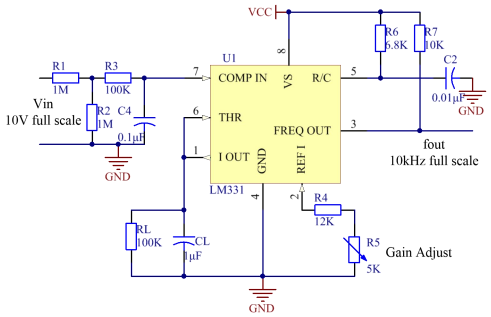

Figure 2. F/V converter circuit

B. Multiple power inversion

The design of the whole power supply provide 5V DC by integrated switching regulator power supply [7], so it can meet design power consistency. Due to the design of each battery requires a separate F/V converter circuit, so each F/V converter circuit also requires a separate power supply, According to the sampling voltage requirements and power consumption for the whole consideration, Sampling voltage has been pressured before it is sent to conversion circuit, so just larger than the voltage of the power supply voltage can be. Based on the above considerations, it can be achieved by 5V power inverter. Dual inverter schematic diagram is shown in Figure 3. Dual inverter schematic diagram is shown in Figure 3. According to V / F converter circuit power requirements, this design converted to DC power supply voltage 10V, output current can reach more than 15mA. Design according to the demand for a separate power supply unit to achieve the same, for example, each 8-way acquisition board designed to collect, you need 8-way power supply. Since the conversion only to meet the high power voltage than the acquisition, 10V power supply output regulation is not required, thereby simplifying the design.

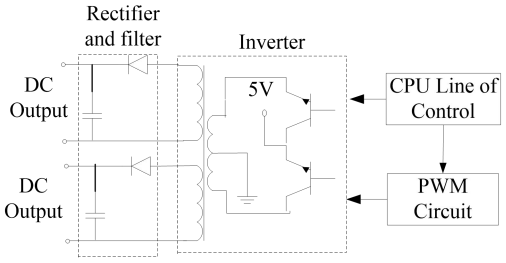

Figure 3. Block diagram of Inverter dual switching power supply

C. To achieve electrical isolation

Electrical isolation is to avoid mutual interference between data acquisition circuit and data processing circuit, so that the insulation between the two circuits, but also to maintain the relationship between the two circuits to ensure energy transfer. The design involves the isolation of signal transmission and power supply isolation, they were used respectively optocoupler isolation and transformer isolation technology to achieve electrical isolation between the two circuits. As shown in Figure 4.

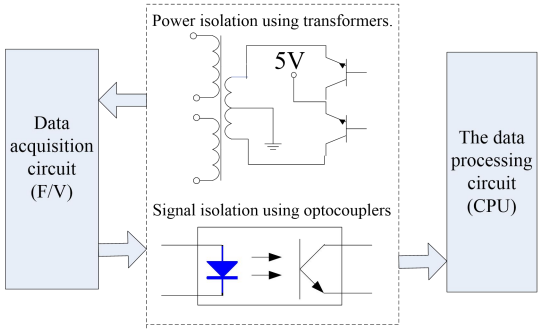

Figure 4. Schematic of electrical isolation

IV. DATA COMMUNICATION

The main processor is responsible for processing the data collected and sent to the instrument processor to display, while the data can also be sent to the remote computer 485 for processing. This data transmission scheme design which not only meets the field instrument display but also meet the remote site can be analyzed by data. Implementation of the principle block diagram is shown in Figure 5.

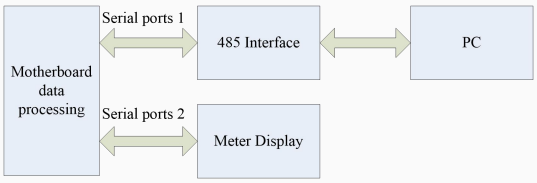

Figure 5. Data communication scheme

V. EXPERIMENTS AND CONCLUSIONS

Design instrumentation installation is complete, the software debugging success. Use stabilized voltage supply debug every channel of instrument. Use fire emergency power for the instrument to be tested. Emergency power supply with 12V/40Ah batteries connected in series. Instrument measuring results is compared with a multimeter measurements, Result can meet the design requirements, and reliable measurement data, to achieve real-time monitoring of the battery voltage. Summary of the design are as follows.

(1) V/F converter with high input impedance, power is very small samples.

(2) Direct sampling of single cells, can fully guarantee the accuracy of measurement.

(3) The application of electrical isolation to improve the reliability of the measurement series with the battery pack.

(4) Design of the communication data can easily meet the needs of the project.

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A Study on LBS Users' Behavior and Attitude-An Empirical Study Based on University Students in Jinan

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***Abstract*—This paper briefly analyses the development and researches of domestic LBS, then put forwards four hypotheses about LBS users' attitude and behavior. We also collected data of university students in Jinan through questionnaires, after analyzing we drew four conclusions: (1) Users who own smart phones tend to get to know LBS; (2) It is easier for LBS users to accept advertisements from merchants; (3) Users have concern about privacy while using LBS, which has nothing to do with gender, but the education background; (4) When it comes to the choice of LBS Apps, gender makes no difference, what really matters is users' education background.**

***Index Terms*— Location Based Services, User Attitude, User Behavior**

I. Introduction

LBS, known as location-based services, refers to the phenomenon that mobile network obtains location information of the mobile terminal users through the specific location techniques, and a value-added service which provides corresponding services to mobile terminal users with the help of the electronic map platform, including positioning and navigation, social sharing, information search, entertainment and other types of services[1]. In November, 2002, China Mobile launched "I am here", "Where are you", "Finding Friends" and other services depending on the brand of "Monternet", setting a precedent for the domestic LBS services. In July, 2003, China Unicom launched LBS-related services relying on the brand of "Star of Locating". Nowadays, with the popularization of 3G network and smart cellphone, especially "DiGu" "JiePang" "Check-In" gradually became the representative of LBS website, the domestic LBS market shows a trend of rapid growth. "2012Q2 quarterly monitoring report on LBS Market of China Mobile Phone"[2], which was released by iiMedia Research Consulting, showed that the number of accumulated users of domestic mobile LBS market reached 217 million, by the end of the second quarter of 2012. Compared with the first quarter, the number had increased by 19.2%. However, in the aspect of the frequency of use, the report also pointed out that 56.3% of users just occasionally used LBS services, and only 3.1% of the users used LBS services more than 10 times a day, which meant that domestic LBS information users had the characteristic of lower frequency of use. As can be seen, the development of LBS is still in an exploratory stage. The user's demand and behavior are cornerstone, regardless of the effective development of LBS marketing and the establishment of business models. However, few domestic studies are involved in analysis of LBS users. Therefore, this paper will conduct a research through LBS users' cognition, attitudes toward information, and services selection.

II. HYPOTHESES

In order to comprehend the LBS information users' attitude and behavior, this paper puts forward 4 hypotheses, and carries out empirical research.

Hypothesis 1: Smart phone users tend to know more about LBS than users without smart phones. Regarding to LBS users' cognition, there is a viewpoint mentioning that "perceived usefulness and the attitude toward using LBS are positively correlated"[3]. According to a survey of Pew Research Center, 74% of the America smart phone users use location-based services[4]. Therefore, for the domestic university students, are there any differences between the smart phone users and users without smart phones in understanding the concept LBS? For this purpose, we raised hypothesis 1 that university students possessing smart phones tend to know more about LBS than students without smart phones.

Hypothesis 2: LBS information users are more willing to accept advertising information pushed by merchants. LBS mobile phone ads have some advantages, such as easy diffusion, strong interaction, and specific target audience[5], by which, a successful business model is shaped[6]. More and more sellers realize tremendous potentiality of LBS-based mobile advertisings, and they actively use the mode of marketing activities. The LBS push services combine online and offline and allow users

to achieve accurate and timely consumptions. Therefore, we raised hypothesis 2 that LBS users are more willing to accept push message, compared with other advertising methods.

Hypothesis 3: Users concern about privacy when they use LBS, and privacy concerns are different in gender and educational levels. Andrey Khurri pointed out that the uncertain factors of further development of LBS are complex, including technology, personal privacy, service demand, user attitude, industrial chain, etc[7]. Among them, privacy brings about serious threat LBS during its development[8], which definitely hinders the users to use LBS. So, what is users' attitude towards privacy issues while using LBS? In fact, since the emergence of LBS, privacy issues have always been the matter that the experts and users care about[9]. Therefore, we assume that users concern about privacy issues when they use LBS, and privacy concerns are different in gender and educational levels.

Hypothesis 4: People of different gender and educational levels have different selections of LBS services. Applications based on LBS include mobile navigation, information search, social sharing, medical aid, etc. Research shows that there are some differences among different respondents when choosing LBS applications. Andrew May found the fact through analysis and research on attitudes and behaviors of three groups of British: "young people", " full-time persons without children" and "full-time person with children" that they have positive attitude towards the LBS application[10]. Therefore, in this paper we proposed hypothesis that there are differences among people of different gender and education levels in selection of different LBS apps.

III. RESEARCH METHODS

This paper adopted the questionnaire investigation method to obtain the original data, and then we used SPSS to analyze. Hypotheses of the research were verified by the chi-square test method.

A. Sample Information

As new-developing application of mobile phone, LBS users are mainly young generation of mobile Internet users. DCCI survey showed that among the mobile Internet users, users of 20-34 years old account for 66.3% and people possessing senior high degree or above account for more than 88.1%[11]. University students are gradually becoming the majority of LBS users, so their attitude and behavior are particularly worthy of being investigated. Therefore, in this paper we chose students from Shandong University, Shandong University of Finance and Economics, Shandong Normal University, Jinan University etc. as the research sample for questionnaire survey.

B. Data Acquisition

In order to have a good knowledge of LBS attitude and behavior of Jinan university student, the research group designed a comprehensive and standardized questionnaire, and distributed them in the university campuses mentioned above between November, 2013 and March, 2014. The other half of the data was collected through online electronic survey.

IV. DATA ANALYSIS

1500 questionnaires were distributed and 1,211 valid questionnaires were collected. The response rate is 81.27%. We can learn from table 1 that among the 1211 interviewees, the number of postgraduates is 411, accounting for 33.86% of the total; the number of undergraduates is 420, accounting for 34.11% of the total; the number of junior college students is 380, accounting for 33.03% of the total. Among them, the number of male is 630, accounting for 52.13% of the total; the number of female is 581, accounting for 47.87%.

TABLE I. THE GENERAL STATUS OF SAMPLE

Items	Category	Quantity	Proportion(%)
Education Background	Postgraduate	411	33.86
	Undergraduate	420	34.11
	Junior College	380	33.03
Gender	Male	630	52.13
	Female	581	47.87

A. Analysis of Respondents' LBS Cognition

Table 2 shows that among the 1211 respondents, 775 of the respondents, accounting for 63.99% of the total, say they have smart phones, and 436 of the respondents say they have no smart phones. 578 students, accounting for 47.73% of the total, have used LBS. 877 respondents, accounting for 72.42% of the total, say they have used or tend to use LBS, and 27.58% of respondents reject to use or are unwilling to accept LBS. Data not only shows that smart phones' penetration is higher in the student groups, but also shows that the proportion of students who are in use or willing to use LBS is high. The results of survey corresponded to the point "university students are becoming the next breaking point of mobile Internet "[12].

TABLE II. COGNITION AND THE USE OF LBS OF THE UNIVERSITY STUDENTS

Items	With Smart Phone	Without Smart Phone	Amount	Proportion(%)
Have Used LBS	578	0	578	47.73
Haven't Used LBS	197	436	633	52.27
Amount	775	436	1211	100
Know LBS	644	113	757	62.51
Don't Know LBS	131	323	454	37.49
Amount	775	436	1211	100

In addition, among the 775 respondents with smart phones, 644 users (83.48% of the total number of respondents) said they knew LBS. Among 436 respondents without no smart phones, 113 users (24.84% of the total number of respondents) said they knew LBS. Overall, 62.51% of respondents said they knew LBS. Data showed that people who have smart phones know more about LBS than those without smart phones, and

the result verifies the hypothesis 1. In order to further verify hypothesis 1, we used the Pearson Chi - Square for testing. Through calculation we got that Pearson Chi–Square is 3.874E2, Asymp.Sig.(2-sided) is 0.000, much less than 0.05. Therefore, hypothesis 1 that users who have smart phones know more about LBS than users without smart phones is established.

B. Analysis of Respondents' attitude toward LBS information push

Table 3 shows that in 1211 respondents, 881 (72.74% of the total number of respondents) university students said that they were willing to use LBS after understanding LBS. Only 330 respondents said that even if they understood LBS, they still refused to use it. Among 775 respondents who have smart phones, 623 respondents, accounting for 80.39%, expressed the willingness to use LBS. Among 436 respondents without smart phones, 258 respondents, accounting for 59.17%, say that they were willing to use LBS after understanding LBS. Thus, it is clear to see the popularity of LBS among university students.

TABLE III. RESPONDENTS' USAGE INTENTION AFTER UNDERSTANDING LBS

Items	Will use	Won't use	Amount
With Smart Phone	623	152	775
Without Smart Phone	258	178	436
Amount	881	330	1211

Whether the users are willing to accept the LBS push information is one of the key factors influencing the participation rate of LBS activity and the quality of service. In 881 respondents (Table 4) who have expressed that they were willing to use LBS after understanding LBS, only 136 respondents, (15.43% of the total), were not willing to accept LBS push information, and nearly 85% of the respondents are willing to accept LBS push information. That is to say, information users are willing to accept the push information. In addition, the survey also finds that in 881 respondents, 451 respondents (51.19% of the total) expressed their willingness to accept advertising information, and this also shows that, to some extent, interactive advertisement of mobile phone based on LBS has great market potential. Therefore, hypothesis 2 that the LBS information users are willing to accept push information is established.

TABLE IV. RESPONDENTS' INTENTIONS TO ACCEPT LBS PUSH INFORMATION

Willingness	Frequency	Proportion(%)
Not at all	35	3.97
Not	101	11.46
Neutral	451	51.19
Will do	247	28.04
Would love to	47	5.33
Amount	881	100

C. Analysis of Respondents' LBS privacy concern

In the process of using LBS, users' attention to privacy is one of the key factors to affect users' acceptance of the LBS. Table 5 shows that, among the 881 users who were willing to use LBS, 382 respondents (43.36% of the total number) said they were worried or very worried about privacy issues, 35.75% of the respondents said they were neutral, and only 30 respondents (3.41% of the total number of respondents) said they did not have any concerns. That is to say, the majority of respondents expressed their concerns over privacy issues in the process of using LBS. If it is easy to disclose users' privacy, the users would not accept LBS. Therefore, merchants need to protect the consumers' privacy to make LBS develop smoothly.

TABLE V. PRIVACY CONCERNS OF RESPONDENTS WHEN THEY USE LBS

Degree of concern	Frequency	Proportion(100%)
Seriously	84	9.53
Fairly	298	33.83
Neutral	315	35.75
Not worried	154	17.48
Not at all	30	3.41
Amount	881	100

Whether there are differences in LBS privacy concerns in gender and education background is the focus of attention. It can be found from the analysis of data in table 6, among 464 male respondents, only 16 respondents (3.44% of the total number of respondents) said they were not worried about privacy issues at all. Among 417 female respondents, only 14 women (3.36% of the total number of respondents) said they didn't worry about privacy issues. Through Pearson chi-square, we got that Pearson Chi–Square is 4.511, Asymp.Sig.(2-sided) is 0.341, greater than 0.05. Therefore, although most users worry about privacy, gender makes no difference.

TABLE VI. CONCERNS OF USERS OF DIFFERENT GENDER ON PRIVACY WHEN USING LBS

Degree of concern	Male	Proportion(%)	Female	Proportion(%)	Amount
Seriously	38	8.19	46	11.03	84
Fairly	155	33.41	143	34.29	298
Neutral	164	35.34	151	36.21	315
Not worried	91	19.61	63	15.11	154
Not at all	16	3.44	14	3.36	30
Amount	464	100	417	100	881

In addition, It can be found from the analysis of data in table 7, among the junior college students, undergraduates and graduate students, there were merely 4, 8 and 18 of respondents said that when they use LBS, they were not worried about privacy issues at all. Through calculation, Pearson chi square is 43.748, Asymp.Sig.(2-sided) is 0.000, much less than 0.05. Therefore, it is considered that there are some differences in privacy issues among people of different education background. Compared with the expected frequency, it can be found that junior college students and undergraduates are more concerned about privacy, and are more worried about the fact that the use of LBS will

disclose their privacy. Most of the postgraduates have no concern for privacy disclosure, and they would like to share their location in social network.

The above analysis shows that although the majority of respondents worried about privacy which seriously hinders LBS propulsion, there is no difference in privacy concerns in terms of gender, and there are some differences among people in different education background. The junior college students and undergraduates are concerned about privacy issues, while there is no postgraduate concerned about them.

TABLE VII. PRIVACY CONCERNS OF RESPONDENTS IN DIFFERENT EDUCATION BACKGROUND WHEN USING LBS.

Degree of concern	Frequency	Expected Frequency	Junior College		Undergraduate		Postgraduate		Amount (Frequency)	Amount (Expected)
Seriously	Frequency		40		27		17		84	
		Expected		27.2		29.1		27.7		84
Fairly	Frequency		105		123		70		298	
		Expected		96.4		103.2		98.4		298
Neutral	Frequency		92		102		121		315	
		Expected		101.9		109.1		104		315
Not worried	Frequency		44		45		65		154	
		Expected		49.8		53.3		50.9		154
Not at all	Frequency		4		8		18		30	
		Expected		9.7		10.4		9.9		30
Amount	Frequency		285		305		291		881	
		Expected		285		305		291		881

D. Analysis of respondents' Selection of LBS applications

The LBS application can be roughly divided into positioning and navigation, information search, social sharing, and entertainment. Table 8 shows that positioning and navigation, social sharing and information search rank top three. Respectively 39.19%, 28.99% and 23.04% of the respondents were willing to use the service, while only 8.79% of respondents expressed willingness to use entertainment service. Data from EnfoDesk also shows that in 2011 the total account number of China Mobile LBS Market were up to 30.62 million, and the current development momentum of "LBS + SNS "model is prosperous[13]. In order to further analyze the relationship between gender and selection of different services of respondents, we got expected frequency and Pearson's Chi-squared of gender and LBS selection through calculation, $x2=5.81$ ($x2=7.81$, $p=0.05$), so the respondents of different gender have no difference in their selection of LBS.

TABLE VIII. RESPONDENTS' LBS SELECTION OF DIFFERENT GENDER

Service	Frequency	Expected Frequency	Male		Female		Amount (Frequency)	Amount (Expected)
Positioning Navigation	Frequency		351		309		660	
		Expected		329.61		330.39		660
Social Sharing	Frequency		240		248		488	
		Expected		243.71		244.29		488
Information Search	Frequency		177		211		388	
		Expected		193.77		194.23		388
Entertainment	Frequency		73		75		148	
		Expected		73.91		74.09		148
Amount	Frequency		841		843		1684	
		Expected		841		843		1684

At the point of the impact of respondents' education background on LBS application selection, the data in Table 9 shows that respondents of different education background have different preferred service types. Among the junior college students and undergraduates, respondents preferred positioning and navigation services, and among the postgraduates, respondents preferred social sharing service. We got expected frequency and Pearson's Chi-squared through calculation, $x2=52.69$ ($x2=12.59$, $p=0.05$), the above result that respondents of the different education background will select different LBS applications can also be verified.

TABLE IX. RESPONDENTS' SELECTION OF LBS APPS OF DIFFERENT EDUCATION BACKGROUND

Service	Frequency	Expected Frequency	Junior College		Undergraduate	
Positioning Navigation	Frequency		219		237	
		Expected		174.01		233.98
Social Sharing	Frequency		95		167	
		Expected		128.67		173.00
Information Search	Frequency		78		151	
		Expected		102.30		137.55
Entertainment	Frequency		52		42	
		Expected		39.02		52.48
Amount	Frequency		444		597	

		Expected		444		597

V. CONCLUSION

In the aspects of LBS users' cognition, 61.85% of respondents said they had already known LBS, and 47.66% of them had begun to use. Among them, people who possess smart phones tend to know LBS, compared with those without smart phones. Although university students have understood LBS, mobile applications are newborn things, in order to further expand its user group, merchants should strengthen LBS propaganda, and let more consumers understand LBS.

In the aspects of users' attitude toward acceptance of LBS push information, 72.27% of the 881 respondents said that they were willing to use LBS after understanding LBS. 79.06% of the owners of smart phones were willing to use LBS, and 59.86% of the users without smart phones said that that they were willing to use LBS after understanding LBS. Compared with other advertisement, the advantages of LBS advertising information push service are timeliness and interaction, and nearly 85% of the respondents were willing to accept LBS business advertising push information.

In the aspects of respondents' privacy concerns, 43.36% of respondents were worried or very worried about privacy disclosure, and 35.75% of respondents kept neutral. We can see that privacy issues based on the propulsion of LBS applications are important hidden peril. In addition, privacy concerns have nothing to do with respondents' gender, but they are associated with their education background. Junior university students and undergraduates worry more about LBS privacy issues, while the postgraduates are willing to share their location information.

In the aspects of the LBS applications' selection, respondents in general will choose in such order: location and navigation, social sharing, information search and entertainment. The selection of applications have nothing to do with respondents' gender, but it is associated with educational background. University students and undergraduates prefer positioning and navigation services, while postgraduates prefer social sharing service.

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Design and Research of Independent Colleges charging management system

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***Abstract*—The Independent Institute is a new sponsoring entity, mainly relying on the resources of the parent institutions to carry out all kinds of teaching affairs, however, the charging mode of independent colleges is different from private universities but also from public universities. For this reason,an charging management system was developed for independent college, designed the datebase specifically for the unique patterns and local financial charges, PHP&MySQL technology was used to achieve the overall process of independent college charging and networked printing bills was achieved.This charging management system can effectively merge with the digital campus platform of parent institution and local financial systems. System test run achieved good results. Provide a reference for the development of related systems.**

***Index Terms*—Independent Institute, charging management system, php&mysql, software testing**

I. INTRODUCTION

Charges management is an important part of the daily management of the Independent Institute, it plays an important role for development of independent institute. However,a separate charge will become the inevitable trend of development of Independent Colleges, but there is not a charge fees system developed specifically for independent colleges in the market. With the continuous expansion of the scale of the independent college students, the original charging methods can not meet the needs of current development of Independent Colleges,The problems of a large amount of charge and accounting complexity have become increasingly prominent. How to improve the Independent Institute of charging mode and achieve standardization and systematic has become an important research topic.

II. THE STATUS QUO OF INDEPENDENT COLLEGE

A. charging obsolete

With the popularization of higher education,there are more people can be accepted in higher education. Independent College school size has gradually expanded. Scale collection of tuition fees are increasing, the original artificial charges and print invoices and billing have been unable to meet the needs of the work of the independent college charging, which restricts the development of the college.

B. charging process is complex

Independent Institute has its particularity, tuition is the main source of income in accordance with relevant national policies. In the process of charging fees category includes tuition, fees, accommodation, course materials, collecting 4-6 examination fees and so on. According to the different professional and different school years, the charges have different standards. In addition to the daily routine operation charges query statistics, we should also deal with the students drop out, back to school, people Ng, deferment, withdrawal and other issues. Invoices must be docked with the printing system of the department of finance. The current charges system can not be combined with the actual management software.

C. sharing difficult of charging data

Independent work is mainly carried out by the Institute of charge finance department, while student management, tuition calls, the changes of student information and other work are mainly done by management department of the students, whether the charge of the tuition can be carried out accurately, standardly is closely related to the timely and accurate sharing of the data of two departments. However, currently, there is no suitable independent colleges actual tuition system, resulting in the changes of the student record information can not be synchronous to the financial sector, which led to receive little or leakage problems of student tuition and other malicious arrears.

III. THE ANALYSIS OF CHARGING MANAGEMENT SYSTEM REQUIREMENTS

A. The goals of the system performance

Practicality: The development of charging system developed is closely related to the actual needs of

independent colleges charge management, and fully utilize powerful computer processing capacity and the network environment of school campus . Under linux server cluster environment, build php+mysql development environment and complete the development of charge management system.

The reliability and safety: Charging system running on a linux server cluster, built eart beat detection system in the system,to ensure the reliabilityof system operation.System development processto achieve timelybackup and restoreof the databaseas well asthe dangerto the operatorasked to confirmthe operationusingthe mechanismto ensure thesecurity of data.

Confidentiality: Data systems includes schools enrollment plan, fees, students basic information and other important information that relates to the college secrets and personal privacy, confidentiality of data should be improved. Make full use of the database design system blockade mechanism, authorization management mechanism in the software design and the use of multi-level passwords and sub-rights management and other measures to ensure the confidentiality of the system.Standard

B. System business Analysis

The business requirements is described by independent colleges charge system , students advance to import basic information , the students just before the toll terminal brush their student card or ID card, the system will automatically generate receivables items and their total payment amount , for full paying students directly CUP card payment fees clicks on the successful confirmation is automatically generated payment number and payment information credentials , according to the credentials students can print the invoice charges . For some students need to pay toll charges to modify the amount and credit card charges, confirm payment information, generate and print invoices credentials entire business process shown in Figure 1 . Students can also pay online[1] , the students use their student number and password charging system , you can view all the relevant invoice payment records and information , system will automatically accounts payable amount of student tuition fees , students can full the amount of the payment . Students can also enter your own amount of this payment and confirm the payment , payment orders generated , students can simply install online banking online payment business process shown in Figure 2.

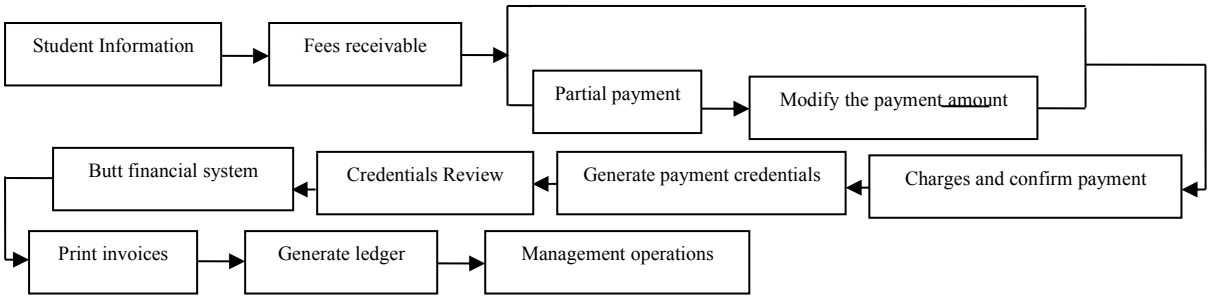

Figure 1. payment system overall business processes

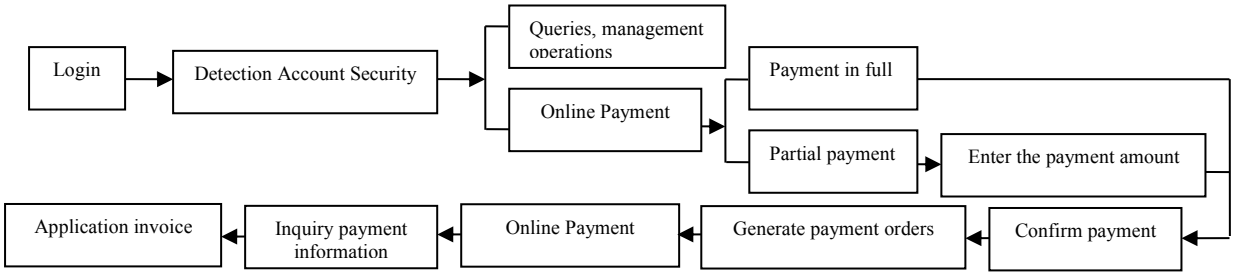

Figure 2. Online payment business processes

C. Analysis of system users

System users are managed by sub-rights, assign different permissions for different users, the user defines the same permissions to the same role, the system administrator define the user's permissions and roles, modify and delete operations[1]. Users are devided into , auditors, invoice printing, system administrator, the finance department managers, database administrators and so on. The role of logining system user's is different, with a corresponding system operating authority.

IV. THE DESIGN OF CHARGING MANAGEMENT SYSTEM

A. System Design

The overall design of the system include system hardware and software design, hardware environments mainly include the network and server. Software is the operating system environment and the software operating environment. Independent colleges charging management system run on the server using an IBM server cluster. Using linux operating system and php&mysql development environment. In the development process of the system,we adequately consider the safety of the system, using the MD5 encryption technology to encrypt the user's password. Ensure the safe and efficient operation of toll systems,

and the use of free open-source environment to save development costs.

B. System function design

Based on the needs analysis of charging management system, the system is a detailed functional module division[9], the main modules include: basic information management, charge management, invoice information, customer information management, statistical inquiry fee information management, data import and export management, report management, database management, system management, tuition deferment management. Functional block diagram of the overall system were shown in Figure 3.

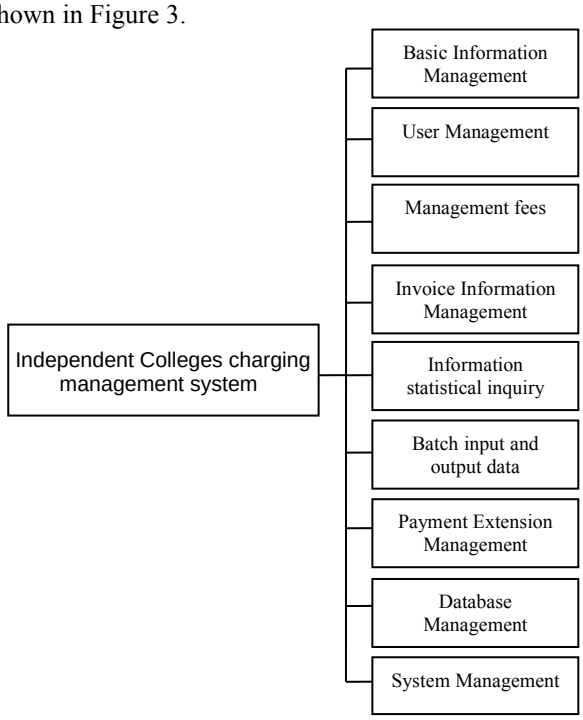

Figure 3. Functional block diagram of the overall system

V. ACHIEVE THE CHARGING SYSTEM

On the basis of needs analysis and design, the system implementation process was achieved by mysql database and php development scripting language. In the implementation process, the security of the system and the system development cost, practicality, advanced, reliability targets were fully taked into account[3]. Development process focused on the reasonableness of rows of data confidentiality, user permissions, role definition, as far as possible in order to improve the efficiency of code optimization code[5]. Database design was met the third paradigm, based on the data sheet was further optimized to ensure data integrity-based, more convenient operation more efficient query execution.

VI SYSTEM TEST

Software testing is the primary means of software quality assurance , it is the final review of software specification , design and coding. It is a key step in software quality assurance. In the software development process, there will be many more complex problems , programmers can not fully comply with the subjective understanding of objective reality . Software developers can not be perfect . To solve these problems and prevent an error in the software life cycle , test is necessary. In the development process of the charging system on the modules were tested. The overall test for toll collection system includes the functional and performance testing.

A. Functional test

Functional test is based on needs analysis and the black box testing method was used. System does not appear functional errors or omissions , interface errors, data structures or external database access errors , performance errors, initialization and termination errors and other problems. System through functional testing.

B. Performance test

Performance test include the response time of the system, the load capacity of the system , concurrent performance and so on [5]. This system was tested via the students of different size, and the corresponding number of concurrent requests, specific data shown in Table I .

TABLE I. STUDENTS OF DIFFERENT SCALE AND THE EXPECTED NUMBER OF CONCURRENT REQUESTS EXPECTED

The number of students	The expected number of concurrent	Expected number of requests
Less than 200	100	2000
2000~3000	200	5000
3000~5000	500	5000
5000~8000	800	5000
Greater than 8000	1000	5000

Use the AB (ApacheBench) tools in Testing process, AB is a performance testing tool of Hypertext Transfer Protocol, primarily to test the current implementation capacity apache.

Simulate multi-threaded concurrent requests by AB tools, mainly testing the pressure of server. System testing is based on a stand-alone server and cluster servers, test specific data in Table II, Table III.

TABLE II. THE CONCURRENT RUNNING THE TEST RESULTS AND DIFFERENT REQUESTS ON THE A SINGLE SERVER

Test Command	Concurrency Level	Time taken for tests	Complete requests	Failed requests	Write errors	Total transferred	HTML transferred	Requests per second	Time per request	Time per request	Transfer rate
./ab -c 1000 -n 100 http://192.168.0.249/index.php	100	0.573741 seconds	2000	0	0	276925 bytes	14098 bytes	1742.95 [#/sec] (mean)	57.374 [ms] (mean)	0.574 [ms]	470.60 [Kbytes/sec]

./ab -c 5000 -n 200 http://192.168.0.249/index.php	200	10.5496 seconds	5000	0	0	1375021 bytes	70014 bytes	499.73 [#/sec] (mean)	400.220 [ms] (mean)	2.001 [ms]	134.13 [Kbytes/sec]
./ab -c 5000 -n 500 http://192.168.0.249/index.php	500	/	5000	/	/	/	/	/	/	/	/
./ab -c 5000 -n 1000 http://192.168.0.249/index.php	1000	/	5000	/	/	/	/	/	/	/	/

TABLE III. THE CONCURRENT RUNNING THE TEST RESULTS AND DIFFERENT REQUESTS ON THE CLUSTER SERVER

Test Command	Concurrency Level	Time taken for tests	Complete requests	Failed requests	Write errors	Total transferred	HTML transferred	Requests per second	Time per request	Time per request	Transfer rate
./ab -c 3000 -n 500 http://192.168.0.249/index.php	500	3.480663 seconds	3000	0	0	834323 bytes	42014 bytes	861.90 [#/sec] (mean)	580.111 [ms] (mean)	1.160 [ms]	233.86 [Kbytes/sec]
./ab -c 5000 -n 500 http://192.168.0.249/index.php	500	6.739712 seconds	5000	0	0	1390137 bytes	70014 bytes	741.87 [#/sec] (mean)	673.971 [ms] (mean)	1.348 [ms]	201.34 [Kbytes/sec]
./ab -c 5000 -n 800 http://192.168.0.249/index.php	800	18.589927 seconds	5000	0	0	1391184 bytes	70056 bytes	268.96 [#/sec] (mean)	2974.388 [ms] (mean)	3.718 [ms]	73.05 [Kbytes/sec]
./ab -c 5000 -n 1000 http://192.168.0.249/index.php	1000	23.19091 seconds	5000	1	0	1390169 bytes	70448 bytes	217.21 [#/sec] (mean)	4603.818 [ms]	4.604 [ms]	58.95 [Kbytes/sec]

Through the above Table 1, Table 2, the test data can be seen on a single server test site, the number of concurrent 200, all requests changed when the data is volatile 5000. When the number of concurrent greater than 500, the number of requests is greater than the entire 5000, began in response to overload. But on the cluster server, concurrent to 1000, all requests greater than 5000, the site also ran stablely, the test results meet the needs of independent colleges charging system.

VII. SUMMARY

For the independent status of the charging, analyzed the independent colleges charge process, using the existing network and hardware environment, developed the system depending on linux server cluster systems and php&mysql environment, through the function testing, system on-line operation is safe, stable and reliable. The independent college charging of standardized, systematic, network problems was solved

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Filling Mining's Influence on Stope's Stress Distribution

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Abstract—Similarities and differences of filling mining and stress distribution of traditional mining was elaborated based on Caozhuang Coal Mine 81006 filling face. Filling rate and the influence of strength of filling body on stress distribution of stope was studied with FLAC3d numerical simulation software, results showed that the plastic zone of abutment pressure would diminish with filling rate increased, when filling rate comes to a certain value the plastic zone of abutment pressure would disappear; the peak value of abutment pressure would first increase and then decrease with filling rate increased; the peak value and scope of abutment pressure would decrease with filling rate increased. The greater was the strength of filling body, the greater was the vertical stress of filling body and the faster vertical stress rose.

***Index Terms*—filling mining, stress distribution, filling rate, strength**

I. INTRODUCTION

Recognizing strata movement and stress distribution was the key to controlling major accidents of coal mine and the center of strata control theory[1]. In recent years, it has made significant progress on research of strata movement law and stress distribution law of the traditional stope, and we have already had deeper understanding to it[2]-[5]. But for the overlying strata movement and stress distribution law of filling mining stope was not yet clear. As filling mining could maximum limit recovery difficult mining coal seams under the conditions of various complicated engineering geology, could effectively inhibit the strata movement, could control the occurrence of dynamic pressure impact, could protect the surface environment, could handle large amounts of solid waste, the application scope of filling mining in the mine expanded unceasingly. In recent years, researchers focused on the application of filling mining methods and the filling process[3-4], but the stress transfer law of filling stope lacked depth and meticulous research. Literature [6] made some description on pressure distribution of the front and the rear of the paste filling working face, but the influence of filling parameters on stress distribution was lack of in-depth research. Based on the above facts, this article has studied the abutment pressure distribution law of filling mining and the stress distribution law of filling body in the goaf, also has analysed changes of the stress with the filling rate and changes in the strength of filling body, and the conclusion can provide the basis for revealing the strata movement law of filling mining and for evaluating filling effect..

II PROJECT EXAMPLES OF FILLING STOPE STRESS DISTRIBUTION

A. Engineering overview

The working seam of Caozhuang Coal Mine 81006 face was 8# coal seam which was 2m thickness on average, 550m depth, 12 ~ 29 °angle. The roof of 8#coal seam was NO.4 lime, 5.3m thickness, and the bottom was fine sandstone, 4.78m thickness. In order to prevent the ledger wall flooding and control the surface settlement, the face was filled with paste-like backfilling material which was designed 3MPa for the single item compressive strength. The working face was divided into I, II, III, IV, four inclined upward short wall mining working faces and filled from the inside to the outside in turn, in which the length of I,II,III sector working face respectively was 92m,88m,81m. Working face arrangement is shown in Figure 1.

B. Vertical stress monitoring of filling body

In order to monitor stress distribution of filling mining and traditional mining in the goaf, we installed Model GYD60 mine-used intrinsically safe stress sensors and the vertical stress curve of goaf which was drew based on results of monitoring is shown in Figure 2.

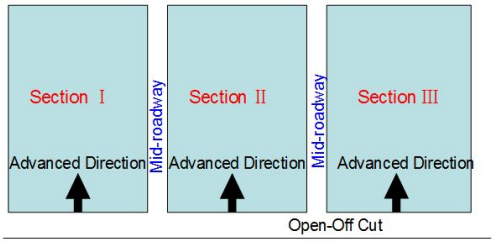

Figure 1. Working face arrangement diagram

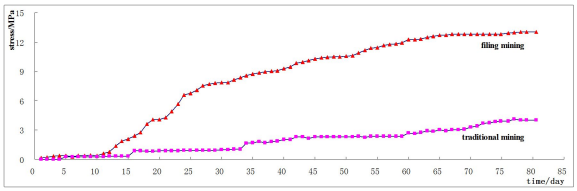

Figure 2. Stress detector monitoring curve

It could be seen from Figure 2 that the vertical stress ascension speed of filling body was obviously higher than traditional mining's, eventually the vertical stress of filling body was 13.01Mpa which was equal to the original stress (γH = 13.75Mpa) fundamentally, and filling body supported the main weight of overlying strata. Under the traditional mining condition, the vertical stress of goaf rose slowly, rising about to 4MPa 80 days after the working face having been pushed out, and the abutment effect of goaf on overlying strata was much smaller than filling body's. It could be expected that the weight of overlying strata was mainly supported by coal body around the stope, forming huge abutment pressure.

C. Lead abutment pressure monitoring of working face

In order to monitor the lead abutment pressure of working face, GYY15Z mine-used drilling vector stress sensors had been installed in 81006 working face and 8# coal traditional working face and the stress monitoring curve is shown in Figure 3.

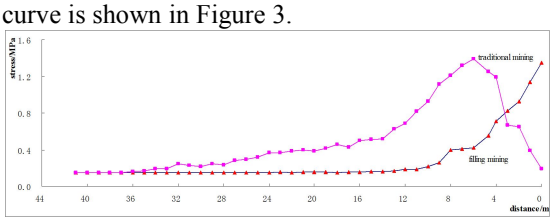

Figure 3. Sensor monitoring curve

As could be seen from Figure 3, the influence scope of lead abutment pressure of filling mining was about 10m, and there was no plastic zone existing, and the stress distribution in front of the coal wall was a monotonous decline curve whose peak value was at the coal wall, and the peak value of pressure was at the edge of the coal seam, and the coal body was at the elastic compression condition. Under traditional mining condition, the scope of abutment pressure was 30m, divided into the elastic zone and the plastic zone, in which the scope of plastic zone was 7m. The distribution of abutment pressure between filling mining and traditional mining was very different and by filling mining you could improve the stress distribution of the coal body in front of the working face.

III. THE INFLUENCE OF FILLING PARAMETERS ON THE STRESS DISTRIBUTION OF STOPE

Case of Caozhuang Coal Mine showed that the stress distribution of filling stope was very different from traditional stope and the reason was that the filling body had an impact on the transfer law of mine ground pressure. Under the condition of filling mining, the filling body was filled into the goaf in time at the rear of the mining face, instead of the coal mined, and to a large extent supported the weight of the overlying strata, weakening mine ground pressure to pass around the stope. The stress distribution law of filling stope was associated with mining conditions and filling parameters, so it was necessary to further study changing law of stress distribution along with the change of filling parameters.

The stress distribution law of the 81006 filling working face sector I was simulated with FLAC3D based on the value. The relation of the stress distribution of filling stope along with the filling parameters was analysed. The model was 200m long, the length of the working face was 90m, the advancing length was 100m, and the mined coal was 2m thickness. In the computation the constitutive relation of the material was based on Mohr-Coulomb model, the mechanics parameters are shown in Table 1.

TABLE I. THE MECHANICAL PARAMETERS OF STRATA

Strata number	Bulk modulus (Gpa)	Shear modulus (GPa)	Density (kg/m^3)	Friction angle (^{0})	Agglutinating power (Mpa)	Tensile strength (Mpa)
epipedon	12.0	6.5	2.000	22	0.8	0.7
Main roof	15.6	10.8	2.300	32	34.7	1.91
Immediate roof	22.6	11.9	2.090	42	6.72	1.56
Coal seam	2.36	7.3	1.370	31	1.0	0.4
Direct floor	22	20	2.500	37	42	9.07
Hard floor	15.6	10.8	2300	30	34.7	2.21
Filling body 1MPa	5	2.5	2.000	22	0.8	0.1
Filling body 2MPa	4.5	3	2.000	22	0.8	0.2
Filling body 3MPa	4	3.5	2.000	22	0.8	0.3
Filling body 4MPa	3.8	4	2.000	22	0.8	0.4

A. The influence of filling rate on the distribution of abutment pressure

The strength of the filling body used in the simulation was 3MPa, the simulation method: the working face advance began from x=40m, filling the goaf when 10m was the working face advanced and the filling distance was 5m, then the goaf filling 5m following the working face advancing 5m. The vertical stress point which was tracked was located at the point of 100m from the open-off cut, the middle position of the coal body. The distribution law of abutment pressure of stope was studied when the filling rates were respectively 0%, 30%, 50%, 80%, 90%, the results are shown in Figure 4.

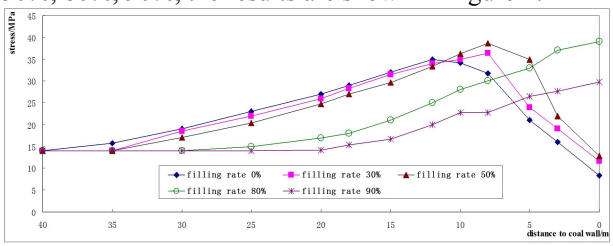

Figure 4. The change of abutment pressure with filling rate curve

The distribution of abutment pressure with different filling rates could be seen from figure 4: (1) the plastic zone existed when filling rates were respectively 0%, 30%, 50%, the width of plastic zone was about 12m, 8m, 6m, and the plastic zone would disappear when filling rates were 80%, 90%. The abutment pressure of plastic zone gradually reduced with the filling rate increased, eventually reducing to 0.(2) the plastic zone existed when filling rates were respectively 0%,30%, 50%,the peak values of abutment pressure were respectively 35MPa,36.4MPa,38.7Mpa, as the filling rate increased with a decreasing trend; for the coal body in the plastic zone, higher were the filling rates, higher were the values of vertical stress; but for the coal body in the elastic zone, higher were the filling rates, smaller were the values of vertical stress.(3)when the filling rates were 80%,90%,there was no plastic zone and the peak values of abutment pressure were respectively 39MPa 、30.4MPa, the peak values and scope of abutment pressure decreased with filling rate increased.(4) Within a certain scope, the peak value of abutment pressure increased with the filling rate increased; the peak value of abutment pressure decreased with the filling rate increased when it exceeded a critical value and the specific critical value was still need to be studied.

B. The influence of strength of filling body on the stress distribution of stope

(1) the abutment pressure

In the actual production process, filling always lagged of working face at a distance and from finishing filling to playing the supporting role a certain amount of time was required[7-10]. Therefore, when the excavation length of model was 10m during the simulation process, filling couldn't be taken timely, as soon as the model calculations came to balance, namely the surface no longer transformed. The simulation of next filling drawing pace was proceeded when the model calculations came to balance after filling ,so repeated cycle, and the full extraction achieved when the cumulative width of filling mining got up to 90 m.

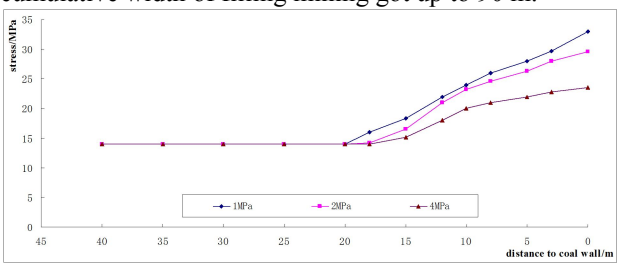

Figure 5. The change of abutment pressure with the strength of filling body

The change of advanced abutment pressure with the change of the strength of filling body was reflected in Figure 5.It showed that: In case of roof-contacted filling, there was no plastic zone with abutment pressure when the strength of filling body was 1MPa, 2MPa, 4MPa,the coal body in front of the working face remained elastic stress state, the peak values of abutment pressure were respectively 33MPa, 29.6 MPa, 23.5MPa, the curve of abutment pressure declined monotonically whose peak value was on the coal wall. The peak value and scope of abutment pressure raised with the strength of filling body decreased, the higher was the strength of filling body, the smaller were the peak value and scope of abutment pressure.

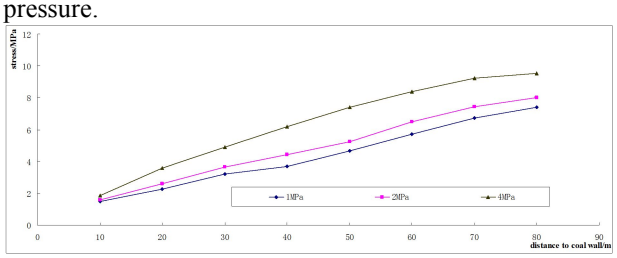

Figure 6. Stress change in filling body with strength

(2) The stress of filling body

Figure 6 reflected the change law of vertical stress of filling body along with the change of strength of filling body, it showed that: The vertical stress within filling body was a monotonous rising curve, and it rose gradually with the working face mined. The farther was the distance from the coal wall of the working face, the bigger was the vertical stress, the bigger was the abutment effect to the overlying strata,. In the same place, the bigger was the strength of filling body, the bigger was the vertical stress of filling body and the faster did the vertical stress rose[11-12].

Improving stress distribution and reducing stress concentration was an effective way for controlling dynamical disaster in coal mine, from the above analysis we know that filling mining can affect stress transfer law of stope and avoid the stress concentrating excessively.

The stress distribution of filling stope is closely related to filling parameters. It can both meet the requirements of strata controlling and save the cost of filling, by studying the relation between the stress

distribution of working face and the filling parameters and adjusting the corresponding filling parameters according to the practical strata controlling of working face.

IV CONCLUSIONS

(1) Filling mining can affect stress transfer laws and improve the stress distribution of stope. The stress distributions of filling mining stope and traditional mining stope are radically different.

(2) The plastic zone of abutment pressure decreases with filling rate increasing and when filling rate comes to a certain value the plastic zone of abutment pressure would disappear; the peak value of abutment pressure would first increase and then decrease with filling rate increase and its critical value is still to be studied.

(3) The peak value and scope of abutment pressure would decrease with the strength of filling body increase; In the same place, the bigger is the strength of filling body, the bigger is the vertical stress of filling body and the faster does the vertical stress rise.

ACKNOWLEDGEMENTS

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Analysis of Non-standard Firearm's Lethality: Numerical Simulation and Experiment

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***Abstract*— The method of numerical simulation has been widely accepted by forensic examiners,especially in Forensic pathology.The numerical simulation program ANSYS simulates the antipersonnel process of the sphere projectiles which are shot by firearm and uses the water by ANSYS to acquire the velocity attenuation curve, displacement curve, reduction of the total energy and the instantaneous cavity. Through comparing with the experiment results, the design of numerical model is improved and errors are reduced. After analyzed results of numerical simulation, it could be concluded that the lethality of non-standard firearm is huge and the instantaneous cavity is the significant factor to cause the tissue trauma and it should be the important reference factor in the examination of firearm's lethality.**

***Index Terms*—numerical, simulation, ANSYS ,non-standard ,firearm, lethality**

I. INTRODUCTION

Non-standard firearms are mostly used gunpowder or compressed gas for energy, and shot spherical metal projectiles.These firearms are always manufactured by non-regular manufacturers or by the suspects through self-control and used for criminal activities. The speed of projectile is usually a few hundred meters per second, not only takes away the consciousness and the ability to resist of the victim but also his life. In the antipersonnel process of the sphere projectiles which are shot by firearm, how to achieve the lethal effect, how to prevent the damage caused by this effect, has been a concern issue in the field of wound ballistics.

High-speed projectile and target interaction is transient, large deformation and strong nonlinear coupling phenomena， then the killing effect manifested as " bludgeoning effect", "penetration effect", "pressure wave effect", "cavity effect" forms, is a composite effect of a complex multi-physics phenomena. In the wound ballistics studies, the simple geometry of spherical projectiles, strong penetration capability, is widely used as the objects, while more than 80% of human tissue is water[1], so water is often used as a substitute for human soft tissue. Over the years, the experimental model of human penetrating trajectory is often composed by these two components.

With the extensive application of finite element simulation technology research, the LS-DYNA simulation program as the representative of the finite element analysis software was more and more used in nonlinear dynamic high-speed collisions, explosions and other impact problems. This paper carries a numerical simulation for the lethality of non-standard firearms. The software will be used to analyze related laws of the spherical projectiles fired non-standard firearms in the water intrusion processes, for the analysis of firearms lethality, and develop scientific lethality standards, standardize the management of non-lethal weapons police use, to explore a suitable numerical simulation model and calculation method of spherical projectiles, provide a reference for the establishment of an non-standard firearms lethality evaluation system.

II. NON-STANDARD BULLETS LETHAL EFFECT

High speed warhead launched into life targets can produce four different forms of function, so that the target would loss life or fighting capacity. Lethal effect principles are: liquid dynamic function, stop function and instantaneous cavity effect[2].

A. Liquid dynamic function

When the high-speed bullet enters the more concentrated parts of the fluid, the sharp increase in the density of the medium, the resistance of the warhead forward suddenly increased, the warhead would pass the energy to the liquid, due to the incompressibility of the liquid, the impact pressure energy spreads around with an enormous pressure,thereby destroys the organization of the site.Generally believed that the rate of the warhead generates hydrodynamic effects should be not less than 600-700m/s.

B. Stop function

Stop function refers to the ability that the bullet hit the enemy and make the enemy lose the fighting ability, the size of the stop function, depending the time the enemy lose the fighting ability after hitting, the shorter the time,

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the greater the power. Stop function is connected with the lateral warheads function, generally considered the larger diameter, the greater stopping power, so non-standard firearms wherever possible to use larger caliber. For the evaluation criteria of lethal effect, it is generally based on measuring the warheads loss energy after hitting.

C. Instantaneous cavity effect

The instantaneous cavity, a physical phenomenon, refers to a high-speed projectile penetrating biological tissue, brings a quickly change, is an important cause of severe trauma tissues and organs, the instantaneous cavity theory is the basis of the mechanism of wound ballistics injury. High-speed projectile penetrating into the aqueous medium process can be divided into four stages, the impact of the water, open cavity, the cavity is closed and the cavity pulsation disappeared.

Firstly, the projectile hit the water in a very short time, the formation of a high amplitude shock wave, in the form of spherical pressure wave propagation to the surrounding; its duration is very short.

Secondly, once the hitting water phase is completed, due to the radial expansion of water particles generated a conical cavity. The picture shows, the velocity of the cavity, is about 1/10 of the ball moving. The maximum displacement of the water cavity is directly proportional to the kinetic energy of the ball into the water. An inertia expansion of the cavity decreases the internal pressure, when the internal pressure is below atmospheric pressure, the formation of the outside air flow into the cavity, the cavity is open to the atmosphere, and then the cavity becomes an open stage.

Thirdly, with the increase distance of projectile penetrating into the water, the volume of the cavity is increasing and the cavity pressure difference between inside and outside is continuous decreasing and the radial velocity of the cavity wall decreases. At the opening of the cavity, water particles on the air - water boundary surface appear reverse speed and converge to the axis, closed cavity began. When the cavity is isolated from the atmosphere by the water layer, it forms a closed cavity.

Fourthly, since the cavity is closed, air inflation to the cavity stopped, the cavity pressure is not directly affected by the atmosphere, and after the cavity is closed by the action of hydrostatic pressure, which tends to a spherical shape; as the reduced volume of the cavity the pressure decreases and shrinkage occurs; Since the cavity is closed, the gas pressure within the cavity will be reduced because of the increasing volume of the cavity when the cavity pressure is greater than ambient pressure, the occurrence of cavities expansion, and so forth to form a cavity pulsation; after 7-8 times, it disappeared.

III.PRE-TREATMENT OF THE PROJECTILE PENETRATING INTO THE WATER

High speed spherical projectile into the water is a highly nonlinear coupling phenomena, in the research process, the domestic and foreign scholars use coupling algorithm fully considered inertial effects and other coupled effects in the impact process, and also to simulate the whole the impact process more accurately[3].

A. Finite element model

Spherical projectile calculation model is formed as follow.Spherical projectile diameter is 9mm, grid using Lagrange algorithm. Since the projectile is relatively stiff, deformation in the course of penetration is small, no quality loss, in this paper, the projectile is made of pure lead, a rigid material model, and the density is 11.34g /cm3, elastic modulus 14GPa, Poisson's ratio of 0.42[4]. Suitable for high-speed flow coupling, and considering the high speed of the strain, strain rate and temperature effects, select the JOHNSON COOK material model for the lead shot. And Grüneisen equation of state was used.

Air and water calculation model is shown in Figure1.In the initial time projectile located in the air, the outer boundary of air and water using a non-reflective boundary conditions, the contact surface of air and water is co-node, grid structure using ALE multi-material algorithm, the warhead and water using flow structure coupling algorithm. Water and air material model are MAT_NULL empty models provided by LS-DYNA. And Grüneisen equation of state was also used.

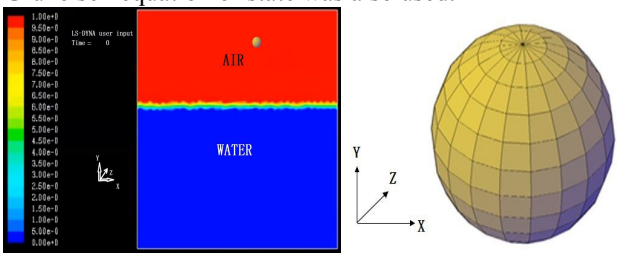

Figure 1. Finite model of the projectile entering water

B. Algorithms Introduction

Lagrange algorithm is shown in Figure2.Lagrange method is used for the solid structure stress-strain analysis, based on the material coordinates, the grid cell described as the "sculpture" in the structure, the described grid and analysis structure is integrated, which means that the finite element node is the material point[5]. When using this method, the analysis structural changes is consistent with the finite element grid changes, the material does not flow between the units. After diving in the water because deformation of lead projectile is extremely slight, this method can accurately describe the structure boundary movement, while avoiding the deficiency dealing with large deformation by this method.

[3] Li Xiaojie,Jiang Li,Yan Hongbao,Zhao Zheng. "Numerical Simulation on Low Inbreaking Handgun Projectile Drilling though the Water ,"Explosion and Shock Waves,Vol, 27,pp. 319-324,December 2007.

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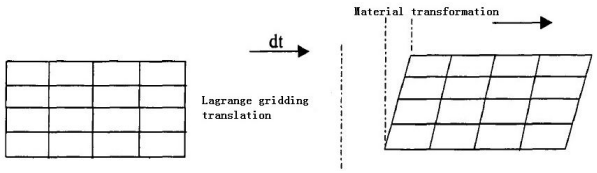

Figure 2. Grids's distortion in Lagrange algorithm

Fluid - structure coupling algorithm is shown in Figure3.The coupling interface between structure and fluid means that the program automatically assigns the surface of the structure is "subordinate" substances; the fluid part is the "main" substances. Lagrangian - Eulerian coupling method in the model can be used in the penalty function coupling coefficient, the main and subordinate interface don't need a special pre-treatment in the contact definition. When use the flow structure coupling algorithm to establish the geometry model and divide finite element grid, the model of structure and fluid , and the grid can overlap, in the calculation get the structural and fluid coupling by certain constraint methods to achieve the transfer of mechanical parameters.

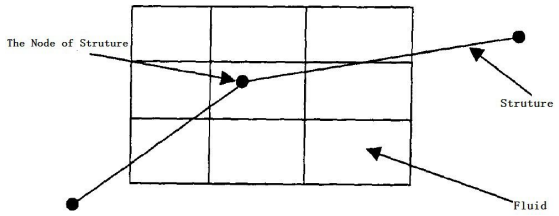

Figure 3. Coupling solution

JOHNSON-COOK material model is formed as follows.

$$\sigma_e = (A + B(\varepsilon_e^p)^N)(1 + C\ln\dot{\varepsilon}^*)(1 - (T^*)^M) \quad (1)$$

Among parameters, ε_e^p is the equivalent plastic strain,

$\dot{\varepsilon}^*$ is the relative equivalent plastic strain rate

T* is the relative temperature

A-yield stress; B-strain hardening; N-strain hardening exponent; C-strain rate dependency;M- Temperature coefficient.

Fracture conditions (strain at fracture)

$$\varepsilon^f = [D_1 + D_2 \exp D_3\sigma^*][1 + D_4\dot{\varepsilon}^*][1 + D_5 T^*] \quad (2)$$

Among parameters, (The equivalent stress ratio of pressure and von Mises)

When the damage parameter is $D = \sum \frac{\varepsilon}{\varepsilon^f} = 1$, the fracture occurred.

ε is the equivalent plastic strain increment during the integral cycle period.

Grüne1sen equation of state

$$P = \frac{\rho_0 C^2 \mu[1 + (1 - \frac{\gamma_0}{2})\mu - \frac{\alpha}{2}\mu^2]}{[1 - (S_1 - 1)\mu - S_2\frac{\mu^2}{\mu+1} - S_3\frac{\mu^3}{(\mu+1)^2}]^2} + (\gamma_0 + \alpha\mu)E \quad (3)$$

C, a, S_1, S_2, and S_3 are constant concerned with the impact compression properties, C is the U_s-U_p (shock velocity - particle velocity) curve intercept; S_1, S_2, and S_3 are U_s-U_p slope coefficient, a is an volume correction to the Grüne1sen coefficient; γ_0 is Grüne1sen coefficient; E is the material internal energy; Volume change rate $\mu = P/P_{0\text{-}1}$[6].

Required concrete material models $\rho = 11.34 g/cm^3$, A=14Mpa,B=17.6Mpa,C=0.0035,

n=0.685 and equation of state parameter show in table I.

TABLE I. THE PARAMETERS OF EQUATION OF STATE

Parameters Material	Lead	Air	Water
$\rho(g/cm^3)$	11.34	0.00125	0.998
C(m/s)	2030	344	1650
S_1	1.47	0	1.92
S_2	0	0	-0.096
γ_0	2.78	1.4	0.35
a	0	0	0

IV. THE RESULTS AND VERIFICATION OF THE PROJECTILE AFTER PENETRATING INTO THE WATER

A. The simulation results and verification of damage performance law

Draw the projectile displacement curve after into water by the velocity attenuation law, shown in Fig 4.After entering the water 0.81ms, the displacement of spherical lead balls is 20.37cm.

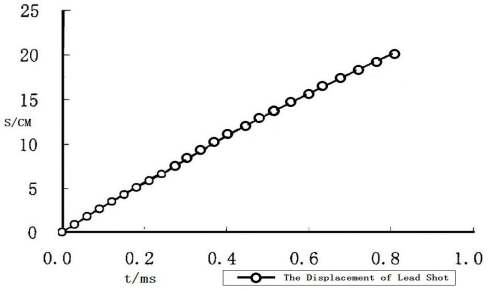

Figure 4. Displacement curve for 9mm spherical lead projectile

The numerical simulation of damage performance law is be expressed as follows.The total energy of the projectile expression is

$$ET = E + I \quad (7)$$

The total energy can be divided into two parts; E is the kinetic energy of the projectile, I the projectile internal energy. After the projectile into the water, its total energy consumption will act on the waters. The larger the total energy consumed, the greater the damage performance is. Calculated through LS-DYNA program, the projectile

[6] Cooper S R,Benson D J,Nesterenko V F."A numerical exploration of the role of void geometry on void collapse and hot spot formulation in ductile materials,".International Journal of Plasticity,Vol. 16,pp. 525-540,March 2000.

penetrating into the water, after 0.81ms, the total energy consumption is ΔE = 163J.

B. Experiment verification of the damage performance law

The experiment verification of the damage performance law is be implemented as follows.9mm diameter lead projectiles at a speed 300m/s shot water tank, and observe cavity forms after the projectile into the water at 5cm and 15cm by high-speed photography, shown in Fig6.From the comparison of the simulation results and high-speed photography of the cavity changes, the conclusion is the instantaneous cavity cross-section formed in the projectile killing is round; and the whole cavity is conical shape with a large inlet; with penetration depth increasing, the cavity diameter gradually becomes smaller. The shape of the cavity obtained by numerical simulation during the lead projectile penetrating process is consistent with shape of the cavity shot by the high-speed photography in the experiment.

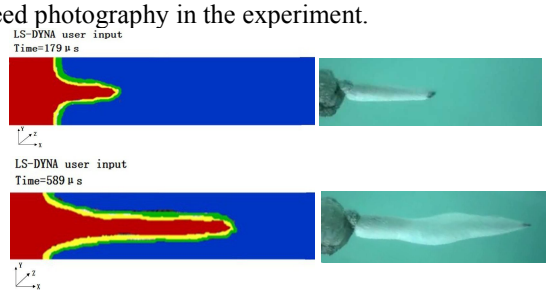

Figure 5. The cavity form comparison between the simulation and the high-speed photography

IV. THE RESULT ANALYSIS

After known the result of penetrating depth numerical simulation, it shows that the 9mm spherical lead projectile which has 300m/s speed could penetrate 20.37cm in 0.81ms. Due to the density of water is about 80 percent of the density of human tissue, as a result, the projectiles could penetrate near 16.30cm, which is approaching the body thickness of adult Asians.

From the result of velocity attenuation numerical simulation, we find that, after penetrated 20.37cm, the 9mm spherical lead projectiles which has 300m/s speed still has 87.49J kinetic energy. In this case ,the kinetic energy exceed the standard of Firearm's Lethality， which is internationally recognized by 78J.

At first, the cavity of spherical lead projectiles is conical, shortly afterwards and it turns into ellipse. Before disappeared, the cavities are always connected to the entrance and pulsate several times[7]. it moves slowly along the direction of projectile until fracture. This phenomenon shows that, after the projectiles gets through the human tissue, the diameter of wound ballistics will continue increase until form the maximum momentary cavities. Compared the shock wave pressure of numerical simulation, the wave trough between the first pressure peak and the second one appear with the maximum momentary at the same time. In other words, the maximum momentary cavities appear after the shock wave pressure sweep past and just at the time of the maximum negative pressure. According to the explain from R Berlin in 1976[8],when high-speed projectile enter into medium, some medium flow adhesively at the front of projectile and flow out from the trajectory with the help of inertia. These medium separate from the projectile surface along a certain curve and form a cavity behind the projectile. Therefore, the wasted energy of projectile is mainly use for forming a cavity behind the projectile. More human tissue suffers shock-wave compression and be injured seriously, because the volume of cavity is much larger than the projectile. In consequence, the instantaneous cavity of spherical projectiles has the maximum lethality than other ballistic effects.

V. CONCLUSION

After using the numerical simulation program ANSYS , we simulates the antipersonnel process of the sphere projectiles which are shot by non-standard firearm and uses the water by ANSYS to acquires the velocity attenuation curve, displacement curve, reduction of the total energy and the instantaneous cavity and summarize the following conclusions.

First,9mm spherical lead projectiles which are shot by non-standard firearm in 300m/s speed could penetrate more than 20.37cm and have the ability that shot through an adult Asian.

Second,after penetrated 20.37cm in water,9mm spherical lead projectiles still have 87.49J kinetic energy and have enough lethality to hurt people.

Third,the instantaneous cavity is the significant factor to cause the tissue trauma and it should be the important reference factor in the examination of non-standard firearm's lethality.

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Performance Optimization for DLA Model Based on GPU

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***Abstract*—DLA (Diffusion Limited Aggregation) Model is one of the most important growth models in fractal theory. People have higher requirement to the computational efficiency when applied to large scale simulation. Thus low cost, low power consumption and high performance GPU parallel to DLA mode acceleration can be used as an effective means to improve performance. First, redesigning the DLA model algorithm can make it possible for parallel computing which is based on GPU. And we put forward the performance optimization strategy, including easing data transmission time, reducing the memory load and storing quantity. By doing this, the computational performance is improved, and better generality can be met. The calculated results show that by using GPU parallel optimization, the computational performance of the DLA model is effectively improved.**

***Index Terms*—DLA GPU performance optimization**

I Introduction

Fractal is a kind of extremely fragmented and complex system with self similarity and affinity, and self similarity with scaling invariance are important features of it. The DLA model [1] is a typical random growth fractal model. The rule is to put a static seed particle in the center of a two-dimensional square lattice, and then set a boundary with a certain size, the boundary is the particle source. Then randomly select a point at the border, a particle is emitted from the point and approach the nucleus at the center through random walk, the random walk step is constant for any direction. When the particle reaches the seed, it will stop walking and becomes a part of the seed; then again from the boundary of random points, another particle is emitted. This process is repeated.

GPU is a low cost, low power consumption microprocessor with high performance, which can deal with the large scale mathematical operation by adopting execution model with single instruction and multiple threads. In 2007, NVIDIA released the Compute Unified Device Architecture (CUDA) including the hardware specifications and the programming environment，which greatly facilitates the parallel programming on the GPU． The CUDA has been used in the applications of computational fluid dynamics [2].

Based on the calculation characteristics of DLA model, the paper tries to take the advantages of the GPU massively parallel computing ability, and applies the parallel computing to the particle motion in DLA, finally we can make the computational performance of DLA model largely enhanced.

II DLA Model based on the parallel computing

A DLA computing model

Choosing L x L square lattice set a fixed particle as "seed" in the plane center. When the program begins, a particle is randomly generated in the plane by using random function. This particle is doing irregular moving in the plane by Brown movement. The particle then produced will touch the “seed” and attach to the “seed” to form particle clusters. After the repetitions, a dendrite floc is formed in the center of lattice [3]. It is shown in the Figure 1.

Figure 1. The floc growth process

B GPU parallel computing architecture

GT200 is made up of scalable streaming processor array and the memory system. The streaming processor array is made up of several thread processing clusters, each of them contains 2-3 SM (stream multi processor) [4, 5], 8 SP (streaming processor) compose a SM. SP is independent of the registers and the instruction pointer. SM has a complete front-end, including fetch, decode, transmission and execution unit etc. In GPU, threads are organized into multiple threads blocks, and are allocated to one SM. The thread in every thread block is submitted to Sp for processing in the form of SIMT. In simple, at the same moment, each SP is computing independently the same calculation. Suppose there are 256 SPs, which means you can have 256 calculation objects at the same time. Figure 2 illustrates the execution grid model of CUDA. Threads are the atomic unit running on the GPU. Each thread will execute the same kernel code for each

different data element. It is similar as the SPMD (Single Program Multiple Data) [6]. Threads are organized into blocks and blocks are organized into grid.

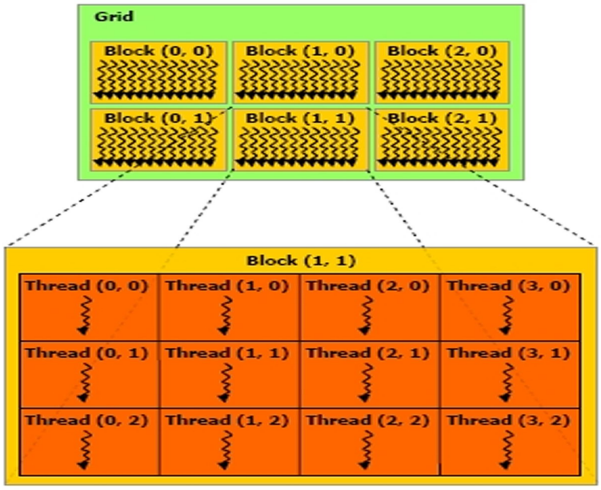

Figure 2. Execution grid model of CUDA

C DLA parallel optimization strategy

In DLA model, the main calculation consumption exists in the Brown Motion of the random particles. Because the regular computation mode which is based on CPU is usually adopting circulation or thread mode, it calculates the particles individually; it needs longer time to simulate the growth and has very low efficiency. With the increases of the dot area and particles selected randomly, the floc needs more time to form in the normal CPU [7]. Considering each particle has same calculation model, the SP in GPU can be used to calculate the Brown motion of particles, and make each SP in GPU calculate the movement of one random particle. Through this, GPU can process much more particles than CPU at same time, thus the efficiency are greatly improved [8].

III ANALYSIS OF TESTING RESULTS

A platform of testing

By comparison, the test is taken at the same computer. Test A is a regular computation based on CPU, test B is a parallel calculation based on GPU. The configuration of the computer can be seen in the following:

Operating System: Win 7
CPU: Intel (R) Core (TM) i5 2300
System Memory: 4GB
GPU Chip: GeForce 8800 GTS
GPU Features: see TABLE I

TABLE I. CAPABILITY OF GEFORCE 8800 GTS.

Features	**GeForce 8800 GTS**
number of register per SM	8192
active warps per SM	24
active threads per SM	768
total SP	96
number of SM	12
global memory	320M

B method of testing

The operation time of the program is decided by the size of the square lattice (L) and the number of particles (N). In the tests, L and N are set, the programs are running under the regular CPU mode and GPU parallel mode. The average time each of them uses is recorded and compared after the tests.

C process of testing

The tests are divided into two groups. In the first group, the size of the square lattice (L) is fixed, the number of particles (N) is changed, and the numerical settings are shown in TABLE II.

TABLE II. SETTINGS OF L AND N.

NO	L	N
1	200	10000
2	200	20000
3	200	30000
4	200	40000
5	200	50000

The test results are shown in Figure 3.

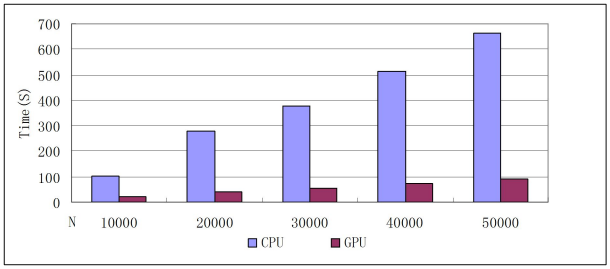

Figure 3. Test results of different N

In the second group, the number of particles (N) is fixed, the size of the square lattice (L) is changed, the numerical settings are shown in TABLE III.

TABLE III. SETTINGS OF L AND N.

NO	L	N
1	100	20000
2	200	20000
3	300	20000
4	400	20000
5	500	20000

And the test results are shown in Figure 4.

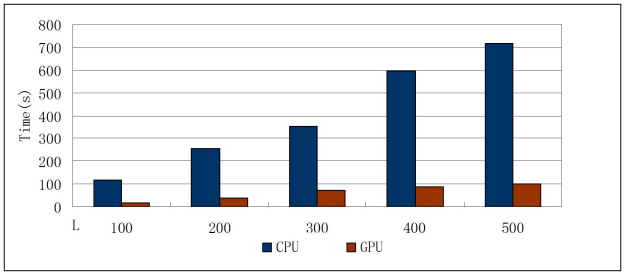

Figure 4. Test results of different L

IV CONCLUSIONS

The paper tries to optimize the conventional DLA model by adopting GPU parallel calculation architecture. By using parallel calculation to the motion of particles, the computation efficiency can be largely improved because more particles can be processed at the same time. We can see from the test results, DLA model based on GPU can get higher efficiency than regular model, especially when the size of the square lattice and the number of particles increase, the calculation efficiency will be more remarkable.

ACKNOWLEDGMENT

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Study on Energy Saving of Regional Heating Adjustment Mode

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***Abstract*—The operation adjustment of district heating system is analyzed with the energy saving calculation of water pump in secondary network to find out the optimal way of adjustment. Through the dynamic adjustment model of heating system and the example of a university in Zhangjiakou， the temperature curve of for supply and returned water in typical day and typical year and the relative flow curve of heating season are drawn. And the power consumption of pump is calculated. The direct connection system has the minimum heating load throughout the heating season and the secondary network least power consumption with the quality-flow dynamic adjustment in stages. So this accommodation mode can reduce the emissions of pollutants effectively and comply with the requirement of energy conservation and emissions reduction.**

***Index Terms*—dynamic adjustment; quality-flow adjustment mode in stages; energy saving**

I. INTRODUCTION

At present most of the secondary heating networks take quality adjustment, few networks take quality adjustment with different quantitative ratio in each period. The power consumption of circulation water pump is greatly. In order to meet the heating needs of the users and achieve energy saving and emission reduction, a kind of control mode and its application prospect in energy conservation is discussed in this paper.

II. THE QUALITY-FLOW ADJUSTMENT METHOD BY STAGES

When the network uses the quantity adjustment, the circulating water becomes less when the outdoor temperature increase. In generally, if the relative flow ratio reduces to less than 60%, the network will appear serious hydraulic disorder due to less flow. So it is not applicable to take quantity adjustment in the whole heating period in the secondary heating network. It's assumed that the outdoor temperature corresponding with severe vertical disorders is critical temperature.

When the outdoor temperature is lower than the critical temperature, the network takes quantity adjustment. When the outdoor temperature is higher than the critical temperature, the network uses the quality adjustment with different quantitative ratio in each period. The circulating water of pipeline network keeps the certain proportion of design flow.

A The dynamic state adjustment model

Taken a hot water heating system in direct-connected system as an example, no water leakage loss and the heat loss of pipeline network in the hypothesis, integrated building thermal physical parameters, according to the energy and mass conservation principle, the dynamic model of heating are established.

The model of boiler in heat source:

$$C_{\mathrm{b}}\frac{\mathrm{d}t_b}{\mathrm{d}\tau}=\mu_1 G_{1\max}h_v\eta_b-C_w G_t(t_b-t_r) \tag{1}$$

Indoor radiator model:

$$C_{htr}\frac{\mathrm{d}t_{\mathrm{r}}}{\mathrm{d}\tau}=C_w\mu_2 G_d(t_b-t_r)-U_{htr}[\frac{t_b+t_r}{2}-t_n] \tag{2}$$

Room temperature model in building:

$$C_n\frac{\mathrm{d}t_n}{\mathrm{d}\tau}=C_w\mu_2 G_d(t_b-t_r)+Q_{\mathrm{int}}+Q_{sol}-U_w(t_n-t_w) \tag{3}$$

Where, t_b is extracting water temperature of boiler, ℃; τ is time; μ_1 is fuel control variables of boiler , the range from 0 to 1, 0 representing the shutdown, 1 representing the maximum fuel consumption; G_{1max} is the maximum value of the boiler fuel, kg/h; h_v is the heating value of fuel, kJ/kg; η_b is boiler efficiency; μ_2 is the circulating water control variables; G_d is the circulating water flow in design, kg/s; U_{htr} is the calculated heat transfer coefficient of radiator, W/(℃•m^2); Q_{int} is the indoor heat gain, W/m^2; Q_{sol} is the solar heat gain, W/m^2; Uw is the total heat transfer coefficient of building maintenance structure, W/℃.

III. THE ECONOMIC ANALYSIS OF HEATING ADJUSTMENT SYSTEM

The building area of the university in Zhangjiakou is 400000 m^2, outdoor design temperature is -14 ℃ , the indoor design temperature is 18℃, The total heating days

are for 151 days. The University currently uses two coal-fired hot water boilers; the evaporation of the boiler is about 14MW. The design supply and return water temperature are 95/70℃. The water is supplied to each user by water separator. There are three variable frequency pumps, one spared. The total circulating water quantity of pump is 450t/h; the pump head is 25mH_20; the electric power is 90kW; the efficiency of the pump is 0.80.

A The change curve of the outdoor temperature

The change curve of outdoor temperature in winter in Zhangjiakou is shown in Figure 1. According to Figure 1, the range of the temperature change in the entire heating season is -20~15℃.

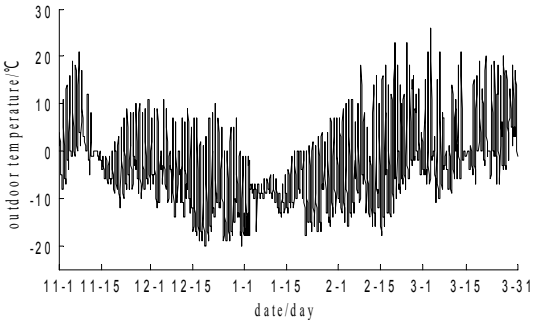

Figure 1. The outdoor temperature change curve of typical year

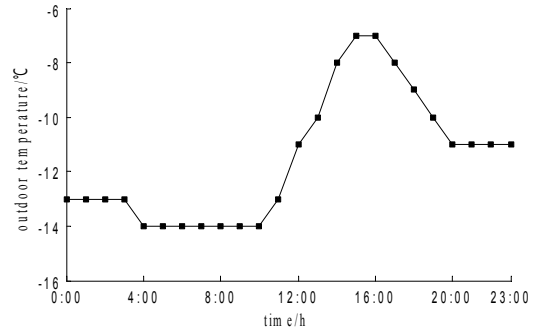

Figure 2. The outdoor temperature change curve of typical day

B The dynamic adjustment curve

The heat gain from solar radiation in Formula (3) is computed according to the building layout, shading coefficient and geographical longitude and latitude of Zhangjiakou. The solar radiation heat at 8:00-16:00 in severe cold day is calculated by the SUN sunshine analysis software, regarding as solar radiation heat of the building. The solar radiation heat of the building is shown in table 1. The indoor heat gain is 3.8W/m^2. Because the building is in the campus, the interior illumination is not used at the same time. The average indoor heat gain is 2 W/m^2 at 8:00-16:00; the average indoor heat gain is 3.2W/m^2 at 17:00-22:00; parameters of the heating system are shown in table 2.

TABLE I. THE RADIANT HEAT OF THE SUN

Time	Direct illumination without Shading (W/m^2)	Scattering intensity (W/m^2)	Reflected illumination (W/m^2)	Total illumination with shading (W/m^2)
8:00	49.3	28.1	6.7	84.1
9:00	157.18	39.63	13.00	209.81
10:00	364.40	51.51	26.66	442.57
11:00	507.14	56.74	37.59	601.47
12:00	578.90	58.84	43.49	681.23
13:00	578.90	58.84	43.49	681.23
14:00	507.14	56.74	37.59	601.47
15:00	364.40	51.51	26.66	442.57
16:00	157.18	39.63	13.00	209.81

TABLE II. THE PARAMETERS OF HEATING SYSTEM OF THE BUILDING

Name	Numerical
Fuel standard value (kJ/kg)	29307.6
Boiler heat capacity (MJ/℃)	65
Hot water heat capacity of radiator (MJ/(℃•m^2))	0.0028
Heat capacity of the indoor air (MJ/(℃•m^2))	0.00336
Rated efficiency of Boiler (%)	85
Experimental factors of heat transfer coefficient of radiator	0.298
Total heat transfer coefficient of building maintenance structure(W/℃)	672000

When the quality-flow adjustment method by stages is adopted, the solar heat gain and internal heat gains are taken into account. The curve of supply and return water temperature are shown in figure 3 in typical day through Matlab simulation.

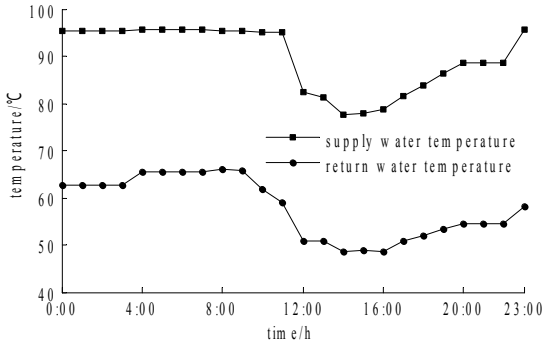

Figure 3. The dynamic adjustment curve of supply and return water temperature in typical day

According to Figure 2 and Figure 3, the quantity adjustment is adopted with constant supply temperature(95℃) in the heating system; the change scope of the outdoor temperature is -12~-7℃ at the 12:00-22:00 period. When the pipe network uses quantity adjustment, considering the solar heat gain and internal heat gains, relative flow will be below 60%. The network will appear serious hydraulic disorder for less flow.So the pipe network uses quality adjustment and relative flow is 0.6. The change curve of supply and return water temperature in entire heating season is shown in figure 4.

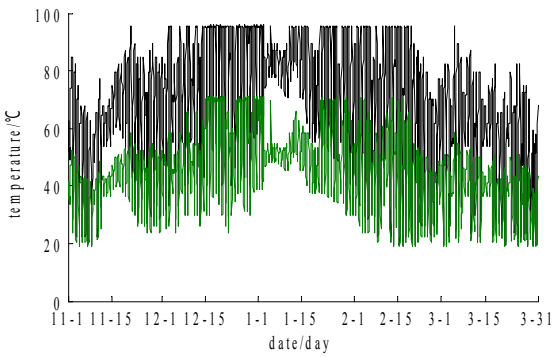

Figure 4. The dynamic adjustment curve of supply and return water temperature in typical year

According to Figure 4, the entire heating season, relative flow changes between 0.6-1; quantity adjustment stage focus in mid December to mid February of the following year; According to Figure 10, the dynamic adjustment basically can make a constant indoor temperature in the range of 18~19 ℃ ,without the fluctuated phenomenon of indoor temperature.

C The analysis of Power consumption of steady adjustment and dynamic adjustment

According to the law of similarity of the pump, pump head is proportional to the square of the flow; shaft power is the third power of the flow. In the quantity adjustment stage of the quality-flow adjustment method by stages, circulating water of the network and circulating water pump speed reduce with the outdoor temperature rising.

The calculation formula of the pump power:

$$P' = \frac{9.8\rho H'G'}{3600\eta} \tag{4}$$

(1) The power consumption of quality adjustment

$$W_{zt} = 24P'N_{\mathrm{p}} \tag{5}$$

(2) The power consumption of quality adjustment with different quantitative ratio in each period

$$W_{jj} = 24N_1P' + 24(N_p - N_1)\overline{G}_1^3P' \tag{6}$$

(3) The power consumption of the quality-flow adjustment method by stages

$$W_{zl} = 24N_l\overline{G}^3P' + 24(N_p - N_l)(\overline{G}^*)^3P' \tag{7}$$

Where, $\overline{G}$ is the calculate relative flow of the quality-flow adjustment method by stages; N_l is the duration of the quality-flow adjustment method by stages, day; $\overline{G}^*$ is the relative flow; N_1 is the heating time when relative flow ratio equaling to 1, day; N_P is the entire heating time of heating time, day.

According to the dynamic and steady adjustment curve of relative flow in entire heating season and combining the calculation formulas of the electricity consumption of water pump, the quality adjustment with different quantitative ratio in each period, the power consumption of the quality-flow steady adjustment method by stages and the quality-flow dynamic adjustment method by stages are calculated. The calculation results are shown in Table 3. According to Table 3, the power consumption of the quality-flow dynamic adjustment method is the least and the energy-saving is more obvious.

TABLE III. THE ECONOMIC COMPARISON OF THREE ADJUSTMENT SCHEMES

Adjustment mode	Relative flow	Circulating water m^3/h	Annual power consumption $10^4kW·h$
Quality adjustment with different quantitative ratio in each period	1.0	770.4	16.52
	0.6	462.24	
Quality-flow steady adjustment method by stages	0.6~1	462.24-770.4	13.14
Quality-flow dynamic adjustment method by stages	0.6~1	462.24-770.4	12.80

D The analysis of the coal saving, emission reduction of steady and dynamic adjustment

The university uses a coal-fired chain boiler for heating. The fly ash ratio α_{fa} is about 12%. The class II bituminous coal is selected for the fuel. Its heat value Q_{net} is 17693kJ/kg. The boiler efficiency η is 85%. The amount of coal consumption for heating can be calculated by:

$$M = Q_{\mathrm{year}}/Q_{net}/\eta \tag{8}$$

Where, M is the coal consumption, kg.

According to all kinds of coal quality data of the major mining areas of the whole nation, which collected by Shanghai industrial boiler, all contents of the class II bituminous coal are shown in Table 4:

TABLE IV. THE COMPONENT CONTENT OF THE CLASS II BITUMINOUS COAL

Component	V_{daf}(%)	C_{ar} (%)	H_{ar}(%)	O_{ar}(%)	N_{ar}(%)	S_{ar}(%)	A_{ar}(%)	M_{ar}(%)
Content	38.50	46.55	3.06	6.11	0.86	1.94	32.48	9.00

Due to the dynamic adjustment consider the influence of solar radiation, the indoor air heat and lighting and other factors on the indoor temperature, the load value of entire heating season is small and the adjustment is in line with the actual, effectively saving heating heat, avoiding the waste of energy, thereby reducing the emissions of pollutants, coal saving emission reduction, as shown in table 6.

TABLE V. THE COMPARISON OF HEATING LOAD BETWEEN THE ADJUSTMENT OF DYNAMIC ADJUSTMENT AND STEADY ADJUSTMENT

Adjustment mode	Heating load in heating season (MW)
Quality-flow steady adjustment method by stages	53220
Quality-flow dynamic adjustment method by stages	49860

TABLE VI. THE COMPARISON OF EMISSIONS OF POLLUTANTS, COAL EMISSION REDUCTION

Adjustment mode	Coal consumption (t)	Fly ash emissions (t)	CO_2 emissions(t)	SO_2 emissions(t)
Quality-flow steady adjustment method by stages	12739.54	496.54	21744.37	494.30
Quality-flow dynamic adjustment method by stages	11935.3	465.19	20371.57	463.09
Emission reduction	804.3	31.35	1372.81	31.21

Ⅳ. CONCLUSION

1) According to the comparison of the three modes of adjustment, the power consumption of the quality-flow dynamic adjustment method by stages is the least, and the optimum adjustment mode.

2) When the adjustment mode of the quality-flow dynamic adjustment method by stages is adopted, the indoor temperature does not appear fluctuated phenomenon, and satisfy the need of the indoor comfort

3) When the adjustment mode of the quality-flow dynamic adjustment method by stages is adopted, the heating load of the whole heating season and the pollutant emission are reduced, meeting the requirement of energy saving and emission-reduction.

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Development of Thermal Simulation Automation System for Electronic Package

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***Abstract*—The technology of thermal simulation is very important in development of a new generation of IC package design, which aims to obtain the temperature distribution and thermal resistance of package. Most IC design engineers and package engineers have many difficulties in performing thermal analysis because they are familiar with the product structure but poor in thermal-physical modeling and FEA (finite element analysis) skills. To assist IC design engineers and package engineers to perform thermal analysis efficiently and accurately, a fully automation system (WBExcel) that has the ability to complete the whole package thermal analysis automatically has been developed based on ANSYS Workbench and Excel. The general methodology of developing this automation system is introduced. The application on PCB level analysis is presented and indicates the reliability and efficiency of WBExcel.**

***Index Terms*—Thermal simulation, Finite element analysis, Electronic package, ANSYS Workbench**

I. INTRODUCTION

In the semiconductor industry, thermal management is a key factor that has become important due to the industry trend towards increasingly smaller, faster and high power devices [1]. AS the increment of the packaging density of IC chips, the working temperature of the package raises which will induces the failure of package. In fact, overheating has become one of the major causes of package failure. In addition, the thermal stress due to mismatched coefficients of thermal expansion (CTE) of different package materials will create distortions, cracks and even damages to the package. It has been reported that failure rate has near exponential dependence on temperature of electronic component [2].

Numerical simulation is a powerful tool for thermal management, not only in aiding product engineers for understanding their thermal testing physics, but also in helping package engineers for better design and optimizing their products. A lot of research works have been done in package thermal simulation and analysis [3]-[10]. G. Hanreich et al performed thermal simulation on PQFP model using finite element method and obtanined the temperature distribution of whole model [3]. Y. N. Shi et al have conducted a series of calculations and analyses based on finite element simulation to study the thermo performance of SOD package [4]. J. K. Kim et al describe an application of the dynamic compact thermal network method to analyze the transient thermal response of a thermal interface material measurement apparatus in multi-dimensional heat flow, and propose a simple modelling procedure for the parametric estimation as a preliminary thermal design [5].

At present, most thermal analysis is generally simulated with commercial FEA software or special thermal analysis tools, which involves complex process of model pre-processor, solution and post-processor. Only the high level professional persons can perform thermal analysis by FEA, because most IC design engineers, package engineers, assembly process engineers are familiar with their product structure but poor in thermal-physical model and FEA skills. To assist semiconductor engineers who do not know FEA and thermal analysis, but who still need to get the thermal simulation to improve their IC product or package design, it is necessary to develop a fully automation interface that has the ability to complete the whole package thermal analysis automatically. Therefore, this paper presents a development of thermal analysis automation system (WBExcel), which can carry out the temperature distribution analysis and calculate thermal resistance automatically based on Excel spreadsheet cooperating with ANSYS Workbench.

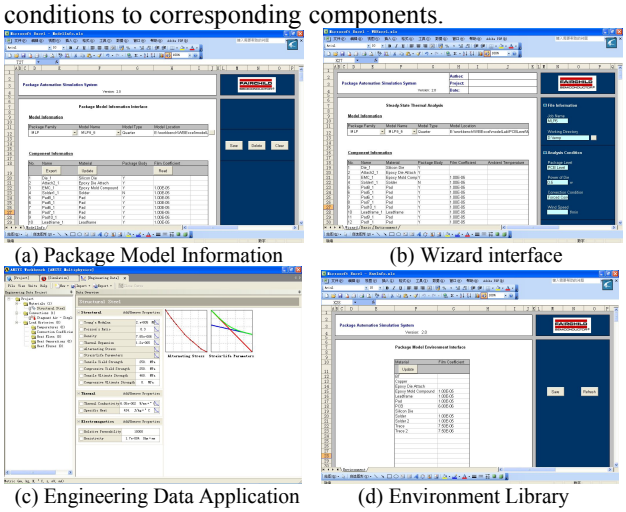
II. BASICS OF WBEXCEL DEVELOPMENT

ANSYS Workbench (Worbench) is a new-generation platform used for developing and managing FEA simulations [6]. It offers highly integrated engineering simulation platform and bi-directional parametric integration with most available CAD systems (Pro/E, Inventor, Solidworks, etc.). The core part of Workbench is the DesignModeler and Design Simulation module, The DesignModeler is used for creating and modifying CAD geometry to prepare the solid model for using in simulation module. Design Simulation is mainly used for performing structural and thermal analyses. In addition, Workbench provides Multi-tiered Customization Tools to support a variety of development efforts. For example, the Workbench Software Development Kit (SDK) is an open architecture platform that allows customers to embed external applications into the Workbench framework using Application Programming Interfaces (APIs) [7]. Especially, the SDK provides the interface to connect with Excel spreadsheet, so that one can start up Workbench and automate thermal analysis based on Excel.

III. ARCHITECTURE OF WBEXCEL

In General, package models from the same family usually have the same or similar structure but different sizes, materials or number of components. It can imagine that there could be a large amount of rework if every model of the same family is simulated according to the general procedure. In fact, it can be found that the process of thermal analysis on these models is almost the same. Therefore, a general process procedure can be summarized by performing careful analysis on all package models from the same family. This general process algorithm can be stored in background and hidden from the user. This algorithm controls material assignment, how to mesh, how to apply thermal loads, what results should be obtained etc. User is only required to input the basic data in an intuitive and simple interface and the other steps of preprocessing (modeling, meshing, etc.), solving and post-processing will be automatically finished.

To build the automated simulation procedure, modeling is the first thing to be considered. Usually user has to spend much time in building a complex package model using general FEA software during pre-processing. But a CAD model can be directly imported into Workbench because Workbench provides import capability and bi-directional associativity with many CAD systems. Additionally, the names of components defined in CAD system will also be imported into Workbench along with the solid model. It is emphasized that the names of components play an important role in identifying the components, assigning materials to corresponding components and applying boundary conditions to corresponding components.



(a) Package Model Information (b) Wizard interface

(c) Engineering Data Application (d) Environment Library

Figure 1. Interface of WBExcel.

Based on the above idea and Workbench customization tools, WBExcel is developed based on Excel which includes four modules: a Package Model Information Library, an Executable Wizard System, a Package Material Library and an Environment Library. Fig. 1 and Fig. 2 show the interface and automated simulation process of WBExcel. User is only required to input basic data in a Wizard interface (an Excel Spreadsheet) and it will link to Workbench and automate the whole steps of thermal simulation according to the general process algorithm. At last, the temperature results and thermal resistance will also be exported into Wizard interface. The four modules of WBExcel are introduced as follow.

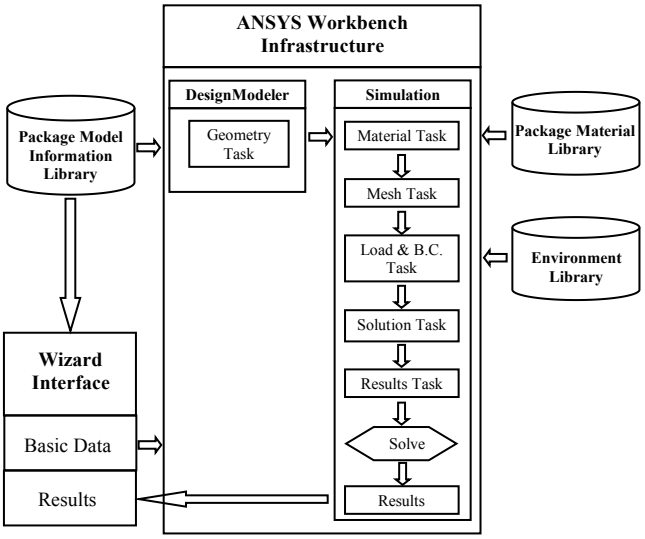


Figure 2. Automated simulation procedure of WBExcel.

A. Package Model Information Library

The Package Model Information Library is a core element of WBExcel. Firstly, it is used for storing CAD models, including PCB level models and Component level models. Secondly, the Package Model Information Library provides an interface for user to manage the models' information (package family, model's name and material, etc.). User can automatically export all components' names which have been defined in CAD software to Package Model Information interface. Then, user may select corresponding materials for every component from Package Material Library, set the heat transfer coefficient to every component according to Environment Library, etc. All package model information is necessary to do the automatic thermal analysis in Workbench, which is saved in an Access database.

B. Wizard System

Wizard System is another important module of WBExcel, which contains the general procedure of thermal analysis for package models. The Wizard System uses Excel Spreadsheet as the user interface (see Fig. 1(b)), which looks friendly and intuitive. It requires user to input the basic data. An example is to input user name, title of simulation, job name, package level, power of die, convection condition (natural or forced convection) and so on. User is also required to select a model to be simulated, and then the model information stored in Package Model Information Library will be exported into Wizard interface automatically. The Wizard System will collect all the information that user inputs and perform the whole thermal simulation automatically according to the predefined procedure in background. The flow diagram of Wizard System is shown in Fig. 3.

The core of Wizard System is a general procedure, which contains PCB level procedure and Component

level procedure. They are developed in JScript and build the connection with other modules to realize the automation of thermal analysis on PCB level models and Component level model. The architecture of PCB level procedure and Component level procedure is almost the same except applying boundary conditions.

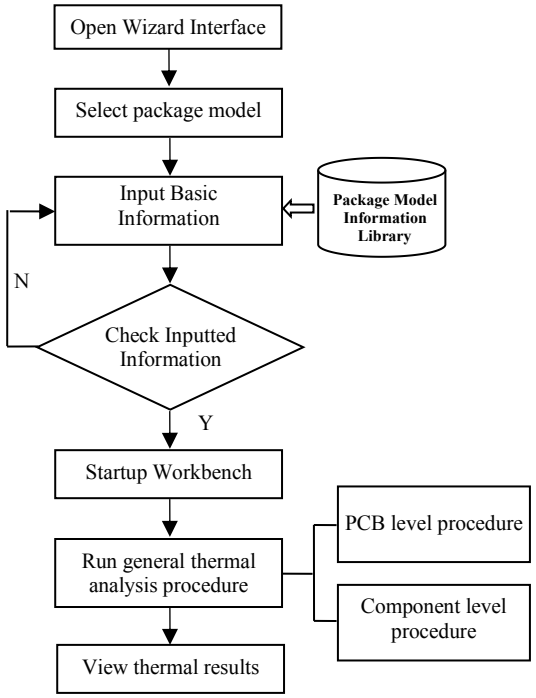


Figure 3. Flow diagram of Wizard System.

Firstly, the selected CAD model from Package Model CAD Library is imported into DesignModeler and applied some operations, such as creating Name Selection (just as grouping geometry items into a component in normal ANSYS code), forming new part (just as gluing function in normal ANSYS), and so on. In fact, all these operations are prepared for meshing and loading in Simulation. Then the operated model is imported into Simulation from DesignModeler. Based on the definition of package model information in Wizard interface, every component of model is assigned to corresponding materials which come from the Package Material Library. An intelligent meshing function is implemented to generate high quality mesh for highly accurate solutions. Heat Generation is automatically calculated from the power of the chip is applied to die. In applying convection boundary, if user chooses "Natural Convection" in Wizard interface, the heat transfer coefficients defined in Environment Library is used for natural convention. For forced convection, the heat transfer coefficients at all surfaces are the same, its value is up to the wind speed.

Finally, Wizard System is automatically implemented for solving the model and saving the results files. The results include contours of temperature distribution, thermal resistance of package model and curve of temperature distribution along assigned path. It is emphasized that the APDL commands may be inserted in the simulation for calculating thermal resistance and implementing path operations because some functions have not yet been developed well by Workbench.

C. Package Material Library

One of the most important steps in thermal analysis is to define material properties for package models to represent actual working conditions. There are various package material parameters that vary depend on manufacturing conditions. Furthermore, many material properties are temperature dependent and may require extraction from experimental inputs. For convenience to the user in creating and maintaining package material database, the Package Material Library (MatML files) is built based on Engineering Data Application of Workbench. The material from Package Material Library will be transferred by Wizard System and Package Model Information Library. Fig. 1(c) shows the interface of Engineering Data Application. Package Material Library allows user to add, delete or modify materials by the interface of Engineering Data Application.

D. Environment Library

Environment Library is a thermal loads database which can be transferred by Wizard System in applying convections. It allows user to modify heat transfer coefficient of different materials in Excel Spreadsheet, as shown in Fig. 1(d). It is especially convenient when user wants to compare the results among different heat transfer coefficient.

IV. Application of WBExcel

To test the reliability of simulation tool, the WBExcel has been applied to PCB level analysis and compared the results to normal FEA procedure in ANSYS. MLP 6×6 is chosen for PCB level analysis, seen as in Fig. 4. For the purpose of convenience in analysis, equivalent fan out trace is used instead of true trace based on JEDEC standard, and quarter model is adopted. The MLP 6×6 package model is placed on a standard test board designed according to the JEDEC standard.

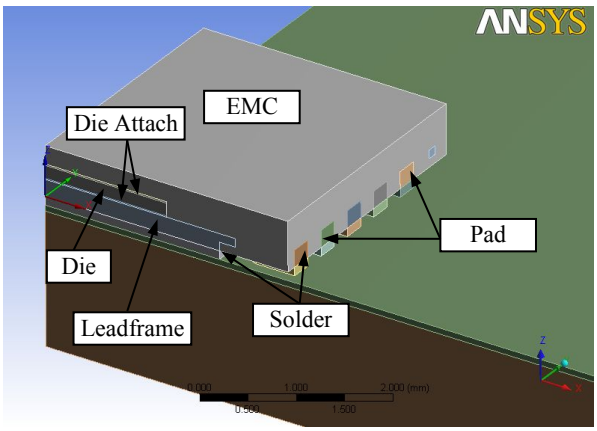
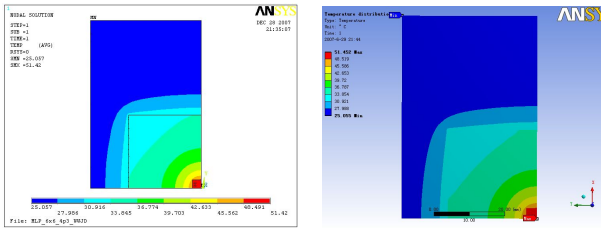


Figure 4. MLP 6×6 model.

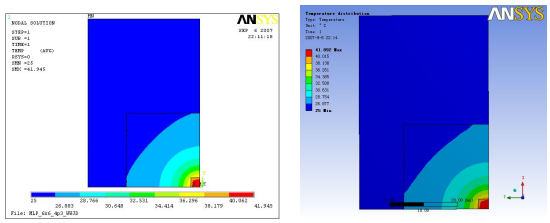
There are other conditions which are inputted forward in analysis: (1) the power dissipation is 0.5W; (2) the ambient temperature is 25 ℃ ; (3) natural and forced

convection are applied individually. For natural convection, the heat transfer coefficient is defined as in Table 4. For forced convection, wind speed of 400 f/min is adopted, so that the value of heat transfer coefficient is 2.83E-5W/mm^2· ℃ according to Ref. [4]. When user opens Wizard interface of WBExcel, inputs the basic data, chooses the model of MLP 6×6 from Package Model Library and clicks "Solve" button, the whole simulation process will be finished automatically. When solution is done, the temperature results and thermal resistances will also be export to Wizard interface. The results are compared with those from the normal ANSYS simulation and measurement.



(a) Result in classic ANSYS (b) Result in WBExcel

Figure 5. Comparation of temperature contour between ANSYS and WBExcel in natural convection



(a) Result in classic ANSYS (b) Result in WBExcel

Figure 6. Comparation of temperature contour between ANSYS and WBExcel in forced convection

Fig. 5 and Fig. 6 compare the contour of temperature between normal ANSYS and WBExcel in natural convection and forced convection respectively. Table 1 and Table 2 compare the thermal results between normal ANSYS and WBExcel in natural convection and forced convection respectively. It can be found that the difference between normal ANSYS and WBExcel is within 1%. It should be noted that the small difference between classic ANSYS and the WBExcel is due to the possible different meshes, solvers and current limitation of workbench tool itself.

TABLE I. COMPARISON OF THERMAL RESULTS BETWEEN ANSYS AND WBEXCEL IN NATURAL CONVECTION

	T_J	T_T	T_C	θ_{JA}	θ_{JT}	θ_{JC}
ANSYS	51.42	51.33	51.23	52.84	0.18	0.38
WBExcel	51.45	51.37	51.27	52.9	0.17	0.36

TABLE II. COMPARISON OF THERMAL RESULTS BETWEEN ANSYS AND WBEXCEL IN FORCED CONVECTION

	T_J	T_T	T_C	θ_{JA}	θ_{JT}	θ_{JC}
ANSYS	41.95	41.82	41.77	33.89	0.26	0.36
WBExcel	41.89	41.76	41.71	33.78	0.26	0.36

V. CONCLUSION

The WBExcel which focuses on simulation automation for IC package thermal analysis has been developed. This system allows users to select the geometry models from CAD Library in co-design communication, and then perform thermal analysis automatically. This automated simulation system has been applied for thermal analysis of a MLP package in PCB level. The simulated results from the WBExcel agree well with the results by using classic ANSYS.

It is especially helpful for engineers who do not know FEA and thermal analysis theories to run the simulation easily by using this system for co-design simulation automation. In addition, the marketing and sales application engineers can also use this system to show customers the thermal performance of products. Even more, a customer could easily run the thermal simulation to select/choose the optimal products through this system. This may extremely save the design cycle time and the cost for new package product development. In addition, it ensures the standardization of results because it avoids the phenomenon that different user gets different results.

ACKNOWLEDGMENT

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Electrical Model of an Atmospheric Pressure Quasi-high-frequency Dielectric Barrier Discharge Cell

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***Abstract*--A dielectric barrier discharge generated by a quasi-high-frequency voltage source through a cylindrical reactor working atatmospheric pressure has been studied and an electrical model characterizing this discharge is proposed. A sinusoidal voltage of up to 5kV peak to peak with frequencies from 20 to 30 kHz has been applied to the discharge electrodes. The proposed model considers the factors which affects the Q-V diagram are the operating frequency and applied voltage amplitude. From analytical results, a Dielectric Barrier Discharge cell can be replaced by voltage–current controlled source.**

***Index Terms*-- Dielectric barrier discharges (DBD), discharge current, electrical model**

Ⅰ. INTRODUCTION

When an electrical field in the discharge gap is high enough to produce a breakdown, very short time duration microdischarges appear in large numbers, occurring discretely in space and time. Dielectric Barrier Discharges (DBD) have attracted a lot of attention because they are considered a source of non-thermal plasmas with a wide variety of applications in the area of materials processing, ozone production and toxic gas decontamination, among others[1-3]. One of the most studied DBD is the electrical model .The DBD cell can be regarded as two capacitors in a serial connection, a variable resistor, two Zener diodes in parallel with the equivalent gap capacitor. The electrical characteristics of such plasma discharges can be represented by a current-controlled current source on behalf of a equivalent signal conduct of the current discharge[4-6]. The electrical model of dielectric barrier discharge cell exists different discharge model because of different frequency[7]. Nevertheless, electrical model of an atmospheric pressure quasi-high-frequency dielectric barrier discharge cellhas not yet been reported.

This paper sets out to present a refined modeling of the DBD electrical elements ,which works on quasi-high-frequency ,so as to afford a better understanding of the current and voltage responses during the discharge, provided that these parameters are measurable throughout the simulation process. This model was implemented in Simulink software which is much faster than a numerical simulation. The discharge cell has been replaced by a current source controlled by a voltage source according to a law of variation which translates this non-linearity. The breakdown and extinction conditions of the microdischarges according to the slope of the applied voltage and the gas voltage have been considered in the simulated model. Another important parameter is the breakdown voltage, which is automatically deduced just by the dimensions of the DBD reactor and the operating frequency. As a final point, the simulation results are compared with experimental data. The developed model facilitates the electrical analysis of DBD configurations, thus allowing the determination of the optimal working condition in DBD reactors. The model can also be used in the design of power sources for DBD reactors.

Ⅱ. EXPERIMENTAL SETUP

Figs 1 depict the schematic of the coaxial DBD reactor that consists of a tube of Pyrex glass of 25mm internal radius (d), 260mm length and 2mm thickness (x).A stainless steel concentric central electrode of 23mm radius (r_0) is set inside the tube. A metallic mesh wraps the tube of Pyrex glass for a length (l) of 260mm that functions as the external electrode. The DBD was powered by the applied voltage $\upsilon_T(t)$ with variable amplitude (0~5kV peak voltage) and variable frequency (20~30 kHz).

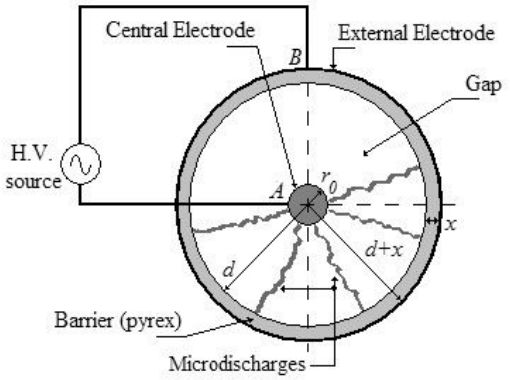


Figure 1. Transversal of the reactor

Ⅲ. ANALYSIS AND MODELING

Considering the schema of Fig 1 , the equivalent electrical model of the DBD reactor consists of two capacitors and R_g in a serial connection. One of the

capacitors represents the capacitance of the dielectric barrier (C_d) and the other represents the capacitance of the gap (C_g). The equivalent capacitances C_g and C_d, not including discharges are calculated by

$$Cg = \frac{2\pi\varepsilon_0\varepsilon_{r1}l}{\ln(d/r_0)} \quad (1)$$

and

$$Cd = \frac{2\pi\varepsilon_0\varepsilon_{r2}l}{\ln((d+x)/d\ )} \quad (2)$$

In (1) and (2), $\varepsilon_0 = 8.854\times10^{-12}\ \ Fm^{-1}$ is the permittivity of vacuum, $\varepsilon_{r1} = 1.000585$ Fm^{-1} is the relative permittivity of atmosphere and $\varepsilon_{r2} = 4.5Fm^{-1}$ is the relative permittivity of the Pyrex glass. By substituting the real dimension values in these equations, the equivalent capacitance values are 173.4 pF and 438 pF for C_g and C_d , respectively. Fig 2 illustrates the equivalent electrical model for this topology. In the model shown in Fig 2, $i_T(t)$ is the total current of the reactor, $i_{diS}(t)$ is the voltage–current controlled source which represents the microdischarges, $v_d(t)$ is the voltage in the dielectric material, $v_g(t)$ is the voltage in the gap, $i_g(t)$ is the displacement current in the gap, $i_{Cd}(t)$ is the displacement current in the dielectric barrier and R_g represents the filamentary channel resistance of the microdischarges.

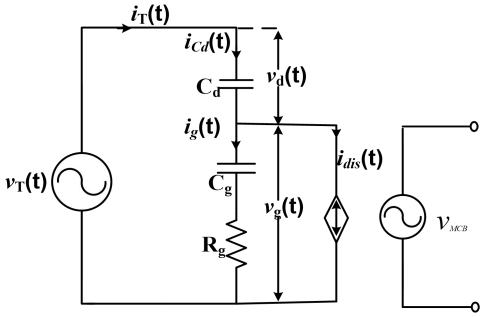


Figure 2. Electrical model of the DBD reactor.

The evolution of i_T (t) during the system operation can be described by three distinctive stages of every semiperiod of the applied υ_T (t) to the DBD. If we select as an initial condition an instant just before the establishment of the electric discharge, then the magnitude of the applied voltage is not enough to establish the gas breakdown and the total current across the cell results insufficient. Once the amplitude of υ_T (t) has surpassed V_b, a charge flux is generated whose current intensity exhibits an abrupt increase due to the dynamics of the gas conductivity. At this moment, i_{dis}(t) constitutes the most important current component to start the discharge process. The discharge current obeys the classical exponential function which governs breakdown in gases. The magnitude of voltage υ_g(t) keeps a constant value during the discharge. The extinction of the discharges takes place at $\frac{dv_a}{dt} = 0$. At this very moment, when discharge is off, one sinusoidal potential V_b is applied to the two dielectrics (υ_T (t) < V_b), which produces a weak electric field due to the constant electron emission i_0 caused by the accumulated charges. As the applied voltage increases, υ_T (t) ≥ V_b, the Townsend criterion is fulfilled. Once the current becomes sustainable because of υ_T (t), the current discharge i_{dis}(t) is only limited by the load. The dynamic interaction of υ_g(t) and i_{dis}(t) during the transition process is quite accurately described by

$$i_{dis}(t) = i_0\,(\upsilon_g(t)/V_b)^{\alpha} \quad (3)$$

where the current i_0 is related to the continuous electron emission from the cathode transported by the external electric field to the anode according to its gas-determined characteristic. Yet, the off-discharge i_0 value is very small when compared to its discharge level and is therefore ineffectual at this stage. This value is heavily dependent on the applied power, according to experimental studies by Naude et al. [8], Hence, we will assume the values of i_0 according to the power managed in experimental discharges as 30 mA for atmosphere, with the consequent adjustment of the simulation parameters. The α coefficient depends mainly on the E/p value and on the separation between the electrodes, d, as described by Roth [8], which has been experimentally validated from 1 to 12.

Using Kirchhoff's voltage and current laws, the currents in each capacitor are determined as follows:

$$i_T(t) = i_{Cd}(t) \quad (4)$$

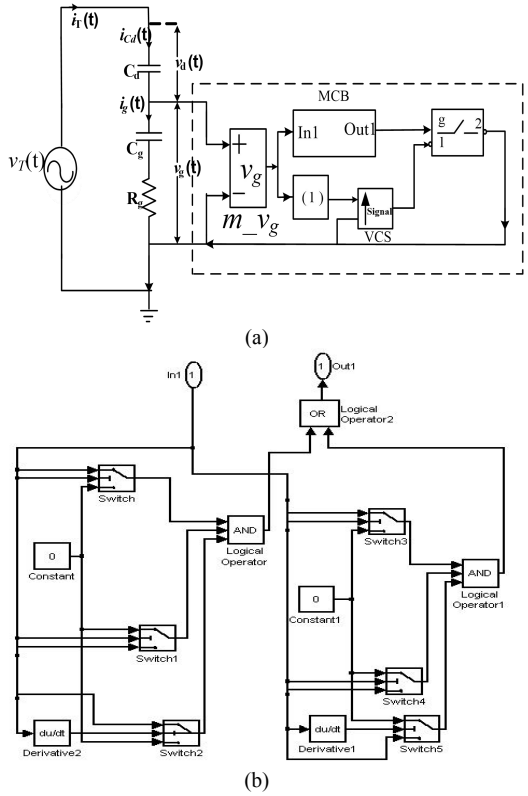
$$V_T(t) = V_g(t) + V_d(t) \quad (5)$$

$$i_{Cd}(t) = i_g(t) + i_{dis}(t) \quad (6)$$

$$i_{Cd}(t) = C_d\frac{dV_d(t)}{dt} \quad (7)$$

$$i_{dis}(t) = C_d\frac{dV_T(t)}{dt} - (C_d + C_g)\frac{dV_g(t)}{dt} \quad (8)$$

The proposed DBD electric model has been implemented on Simulink by MATLAB, as seen in Fig. 3. It contemplates the previous electrical analysis and the already described electric configuration. The measurement of the applied voltage is carried out by the m_v_g block and the equivalent signal is sent to In1 of the MCB block., and the MCB block works as an on–off control of the microdischarges. The resultant waveform of this product is the microdischarge waveform that controls the VCS voltage–current controlled source. MCB works in the two states， "1"and "0". When the MCB output is "1", the ideal switch is closed. The output current i_{dis}(t) increases, as described by (3). When the MCB output is "0",the ideal switch is open. The microdischarges is extincted, and $i_T = i_g$.



(a)

(b)

Figure 3. (a) Proposed DBD Simulink/MATLAB model and (b) MCB

Ⅳ.Simulation Process

The proposed high-power system is mainly composed by the DBD model, driven by an (HV) source. In order to validate the proposed-model simulation, experimental tests have been carried out with atmosphere. The capacitance values in the model are those obtained with equations (1) and (2). The breakdown voltage V_b can be deduced [9].The calculated gas capacitances, breakdown voltage, α parameter value, and voltage source excitation frequencies are listed in Table I

Table I
Simulation Prameters as a Function of the Appled Gas

C_d/pF	C_g/pF	V_b/kV	α	Exciation fre -quency/kHz
438	173.4	3.667	5	24.15

Departing from the obtained simulation results, the three most influential electrical parameters i_T (t) υ_g(t), and υ_T (t), have been considered in Fig. 4 and Fig. 5 in the cases of atmosphere. With the database of the accumulated charge and the applied voltage, the Lissajous diagram at the operating frequencies was traced in Fig. 6.

Ⅴ .Results and Discussion

Fig 7 presents some experimental measures of the voltage v_T (t) and the total current i_T(t) where the ignition and extinction conditions are appreciable.

The electrical simulation model was run at the same values of operating frequencies and the same values of amplitude of the applied voltage. The period of the microdischarges was set to order of the nanoseconds. During the discharge process, the gas gap voltage remains unchanged.

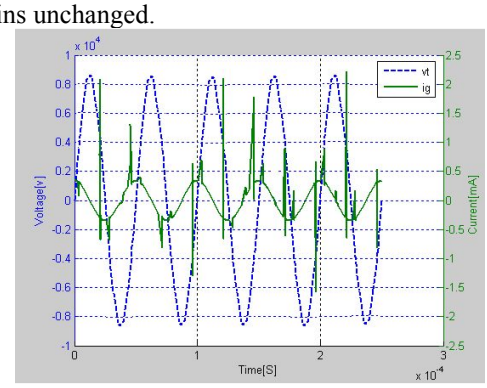


Figure 4. Theoretical vT and iT at 24.15kHz

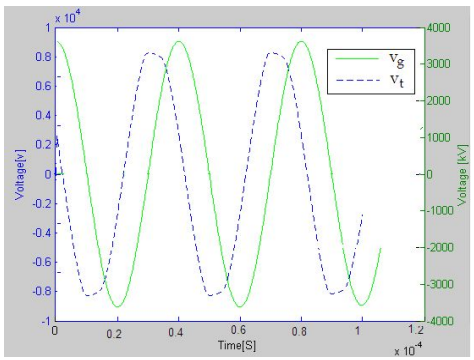


Figure 5. Theoretical vT and vg at 24.15kHz

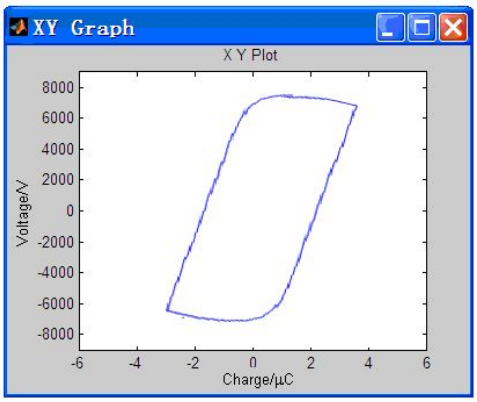


Figure 6. Theoretical vT versus q(t) Lissajous diagram 24.15kHz

The latter characteristic of the energy transferred to the cell has been calculated applying the Lissajous Q–V diagram, which is shown in Fig.7.It should be noticed that the simulation conditions have been maintained. There exists a considerable similarity between the experimentally measured values, those produced by Simulink/MATLAB. The efficiency of the process clearly increases at greater excitation frequencies and larger amplitude of the applied voltage in the discharge. The Lissajous Q–V diagram changes gradually from the parallelogram to the similar ellipse [10].

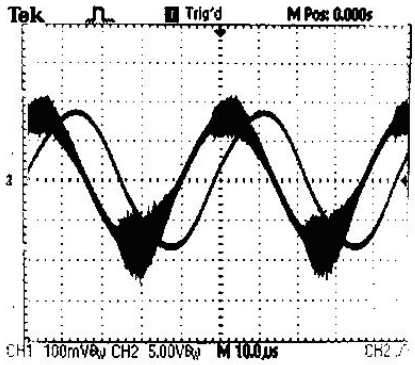


Figure 7. Experimemtal vT and iT at 24.15kHz

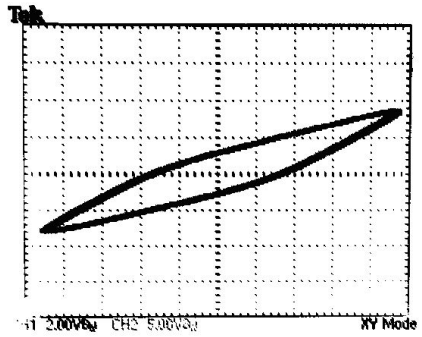


Figure 8. Experimemtal vT versus q(t) Lissajous diagram24.15kHz

VI. CONCLUSION

The flexibility of the proposed model enables one to adjust several parameters the α factor and the breakdown voltage V_b in order to obtain a faithful simulation outcome. External model parameters such as the excitation frequency and applied voltage amplitude $\upsilon_T(t)$ can also be changed so as to check their effects on discharge parameters like the breakdown voltage V_b, total voltage υ_T (t), current i_T (t), and, in particular, those which are not measurable in the real process such as the dielectric voltage $\upsilon_d(t)$ and the gas voltage $\upsilon_g(t)$. These advantages considerably facilitate the design of an appropriate HV power supply for DBD applications.

A series of experiments with electric discharges in a DBD reactor at atmospheric pressure has been carried out. The experimental results were satisfactorily compared with the simulation predictions of the proposed DBD reactor model. Thus, the model allows one to both predict with accuracy the discharge behavior using the experimental parameters and verify the power condition of the system at quasi-high-frequency. The most importance is that the powerful electrical parameters can be provided for the plasma source design.

ACKNOWLEDGMENT

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