Development and Application of Computer Simulation Technology in Equipment Diagnosis

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ABSTRACT : *With the development of computer hardware and software, computer simulation technology has been widely used in equipment diagnosis. Under the comprehensive application of control theory, mathematical algorithm and software science, computer fault diagnosis has gradually formed a new discipline, which effectively solves the problem of equipment fault diagnosis. According to the principle of computer simulation technology, this paper analyses its development and application status. Through this research, the development of computer fault diagnosis technology can be promoted to a certain extent.*

KEYWORDS -*computer; simulation; diagnosis; control*

I. INTRODUCTION

Computer simulation technology belongs to a science in the field of computer. It integrates graphics, sound and so on. It is manifested in multi-dimensional form, which is conducive to the analysis and treatment of practical problems for engineers and technicians. This technology requires good human-computer interaction [1]. With the development of computer hardware and software, simulation has become a conventional technology in various industries and fields. For equipment diagnosis, the experimental method is inefficient and contingent. It needs many experiments to satisfy the need. Computer simulation technology can effectively solve this problem and has a very good application effect in equipment diagnosis.Computer fault diagnosis of automobiles is shown in Fig.1, which has obvious intuition and convenience.

Fig.1 Computer fault diagnosis of automobiles

Computer simulation technology is the most important part of system simulation. It combines engineering control theory and mathematical algorithm, requiring technicians to have significant engineering background. Software simulation requires good hardware support, and the development of hardware technology promotes the ability of software development [2]. In engineering, computer simulation technology is an important means of R&D. It can not only solve the cost problem, but also effectively shorten the R&D cycle, improve the safety and quality of equipment. It is also one of the important indicators reflecting the technical level of enterprises.

II. PRINCIPLE OF COMPUTER SIMULATION TECHNOLOGY

2.1 Basicprinciples of simulation

The research object in engineering, such as sudden equipment failure, is generally difficult to directly carry out mathematical calculation or computer processing. This requires the establishment of an effective mathematical model, which can reflect the essence of Engineering problems, and also meet the characteristics of computer processing, that is, to transform engineering problems into computer-processable mathematical models [3].

Mathematical model is a typical Abstract model, which does not have good human-computer interaction. Therefore, computer software needs to integrate mathematical rules into simulation models. Technicians only need to input specific boundary conditions to obtain the essential characteristics of the subject. In other words, the computer simulation method belongs to the three-dimensional analysis method, which has better intuition and operability. With the upgrading of analysis software, the mathematical models of

internal integration are more and more abundant, and the engineering problems that can be dealt with are more comprehensive. From the perspective of the object of study, the main steps of computer simulation include: model building and model processing. The method of computer simulation combined with some experimental verification has a very good application effect in engineering.

2.2. Model building

The construction of the model is the first step in the execution of computer simulation, which converts abstract objects into visual systems and at the same time, gives precise boundary conditions or constraint equations. The whole process is the transformation from mathematical model to computer model, and it is also the key point to test the technical personnel's business ability. Generally, according to the time correlation, the mathematical models can be divided into static model, continuous time dynamic model, discrete time dynamic model and mixed time dynamic model. According to the requirements of variables, the mathematical model can be divided into continuous variable system model and discrete event system model. It can be seen that the construction of the model needs repeated debugging to meet the accuracy requirements. For example, the stereo causality modeling and uncertainty reasoning in dynamic fault diagnosis is shown in Fig.2.This modeling method can meet the dynamic, real-time and high reliability fault diagnosis requirements of complex systems, and overcome the dynamic uncertain causality.

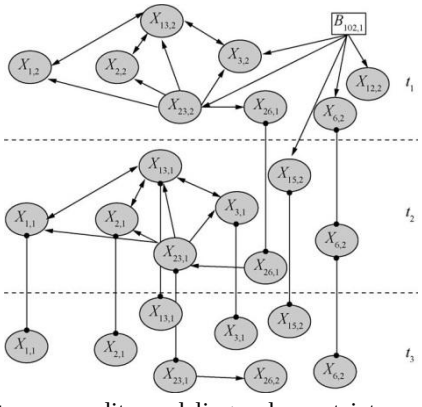

Fig.2Stereo causality modeling and uncertainty reasoning in dynamic fault diagnosis

2.3 Model processing

After the computer simulation model is built, it needs to be processed to be recognized directly by the computer processor, that is, to complete the conversion of computer language. The whole process is usually equipped with special software modules. Because the process is relatively simple, the module can also be developed by itself.

The computer simulation model transformed or processed can be directly imported into software for analysis. This process often needs to consume a large amount of computer memory, at the same time. There are certain requirements for processors. However, when the simulation results come out, it cannot be directly identified as the final accurate value, which needs to be gradually verified by reliability experiments. At present, the common methods are confidence channel method and reverse verification method of simulation process.

III. APPLICATION OF COMPUTER SIMULATION IN FAULT DIAGNOSIS

3.1. Model diagnosis

Faults of equipment generally include mechanical and electrical faults. For the research of fault diagnosis, after years of development, a variety of mathematical algorithms have emerged. For example, neural network algorithm (as shown in Fig.3), particle swarm optimization algorithm [4]. There are some difficulties in applying these algorithms to computer simulation calculation.

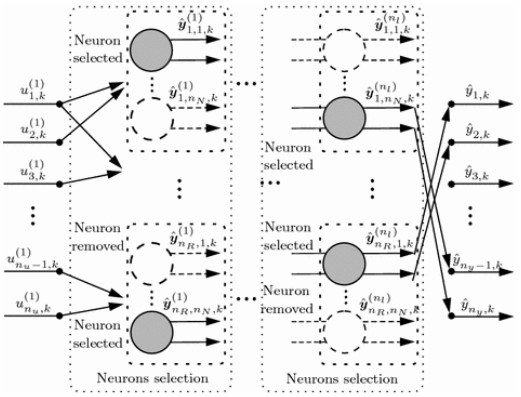

Fig.3Neural network algorithm

Many fields also depend on manual programming, which limits their further application to a certain extent. In addition, there are many diagnostic models, such as Support Vector Machine (SVM), whose calculation process is based on VC theory and structural risk minimization principle, which has good application effect for fault sample collection. Small sample is the development trend of fault diagnosis simulation technology, that is, to obtain more complex

functional relationships based on limited sample information. SVM has good non-linear processing ability, and uses the principle of minimization to improve the local rationality of samples. It is also applied to regression analysis, probability prediction and fault estimation. The combination of wavelet analysis is a necessary means of fault diagnosis, which can greatly enhance the extraction efficiency of feature vectors.

3.2. Wavelet analysis

The application of wavelet analysis in fault signal monitoring has been widely verified. Wavelet Packet Analysis (WPA) decomposes the collected signals, i.e. carries out frequency band analysis. These vibration signals need to be amplified in a certain range, and then statistics and analysis can be realized. In the whole process, the eigenvector is used to express the signal characteristics, that is, to analyze the energy in the frequency band of the signal. In the process of computer simulation, the conversion from time domain to frequency domain is often indispensable [5]. As a typical frequency domain analysis method, Fourier transform can be implemented by computer. Combining Fourier transform with wavelet analysis can effectively eliminate unsteady factors in fault signals, as shown in Fig.4. In other words, because Fourier analysis uses sinusoidal signals, there are many unreasonable in signal processing. Wavelet analysis can distribute signals in arbitrary frequency bands, which helps to simplify Fourier analysis.

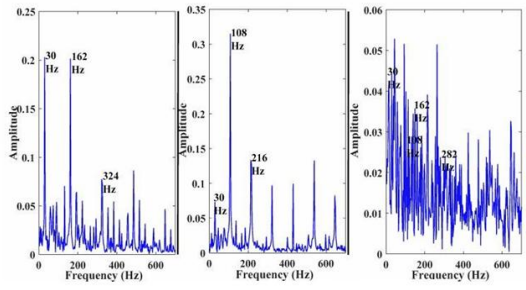

Fig.4 Fourier transform with wavelet analysis

3.3. Development of Computer Simulation in Fault Diagnosis

Equipment failure often has complexity and non-linearity. The inducing factor may be a single variable or a multi-factor mapping effect. The efficiency and accuracy of fault diagnosis can be improved by computer simulation, and the fundamental factors can be obtained more fully by mathematical method to prevent the omission of some specific fault factors. In addition, multi-image modeling is also one of the development directions of computer simulation. Taking rotating machinery as an example, the diagnostic method based on computer simulation can effectively improve the robustness.

At present, there are many kinds of computer simulation software with various functions. Choosing reasonable simulation software is also an important part of computer simulation analysis. When designing or optimizing the simulation software, on the one hand, we need to consider the engineering background and integrate the technical personnel's understanding of data modeling; on the other hand, we should give full play to the advantages of the software's interactive interface and pay attention to maintenance methods. Taking MATLAB as an example, this software is very powerful comprehensive mathematical software, which has a good application effect in fault diagnosis simulation. Common mechanical or electrical faults are not intuitive enough, but in the SIMULINK toolbox, there is a rich library of components, including mechanical parts and electrical components. The development and application of computer simulation software is the main direction of the development of intelligent diagnosis technology, and also an important indicator to measure the level of industry development.

IV. CONCLUSION

Advanced fault diagnosis process cannot be separated from computer simulation analysis, which is also the development trend of fault diagnosis system. Computer simulation based on image processing will be more advantageous, and can occupy a good advantage and market conditions in the industry or field. At present, simulation analysis with high reliability is still inseparable from the professional qualities of technicians. In order to further meet the needs of industry, more intelligent simulation analysis still needs to be further studied.

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