The Optimization Method of Mechanical Fault Diagnosis Based on Artificial Intelligence Technology

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Abstract. In order to overcome the problems existing in the traditional mechanical fault diagnosis, and to improve the accuracy of mechanical fault diagnosis, an optimization method of mechanical fault diagnosis based on artificial intelligence technology is proposed in this paper. The optimization method combines a variety of current popular high and new technologies, such as artificial intelligence technology, expert system and artificial neural network technology. at the same time, the optimization method also breaks the traditional mechanical fault diagnosis mode based on fuzzy set theory. Based on this, the optimization method also makes an in-depth analysis and research on artificial intelligence technology, which promotes the application and development of artificial intelligence technology, and expands the application scope and application field of artificial intelligence technology. The research results show that the optimization method can scientifically overcome the problems existing in the traditional mechanical fault diagnosis, and can improve the accuracy and scientificness in the process of mechanical fault diagnosis, so it has strong feasibility.

Keywords. Artificial intelligence technology; Science and technology; Mechanical fault diagnosis; Optimization method

1. Introduction

With the development of industrial modernization and automation, The traditional mechanical fault diagnosis method can no longer meet the safety requirements of production equipment. More and more experts and researchers gradually apply artificial intelligence technology. It can be effectively applied to the fault diagnosis of mechanical equipment in enterprises. And gradually combine several intelligent technologies for the modern management of enterprise equipment, To provide a certain technical basis for the improvement of the comprehensive efficiency of enterprises, So as to create greater economic benefits for enterprises.

2. Theoretical Basis

2.1. Artificial Intelligence Technology

Artificial intelligence technology is a comprehensive technology. It belongs to the field of technological science, and it is regarded by a large number of experts and researchers as a new product of the 21st century. Can bring great changes to human life and work. Artificial intelligence technology has three
characteristics. They are simulation, extensibility and expansibility. Artificial intelligence technology, in essence, it is a technology that can simulate human thought and behavior [1]. It can also scientifically and appropriately extend and expand human thinking and serve the high and new technology of mankind. In addition, artificial intelligence technology is based on the most advanced scientific and theoretical knowledge of the 21st century. Covering a variety of comprehensive science and technology. For example, cloud computing technology, big data technology, etc. At the same time, people gradually realize that artificial intelligence technology has strong expansibility. It can help the major industries to further update and optimize. Three characteristics of artificial intelligence technology is shown in figure 1.

![Figure 1. Three characteristics of artificial Intelligence Technology](image)

Artificial intelligence technology, in essence, It is an emerging technology that relies on high-tech machines. Or you could say, In order to realize the intelligence of major industries, artificial intelligence technology is born. In addition, artificial intelligence technology is an important component in the computer field, which can imitate human behavior and way of thinking. And then make an appropriate scientific response to the tasks sent by human beings.

At present, more and more experts and scholars have begun to conduct in-depth research and discussion on artificial intelligence technology. In addition, more and more experts and researchers begin to think that artificial intelligence technology has strong intelligence and convenience. It can change the way people live and work to a certain extent. Therefore, more and more researchers and experts are constantly analyzing and studying artificial intelligence technology. And skillfully combine artificial intelligence technology with science in other fields. And then promote the development and application of artificial intelligence technology in many fields. In addition, this has also promoted the continuous development of the major traditional industries in the direction of intelligence. At the same time, our citizens are also aware of the powerful intelligence of artificial intelligence technology [2]. It is not only the crystallization of human wisdom, but also an important research achievement of experts and scholars in the 21st century. Moreover, artificial intelligence technology can also play its own function of information collection. And then accurately imitate the way of human thinking and behavior, so as to provide high-quality and scientific services for human beings. However, it is worth noting that. Artificial intelligence technology needs to be distinguished from human intelligence. Moreover, in the process of using artificial intelligence technology, The problems that experts and researchers should pay attention to are a series of social problems such as ethical and moral problems in the application of artificial intelligence technology [3].

2.2. Mechanical Fault Diagnosis

Mechanical fault diagnosis is no stranger to people. It appears frequently in people's practice. In addition, mechanical fault diagnosis, in essence, It is an important technology in daily life. Moreover, mechanical fault diagnosis is not only a clear and accurate analysis and study of the specific conditions of the machine in the process of operation, but also timely analysis and diagnosis of whether the current machine operation is normal or not. When the machine is running. When there is an abnormality, the mechanical fault diagnosis can be fed back to the staff in time. At the same time, mechanical fault diagnosis can find the cause of machine failure in time. And carry on the systematic analysis, thus generate the fault analysis report [4]. In addition, it is worth noting that mechanical fault diagnosis, which can also comprehensively and systematically predict the direction and trend of fault development, which provides great convenience for mechanical fault diagnostics and mechanical fault maintenance personnel. Save their energy and time, and then improve the work efficiency of the major industries, but also improve the profit margins of the major enterprises. Main ways of mechanical fault diagnosis is shown in figure 2.
Fault diagnosis technology, in essence, is used by experts and researchers in fault diagnosis devices and fault diagnosis instruments. However, with the rapid development of science and technology, For example, computing technology, embedded technology and various instrument technologies based on virtual reality technology, fault diagnosis technology has also undergone earth-shaking changes. At the beginning, fault diagnosis devices and instruments were mainly analog monitoring instruments. With the development and integration of science and technology, After that, the fault diagnosis device is gradually developed on the platform of computer technology, and it has the functions of real-time and on-line monitoring. Finally, the fault diagnosis system has gradually been based on microcomputers. Its size has gradually shrunk and become a convenient and portable monitoring and analysis system.

The system based on fault diagnosis technology has powerful analysis function and management function. It is mainly reflected in the in-depth analysis and research of the signal, as well as the accurate collection and management of data [5]. In addition, the fault diagnosis technology has a powerful comprehensive function, which can scientifically and comprehensively collect various indicators of the running state of the machine. Fundamentally speaking, it can improve the accuracy and scientificalness of fault diagnosis. At present, more and more experts and researchers begin to analyze and study fault diagnosis technology. Organic combination of process distribution technology and fault diagnosis technology. This has also become one of the research hotspots of current research scholars and experts.

3. Application Direction of Artificial Intelligence Technology in Mechanical Fault Diagnosis

Mechanical fault diagnosis, in essence, can collect specific information about the operation of all kinds of machines. And analyze and study these specific information, and then judge the current running state of the machine. If the mechanical fault diagnosis determines that the machine is in a normal state, the machine will continue to be monitored in real time. If the mechanical fault diagnosis determines that the machine is in an abnormal state, The root cause of the abnormal state of the machine is further analyzed. Furthermore, the development trend of the fault is analyzed, and the corresponding solutions are put forward for the staff.

Mechanical fault diagnosis can be divided into two parts, one is fault mechanism, the other is technical detection. These two are also two indispensable contents of mechanical fault diagnosis. In addition, mechanical fault diagnosis, in essence, depends on the basic theory of mechanical fault and the principle and method of mechanical fault. Mechanical fault diagnosis, specifically, is a science and technology of signal processing. It is also a kind of science and technology with powerful pattern recognition.

For example, in engineering, typical expert systems include Saxon system, delta system, and actor system, which can help engineers discover structural analysis problems, delta system, and actor system, which can help operators detect and deal with nuclear reactor accidents. Modern industry is developing faster and faster. Therefore, experts and researchers have higher and higher requirements for production equipment and become more and more complex, which requires experts and researchers to discuss and study all aspects of production equipment comprehensively. This includes the feasibility, safety and maintainability of the equipment in the course of operation, and enables the operator of the production equipment to operate and operate freely. Or once a fault occurs, it can be diagnosed timely and accurately and can be quickly eliminated [6].

Nowadays, the technology of mechanical diagnosis is the basic method to carry out modern management equipment and improve the comprehensive benefit of mechanical diagnosis technology. For instance, In terms of fault diagnosis, in 1967, under the initiative of NASA, the U.S. Naval Research Office presided over the U.S. mechanical failure prevention group, actively engaged in the research and development of fault diagnosis technology. At present, all kinds of fault diagnosis and maintenance expert
systems have been used in the fault diagnosis and maintenance of active equipment such as F-15 fighter, B-1B bomber, naval vessels, Army Ordnance devices, etc. After a large number of operations, we have learned that in order to reduce the cost of technical maintenance, in order to achieve greater economic benefits, we must take the technology of mechanical vibration detection and mechanical fault diagnosis as the basis. This can also avoid unnecessary accidents. Ensure the safety of equipment and equipment operators, so that productivity can be continuously improved.

In the past, this traditional method of mechanical fault diagnosis can well deal with simple operation process, simple fault and so on. With the continuous development of modern technology and automation technology, the technical requirements for equipment are getting higher and higher, and a variety of operating procedures are also needed. It is inevitable that there will be a lot of failures, and even sudden failures will occur. This requires experts and researchers to develop mechanical fault diagnosis methods suitable for modern production of science and technology. Then we must use science and technology to improve the traditional technology of mechanical fault diagnosis. Open up a new mechanical fault diagnosis technology, and this new mechanical fault diagnosis technology is also widely used in the operation of enterprises. It is believed that this will be the trend of modern mechanical fault diagnosis [7].

4. The Optimization Method of Artificial Intelligence Technology in Mechanical Fault Diagnosis

Artificial intelligence technology must be applied to optimize mechanical fault diagnosis. Artificial intelligence is to explore the simulation of human behavior and the technical methods used. Through the promotion of human intelligence, applied to machine intelligence.

4.1. Expert System

Expert system is an intelligent computer program system, which imitates human experts to solve domain problems. The expert system is shown in figure 3. This computer software system is a widely used artificial intelligence technology. The expert system is mainly composed of knowledge base, inference engine and man-machine interface. It is a practical discipline that came into being in the early 1960s. The expert system, a computer software system, In the aspect of knowledge expression, it is obtained according to the existing artificial intelligence language and the expression in accordance with human psychological logic [8]. And make people's acceptance and use and a wide range of applications. In order to achieve obvious results in mechanical system fault diagnosis, analog reasoning logic is mostly used in expert systems to reduce the complexity of the system. The discussion of mechanical fault diagnosis expert system and the gradual development of mechanical fault diagnosis expert system is one of the most remarkable achievements in this field.

![Figure 3. The expert system](image)

4.2. Artificial Neural Network

Artificial neural network, in essence, is a powerful and complex network. In addition, to be exact, it has countless neurons, which are organically and scientifically combined. And the artificial neural network is based on the biological nervous system, and can accurately imitate the nervous system. Generally speaking,
the artificial neural network is determined by two characteristics, namely, the activation characteristic and the connection mode.

Artificial nervous system, because it has the characteristics of fault tolerance, memory, association and dealing with mechanical complex patterns, This enables timely tracking and monitoring of a series of problems arising from the complex operation of mechanical equipment. For example, the causes of a variety of failures are traced back, the location is identified and reasonable maintenance is carried out. So as to save the maintenance cost, save the maintenance time, etc. All these can play an important and positive role in mechanical fault diagnosis [9].

4.3. Fuzzy Set Theory

Fuzzy set theory, that is to say, it is not clear and fuzzy. Thus there is uncertainty. The effective way to deal with this uncertainty scientifically is the fuzzy set theory established in 1965.

In order to reduce the complexity of the problem, we must deal with the incomplete and uncertain factors in the information vaguely. Fuzzy logic belongs to the extension of multi-valued logic, so it can complete approximate reasoning. This can not be done by traditional mathematical methods.

The method of fault diagnosis for analog circuits has been proposed, in essence, It is a method of fuzzy fusion of a variety of electricity and tested information [10].

A diagnostic algorithm for the fusion of fuzzy information of circuit gain and measurable point voltage, Can diagnose the fault of fusion. It is shown in figure 4. Through the simulation experiment, it is concluded that these methods play an obvious role in improving the mechanical system, fault location and accuracy.

![Figure 4. The optimization method of artificial intelligence technology in mechanical fault diagnosis](image-url)

5. The Development trend of Artificial Intelligence Technology in Mechanical Fault Diagnosis

With the continuous development of the machinery industry, the demand for mechanical fault diagnosis technology is getting higher and higher. Therefore, more and more researchers begin to study and analyze the topic of mechanical fault diagnosis. And try to combine various high and new technologies with artificial intelligence technology. So as to improve the work efficiency and application rate of artificial intelligence technology, And improve the scientific nature of various industries, and then promote the development of traditional industries in the direction of intelligence.

At present, there are three main methods of artificial intelligence. They are expert system, artificial neural network and fuzzy set theory, each of which has its own advantages and limitations.

Expert systems have been widely used in many fields. However, the existing knowledge is difficult to maintain, the scope of application is narrow, and the diagnostic ability is weak. Of course, with the development and infiltration of knowledge and technology, The theory and method of expert system can be improved. The above problems are gradually alleviated or eliminated. This requires the combination of several methods, such as fuzzy logic, fault tree and machine learning methods.

The application of neural network technology can make up for the problems encountered in the application of traditional expert systems, but there are still limitations in fault diagnosis. For example, the error of artificial neural network extrapolation is relatively large, it is difficult to ensure the accuracy and fault tolerance; It is difficult for artificial neural network to realize the logical reasoning of structured knowledge. There is also a lack of explanatory ability, and the diagnostic results are not easily understood by the operator.
The intervention of fuzzy set theory, the fault diagnosis of the corresponding intelligent diagnosis system can be improved in terms of more mature principle, more perfect technology, fault tolerance and so on. Maintainability problems, the treatment of uncertain factors can only be limited improvement.

6. Conclusion

With the rapid development of modern industrialization, the requirements for the safety and reliability of equipment in production enterprises are getting higher and higher. Mechanical fault diagnosis can apply computer information technology and judge whether the running state of the equipment is normal or not according to the relevant information about the operation of the equipment. If there is an anomaly, the location and cause of the anomaly can be determined, the abnormal trend can be determined, and the maintenance method and reasonable cost can be judged by intelligent technology. Solve the problem as soon as possible to improve the economic efficiency of the enterprise. A novel optimization method of mechanical fault diagnosis based on artificial intelligence technology is proposed in this paper. It can not only improve the application range of artificial intelligence technology, but also improve the accuracy and scientificness of mechanical fault diagnosis. In a word, with the continuous development of artificial intelligence technology, more and more traditional industries in our country will continue to develop and update. And then promote the traditional industry of our country to develop in the direction of modernization and scientization.

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