Artificial Neural Network and Its Application in Mechanical Engineering

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Abstract: This paper first introduces the basic concept of artificial neural network, introduces the development history of artificial neural network, and analyzes the application of artificial neural network in mechanical engineering based on actual cases.

Keywords: Artificial Neural Networks; Mechanical Engineering

1. The concept of artificial neural networks

Artificial neural network is a complex network system composed of a large number of neuron-like processing units connected to each other, which is a simplification and simulation of the organizational structure and operating mechanism of the human brain. It establishes a highly nonlinear ultra-large-scale dynamic complex network system in the form of neurons, which is characterized by extensive connectivity, parallel processing and adaptability in multiple dimensions. The information processing of the neuron network is realized by the interaction between multiple neurons, which can effectively classify and process the information, and continuously optimize and adjust in the process to achieve better results.

2. Development of artificial neural networks

The development of artificial neural networks can be traced back to the 20s of the 40s of the century, and people began to study them. The famous American psychologist McLodge and mathematical logician Pitts proposed the MP model, which is a basic model with a simple structure and lays the cornerstone of artificial neural networks. In 1949, psychologist Hebb proposed the hypothesis of variable synaptic connection strength, which laid the foundation for the development of functional artificial neural networks. It was not until 1969 that it was discovered that artificial neural networks could not solve the problem of linear indivisibility, which led to a considerable period of downturn. Later, with the development of computer science, since the 80s of the 20th century, artificial neural networks have returned to people's field of vision, setting off a research boom. At this time, the artificial neural network model has been relatively mature, and people's research on it has been deepened, combined with powerful computers with data processing capabilities, people are slowly applying in many fields. For example, in the field of medicine, mechanical engineering, psychology, etc. have achieved unprecedented development. At present, hundreds of artificial neural network models have been developed, each with unique advantages and applied in different fields.

3. Application of artificial neural networks in the field of mechanical engineering

3.1 Application in troubleshooting

Failure is fatal to a machine or system. Even a minor failure can have a negative impact on the whole, rendering it lose its prescribed function. However, traditional troubleshooting methods place higher demands on technicians and corresponding costs. Therefore, in order to reduce costs, people are looking for new troubleshooting methods. The development of artificial neural networks has provided new solutions for it. For example, the transformer we are familiar with, as a kind of power equipment, plays an important role in the power system and machinery. There are two types of

transformer faults, one is an external fault and the other is an internal fault. Because external faults are easy to find and find, only internal faults are considered. Internal faults include overheating faults and discharge faults, the former being caused by internal local overheating or temperature rise; The latter is caused by various reasons such as impurities and poor contact. Therefore, there are many factors that cause failure, and traditional diagnostic methods are not suitable. The application of artificial neural networks can better solve these problems. BP network is a more mature network in artificial neural networks, which has many advantages such as non-linear mapping ability, self-learning and adaptability, and classification. Through its learned algorithm and neural unit processing, it constantly adjusts and corrects the weight between each neural unit, so as to achieve the purpose of quickly and efficiently diagnosing the internal faults in the transformer, greatly improving the accuracy of diagnosis and reducing maintenance costs.

3.2 Application in monitoring and control

Complex machining is a very complex processing process, which will be affected by many factors such as environment and processing technology. Therefore, it is very difficult to monitor and control the processing process, and the operation requirements for technicians are relatively high. The development and application of artificial neural networks can improve this situation and realize monitoring and control in the machining process. The automotive gearbox is one of the indispensable and important components as a part of the car. It not only controls the speed of the vehicle, regulates the load on the engine, but also improves fuel economy. And its fatigue life has become the most important factor restricting it. The fatigue life monitoring test of an automotive transmission is a complex test that tests a variety of properties, and the results are generally judged by the operator through hearing and experience. This can lead to inaccurate results and unreliable data. Therefore, the search for the monitoring and control system of fatigue life of automobile gearbox has become the direction of exploration of scientific research and technical personnel. As a simplified simulation of the tissue structure and operation mechanism of the human brain, the artificial neural network can effectively monitor the fatigue life status of the automobile gearbox. First of all, before monitoring and controlling it, we need to select the characteristic parameters that represent its state, through which we can use the BP artificial neural network to judge the state. These parameters are used as input parameters, and the algorithm learned by the BP network is used to continuously adjust the weights to reflect the characteristic parameters; At the same time, it is constantly learning to improve the accuracy of the system's judgment. This information can be used as an effective reference for judging the state of good or bad. Combined with the automation of machinery, make full use of the ability of artificial neural networks to select, extract, monitor and control parameters, and realize the monitoring and control of fatigue life of automobile gearboxes.

3.3 Application in Automation

With the development of the economy, the innovation of science and technology, the market demand for products is increasing, more and more types, the requirements of the division of labor are getting higher and higher, and the more mature automation technology can no longer meet this phenomenon. As a result, the automation field also needs to find new technologies and algorithms to improve efficiency and accuracy in order to meet the different needs of the market. Artificial neural networks offer a new direction in the field of automation. Performance is an important criterion to measure the quality of a product, and performance testing is an indispensable process in the product design process. Traditional performance testing is mainly manual, and the results are obtained through the observation, calculation and processing of testers. However, when the tested parameters become more complex and complex, it will bring a very large workload, seriously reduce work efficiency, and the test data obtained may not be comprehensive. The application of more mature automated test systems solves this problem, but it cannot meet the growing market demand, and the application of artificial neural network technology will optimize the structure and function to make it go to a higher level. The application of BP artificial neural network in automated testing highlights its characteristics of non-mapping, self-learning ability and super computing power, and can use different algorithms to calculate data and organize and summarize according to the program code and initial data provided by people, greatly improving work efficiency and comprehensiveness of results, and realizing the development and

optimization of automation technology.

4. Concluding remarks

This article introduces the characteristics and development history of artificial neural networks, focusing on their application in the field of mechanical engineering. The development of artificial neural networks has provided new ideas and directions for different research fields, and its advantages have been fully applied to production lines in many industrial fields. Although the development of artificial neural networks is still in the initial stage of development, theoretical research is greater than practical application, but with the development of technology and the deepening of scientific research, it is believed that artificial neural networks will be widely used in the field of mechanical engineering in the near future.

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