

Study on an Intelligent Ferrography Diagnosis Expert System

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Wear is one of the main factors causing breakdown and fault of machine, so ferrography technique analyzing wear particles can be an effective way for condition monitoring and fault diagnosis. On the base of the forward multilayer neural network, a nodes self-deleting neural network model is provided in this paper. This network can itself delete the nodes to optimize its construction. On the basis of the nodes self-deleting neural network, an intelligent ferrography diagnosis expert system (IFDES) for wear particles recognition and wear diagnosis is described. This intelligent expert system can automatically sum up knowledge by learning from samples and realize basically the entirely automatic processing from wear particles recognition to wear diagnosis.

Keywords: ferrography technique, neural network, expert system

1. INTRODUCTION

Wear is one of the main factors causing fault of machine, with about 80% fault produced by wear^[1], so ferrography technique for wear diagnosis proves promising wide outlook. However, due to its complexity and randomness, ferrography technique has been carried out by domain experts who have enough experiences, which limit development and generalization of ferrography technique. These questions are more likely solved by an Intelligent Ferrography Diagnosis Expert System (IFDES) which is presented to realize the automation of ferrography diagnosis.

2. IFDES STRUCTURE

IFDES is developed to simulate domain expert analysis. Its main aim is to sum up ferrography workers' experiences by simulating analysis course done by them and automate ferrography analysis. With this idea, we give the system structure as figure 1. According to the information flow, the system has three layers: the layer capturing wear particles micro images, the layer recognizing wear particles, and the layer diagnosing wear faults.

3. A NODES SELF-DELETING NEURAL NETWORK

A forward three layers neural network is employed to finish wear particles recognition and wear diagnosis in the IFDES. It should be trained before it works, and the aim to train the network is to make it learn knowledge from the samples given by experts. Backpropagation algorithm is often employed to train the forward neural network. The size problem is the most important to improve the ability to learn and have a good generalized property. The principle to give the node number of the neural network is to use the minimum nodes to realize the all sample maps. According to this regular, we develop a nodes self-deleting neural network to solve this problem. It is to say that the enough nodes are initially given, and the network can self delete the redundant nodes according to the similarity among different nodes when being trained.

4. KNOWLEDGE GAIN, EXPRESSION AND INFERENCE OF IFDES

This system is developed on the basis of the nodes self-deleting neural network, so its knowledge gain, expression and inference at the wear particles recognition and wear diagnosis relate naturally the features of a neural network. The knowledge in this system is gained by the learning of neural network, which is a course adjusting weights according to a certain learning algorithm. The course updating knowledge is the one that the neural network learns again. When the new knowledge is needed to add to the system, the network may learn again from the samples to which the new samples have added. So if you want to update the knowledge database, you can only update the samples and then let the network learn again.

The knowledge is hidden in the system by transforming the knowledge into the weights of the network, and it is dispersedly stored in the weights. The knowledge gain and expression is completed at the same time. The knowledge inference is the course that the system works. After the input features are given, the system can automatically infer by the numerical computation on the basis of the weights of network.

5. CONCLUSIONS

- 1) The system realizes the wear diagnosis automation, which includes micro image capture, wear particles recognition and wear diagnosis.
- 2) Overcome on some degree the disadvantages of traditional expert system by using fuzzy neural network.
- 3) The nodes self-deleting neural network can be auto optimize the structure, which solves basically the main problems on a forward multilayer neural network.
- 4) Knowledge gain, expression and inference are convenient because the artificial neural network suits the nonlinear problem of ferrography diagnosis.

7. REFERENCES

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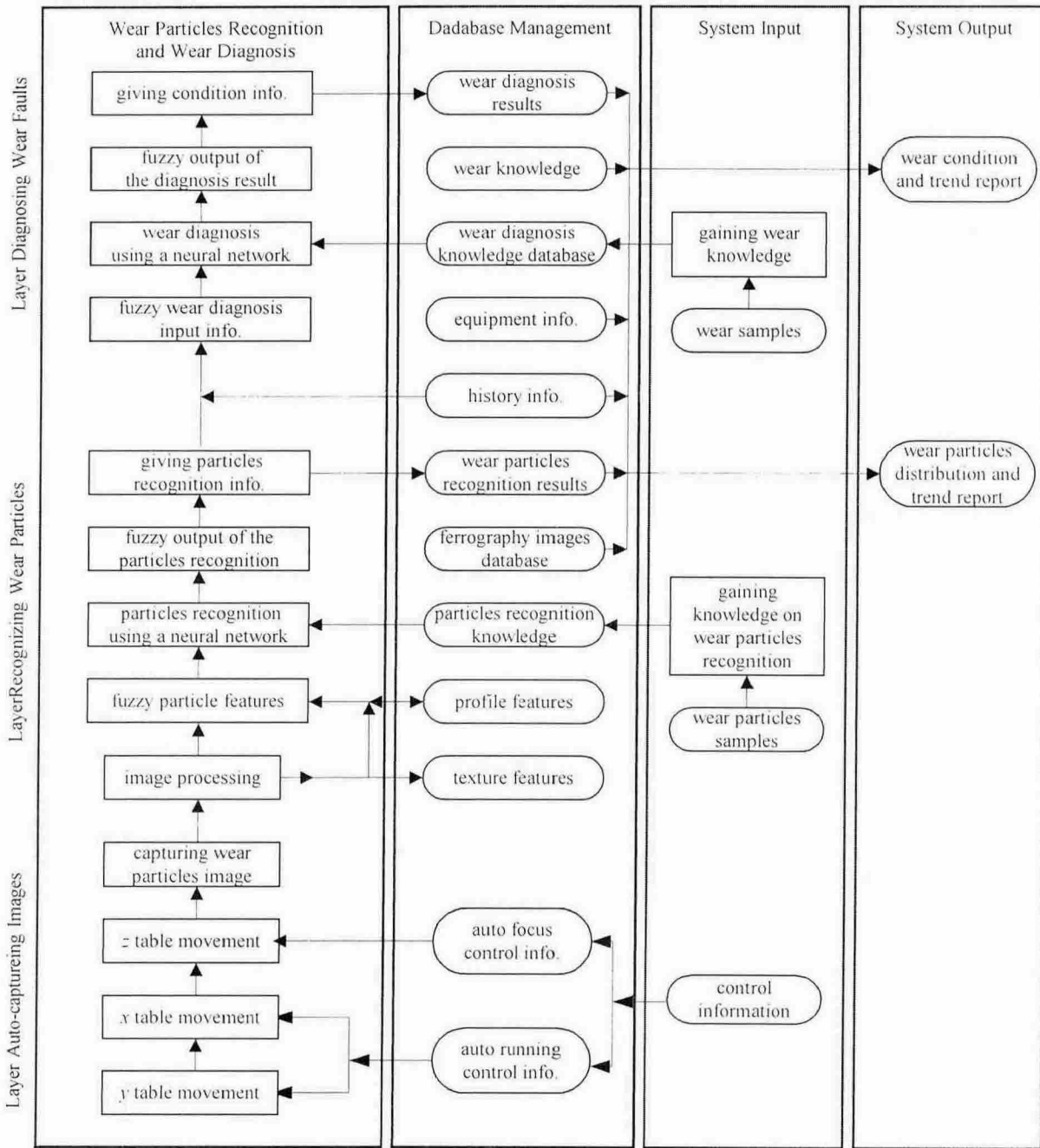


Figure 1. IFDES Structure

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