Research on technical condition evaluation of marine diesel engine based on information fusion

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Abstract: In order to accurately grasp the technical condition of marine diesel engine, it is necessary to evaluate the technical condition of marine diesel engine. However, the current research on the technical condition evaluation of marine diesel engine is not perfect. The current evaluation method cannot completely and accurately reflect the real situation of the equipment. The technical condition evaluation of marine diesel engine has its own characteristics and difficulties, that is, the diversity of the technical condition, the complex relations among condition, the numerous potential factors affecting the condition, and the large uncertainty in the evaluation process. To improve the accuracy of the evaluation, this paper proposes a technical condition evaluation model based on information fusion, which improves the accuracy of evaluation by integrating multi-source information.

Keyword: marine diesel engine; technical condition evaluation; information fusion

1. Introduction

The extensive use of marine diesel engines in ships is the key to the safe operation of ships [1]. Due to the poor use of marine diesel engines, in order to ensure the safety of ships, it is necessary to assess their technical status in order to grasp their technical status in a timely and accurate manner.

In order to grasp the technical status of marine diesel engine in a timely and accurate manner, it is necessary to evaluate its technical status [2]. However, the current study on the technical status evaluation of marine diesel engines is not perfect enough. The current evaluation method does not fully reflect the true situation of equipment, and there are certain deficiencies and limitations. The structure of marine diesel engines is complex, and there are many parameters that can be used for evaluation, including aerodynamic thermal parameters such as temperature, pressure, speed, and vibration, as well as historical data, test parameters, and control information. And this information is likely to be vague and uncertain. At the same time, the evaluation of the technical state of marine diesel engine has its own characteristics and difficulties, that is, the technical state of marine diesel engine is diverse, the connection

between states is complex, and there are many potential factors that affect the technical state, and there are large uncertainties in the evaluation process. In order to improve the accuracy and accuracy of the assessment, the uncertainty of this information must be minimized during the assessment process. Therefore, in the assessment process, multi-source information on the subject of the assessment should be obtained from all aspects to obtain more accurate and reliable assessment results.

With the increasing amount of information acquired, it is difficult for a single assessment technology to handle this vast amount of information, and it is therefore very necessary to study and adopt information fusion technologies suitable for the assessment area. In this paper, a model of marine diesel engine state evaluation based on information fusion technology is proposed to improve the accuracy of the evaluation by integrating multi-source information.

2. Structure of marine diesel engines

The marine diesel engine is a thermal generator that introduces fuel into the cylinder to burn, and then passes the gas expansion, pushes the piston, and the crank connecting rod mechanism to output mechanical work. The main components of the diesel engine include: main sports firmware, main fixtures, gas distribution system, fuel system, lubrication system, cooling system, control system and supercharging system [3] And ... Among them, the normal operation of combustion chamber components, gas distribution mechanisms, lubrication systems, and cooling systems plays an important role in the normal operation of diesel engines and the safe navigation of ships [4,5].

3. Multiple information fusion methods

At present, the information fusion methods used for technical status assessment include: neural networks, hidden Markov models, support vector machines, and D-S evidence theory.

3.1. Neural Network

Neural network is an Abstract:modeling of human neuron network from the information processing angle. It is a nonlinear and adaptive information processing system composed of a large number of processing units. It has nonlinear, non-limited, very qualitative,

non-convex and other characteristics.

3.2. Hidden Markov model

The Hidden Markov model is a statistical model used to describe a Maerkefu process with implicit unknown parameters. The difficulty is to determine the implicit parameters of the process from observable parameters, and then use these parameters for further analysis.

3.3. Support Vector Machines

Vector support machines are a method of supervised learning and can be widely used in statistical classification and regression analysis. It has unique advantages in solving small sample, nonlinear and high-dimensional pattern recognition, and can be generalized to other machine learning problems such as function fitting.

3.4. D-S evidence theory

D-S evidence theory is the main means to deal with uncertain, incomplete, and inaccurate information. It is an uncertain and imprecise inference method. In the fields of multi-source information fusion and uncertain information processing, the D-S evidence theory is a very effective theory. Its greatest advantage is that it does not require prior information. This is also an important reason why the D-S evidence theory has been rapidly developed in recent years.

Different methods have their own advantages and disadvantages. For example, neural network methods are often not easy to obtain ideal training samples, and once training samples can not be obtained, the method can not be used. And when the number of samples increases, this method can not meet the requirements of timely and rapid. Among the many information fusion methods, the D-S evidence theory can deal with the ignorance caused by uncertainty, and can effectively integrate multi-source information, which is very suitable for technical status assessment.

4. Multi-information integration framework

The information fusion in the evaluation of the technical state of marine diesel engine includes two aspects: First, the use of various parameters to diagnose the thermal performance of diesel engine and sensors; The second is the comprehensive diagnosis of the thermal and mechanical performance of diesel engine by means of data fusion technology or expert system.

Compared with using a single information to evaluate the technical state of marine diesel engine, obtaining multi-source information, and then performing the technical state evaluation of diesel engine after Fusion, the results obtained will be more accurate.

This paper divides the information fusion into three levels: the fusion of sensor data layer, the fusion of technical state characteristic layer and the fusion of information decision-making level. On the basis of these three levels, the technical state evaluation model of marine diesel engine is obtained.

4.1. The fusion of sensor data layer

It is the number of data collected by multiple sensors for a certain parameter of the engine.

The process of extraction according to association and fusion. Including various temperature, pressure, speed, vibration and other aerodynamic thermal parameters, as well as historical data, test parameters, control information.

4.2. Integration of technical state feature layers

The source of information in this layer does not have to come from sensors. It can come from the experience or knowledge of experts, or it can come from the historical data of the engine to extract related feature information from these information. For example, changes in the performance of diesel engine components, environmental changes, etc.

4.3. Integration of information decision-making levels

It is a fusion analysis of evaluation results. For example, the damage assessment of the engine,

5. Summary

Accurate understanding of the technical state of marine diesel engines is the basis of ship maintenance and use. In this paper, based on the introduction of the basic structure and information fusion method of diesel engine, a model of marine diesel engine technology state evaluation based on three levels of sensor data layer Fusion, technical state characteristic layer fusion and information decision-making level fusion is proposed. It is worth applying it in engineering practice to provide the fusion basis for the accurate grasp of the technical state of marine diesel engine.

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