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Research on Military Intelligent Equipment Support Integrating Artificial Intelligence and PHM

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Abstract: Aiming at the problems of low intelligence and networking in predictive maintenance of military intelligent equipment, and difficulty in physical model modeling, the AI-based military intelligent equipment remote fault prediction and health management system (PHM) implementation framework, key technologies and guarantee decision-making methods are studied.The operating mode of the PHM system is explained in detail, and the software architecture and key technologies of the PHM system are analyzed on this basis. The outstanding features of AI-wide communication, pan-awareness, and self-learning are used to construct the health management of military intelligent equipment that integrates the PHM system architecture. The system realizes data-driven, intelligent and networked guarantee for the health management of military intelligent equipment. This paper provide reference and reference for military intelligent equipment support suitable for complex conditions, reduce operation and maintenance costs, and continuously improve the level of military intelligent equipment support.

1. Introduction

Military intelligent equipment is a collective term for all types of equipment with prediction, perception, analysis, reasoning, decision-making, and control functions. It is a more advanced type of equipment that can improve production efficiency and manufacturing accuracy on the basis of equipment numerical control. Such as high-end CNC machine tools, industrial robots, the key technologies for their development include fault diagnosis, health maintenance technology[1]. Fault prediction and health management technology are the development direction of future military intelligent equipment system support and maintenance. As military intelligent equipment becomes more and more complex, it is very difficult to establish mathematical or physical models of the components or systems of complex military intelligent equipment. Therefore, compared with the physical analysis model, the use of historical data of various stages in the life cycle of the component or system for modeling will be more conducive to the realization of the PHM function [2].

Considering that military intelligent equipment is developing in the direction of informatization, intelligence and networking, this requires that its maintenance methods must also be intelligent and networked. This article focuses on the integration of PHM and AI in the artificial intelligence

environment to develop military intelligent equipment Support research, advance military intelligent equipment support decision-making, support force structure, support method reform, and support effectiveness jump, provide support for the realization of the intelligent and networked maintenance methods of military intelligent equipment PHM.

2. Future-oriented military intelligent equipment combat mode

The widespread application of intelligent technology has promoted major changes in the mechanism of combat victory. Intelligent power has surpassed firepower and information power has become the primary factor in determining the victory or defeat of war. Control instead of destruction has become the preferred way to conquer opponents. In the combat system, the effect of clusters is as follows: May exceed the effect of concentrated forces. Correspondingly, on the intelligent battlefield in the future, the "new type of intelligent warfare" in which the rival parties compete on intelligence, the "coordinated distributed warfare" and "reactor offensive and defensive warfare" in which the competition is based on control, and the "cluster joint warfare" which is based on the competition in clusters. And the "electromagnetic integrated warfare" derived from new concepts and new mechanisms will become the basic style of intelligent combat..

2.1. New intelligent warfare

Intelligent algorithm warfare, computing power warfare, data analysis warfare. The key to intelligent combat is to seize the "intellectual power". A series of combat operations around the "intellectual power" have become the main operations on the intelligent battlefield. Intelligent algorithmic warfare is used for various source code battles on the intelligent battlefield, which embodies the combat mechanism of intelligence winning; computing power warfare is used for various computing power battles on the intelligent battlefield, which embodies the battle of speed victory. Mechanism; data analysis warfare, used for various data wars on the intelligent battlefield, embodying the combat mechanism of big data victory. In the future, intelligent combat will not only be drawn out, but also calculated. Algorithms, calculations, and data are the three major elements of mainstream artificial intelligence, and they will also become the key areas of intense competition for intelligent warfare[3].

2.2. Coordinated distributed warfare

Cognitive warfare, dynamic warfare, and distributed warfare. The cognitive domain is a combat domain that produces perception, cognition, and decision-making. With the breakthrough of emerging technologies such as nano-weapons, biotechnology, and brain-computer fusion, the battlefield will surely accelerate the shift of the battlefield from the physical domain and information domain to the cognitive domain. Distributed coordinated operations can integrate land, sea, air, space, electricity, network and other operational domain carrying platforms to build a comprehensive three-dimensional situational awareness network. Through military communication networks and integrated command and control systems throughout various domains, The implementation of weapon system cluster/division saturation attacks improves the overall combat and strike effectiveness[4]. "Dynamic warfare" builds a system for connecting manned and unmanned platforms to realize an efficient situational awareness network, a powerful offensive network and a flexible defense network, and fundamentally realize the idea of distributed coordinated operations. The use of artificial intelligence technology to highly integrate the brain and the computer to realize the complementary advantages of human brain logic thinking and computer high-speed computing. Use computers to simulate commanders to plan combat activities, make

combat determinations, and deal with emergencies, and it is expected to achieve the operational level Intelligent command and control. "Distributed warfare" is based on the joint operations of various services and arms in a complex environment. It is layered, classified, and classified into decentralized offensive formations, centralized command, distributed organization, and coordinated operations to enhance the communication, perception, complementation, and support capabilities in operations, optimize tactics, tactical design, and exert overall combat effectiveness. .

2.3. Reactance offensive and defensive warfare

Telecommunications network warfare, industrial control network warfare, and wireless network warfare. With the deepening of the integration of the real world and the network world, the struggles based on professional fields such as telecommunications network space, industrial control network space and wireless network space have leapt into the main battle field and will become a typical form of intelligent network warfare. Telecommunications network warfare mainly refers to the offensive and defensive struggle initiated in the national backbone communication networks such as international communication networks, mobile communication networks, and metropolitan area networks to achieve the purpose of communication paralysis, network interruption or data theft in a wide area. Industrial control cyber warfare is mainly aimed at offensive and defensive operations launched by large-scale intelligent equipment-intensive networks with various industrial and commercial attributes, such as the national power network, bank financial network, water conservancy engineering network, and so on. Through the implementation of specialized network attacks on the core access equipment of the industrial control network, the equipment will operate abnormally or fail to achieve the overall paralysis or damage to the target system. Wireless network warfare is mainly for offensive and defensive operations conducted on information networks (including battlefield wireless networking) based on wireless electromagnetic signals. It is a commonly used combat style and an important means of network warfare on the battlefield in the future. Through brute force deciphering, password intrusion or camouflage infiltration and other network attacks, access to the internal network of the enemy's open link to achieve the purpose of paralyzing, stealing, blocking, deceiving or disturbing the enemy.

3. Future-oriented military intelligent equipment support system architecture

Based on the PHM system design concept, combined with the complex and high-tech characteristics of military intelligent equipment itself, guided by actual application and missions, the introduction of modular management, dynamic control, and autonomy-oriented concepts to build military intelligent equipment that is integrated with artificial intelligence[5]. The guarantee system architecture is shown in Figure 1.

Status information collection: According to the specific conditions of the equipment, single or multiple detection methods are used, and the detection methods of the same equipment are coordinated and complemented. By selecting appropriate sensors to collect status information indicating whether the system is normal or not, the information is effective Obtain. Set the effective threshold of the parameters in advance, and exclude heterogeneous data in advance. Use advanced communication technology to connect various data sources to the military intelligent equipment health management system.

Data analysis and processing: Use data analysis methods to analyze data, perform simple abnormal judgments on the data according to abnormal judgment criteria, and eliminate or filter abnormal data. Through the data preprocessing method, the data is processed into the format required by the system. In addition, it also has functions such as data conversion and data transmission.

Health status assessment: It mainly accepts the processed data from the data acquisition and processing module, and completes the functions of airborne equipment or system status monitoring and fault detection, status abnormality analysis and historical monitoring data query. Status monitoring and fault detection functions include: real-time status data monitoring, offline detection of status parameters, fault feature tracking and comparison, fault detection and isolation. Provide a human-computer interaction interface to realize the visualization of equipment abnormalities and fault detection functions.

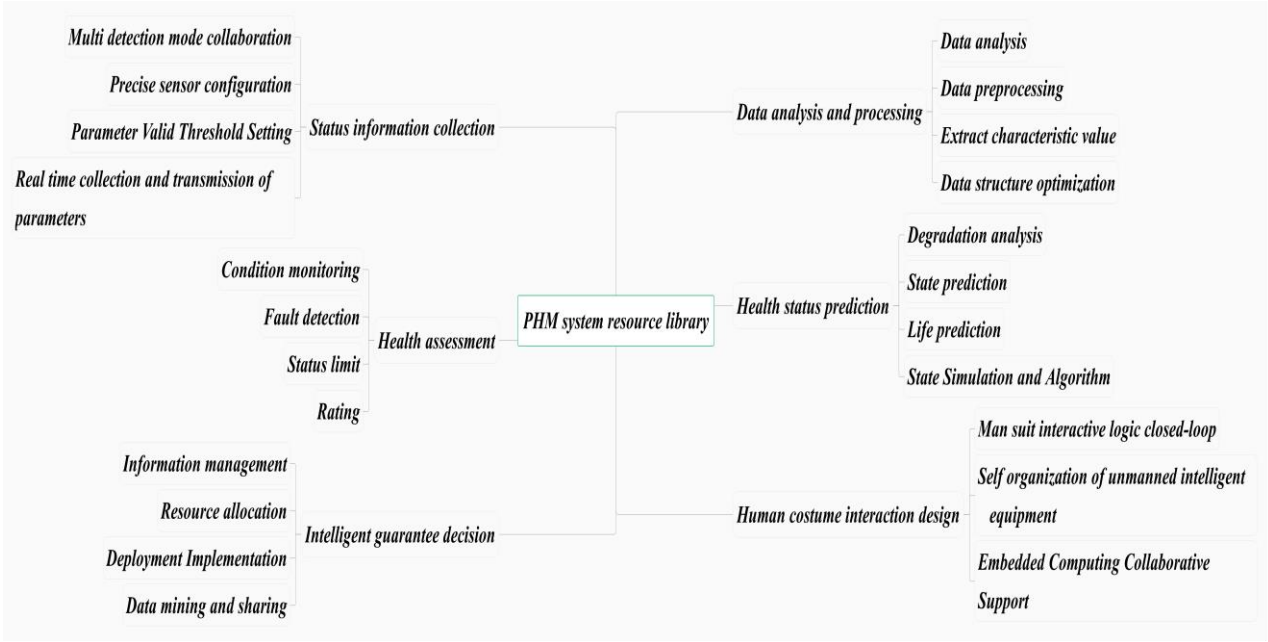

Figure 1: Military intelligent equipment support system architecture

Health status prediction: It mainly completes functions such as the determination of health characteristic parameters exceeding the limit, the classification of health status, the evaluation of health status, the current health status management, the health status alarm, and the historical health status query. When the system fails, the diagnosis records the time when the failure occurred, and the cause of the failure is determined, the health status level is evaluated according to the criteria for the classification of the health status level, and the health status evaluation result is given. The health status information is stored in the historical database to realize the functions of intelligent equipment's status degradation process analysis, equipment status prediction, equipment remaining life prediction, prediction model and algorithm management. In the predictive model and algorithm management module, you can manage and configure parameters for the built-in predictive model of the system, and add user-defined predictive models and algorithms according to the relevant conventions of the system. Combining the knowledge base, experience library, and system encapsulated prediction algorithm, after the analysis task is completed, the evaluation, prediction, and analysis results are sent to the decision support layer of the system to assist the command manager to make judgments and decisions.

Smart support decision-making: by reading the conclusions of condition monitoring, fault diagnosis and life prediction, combining component information in the equipment management database, business optimization decision elements, and comprehensive selection based on safety, mission, availability, and serious economic consequences Decision objective function, construction of decision optimization model, call decision algorithm to achieve the optimal guarantee decision, the conclusion of the decision can be bound with the business process of the business department, so as to directly enter the decision deployment of the guarantee process. On this basis, data mining

and data synchronization are carried out, intelligent equipment guarantee rules are explored, equipment health management information is shared, and high-level data integration and research judgment are formed.

4. Conclusions

The maintenance support system after the application of health management technology is developing towards more intelligence, automation and optimization, and the condition assessment is more timely and accurate. It guides maintenance based on the conclusion of health management, and realizes a timely and appropriate maintenance mode based on conditions. Therefore, in-depth research on the application of PHM systems and artificial intelligence in complex military intelligent equipment systems has very important national defense value and military benefits.

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