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RESEARCH ON FAULT DIAGNOSIS TECHNOLOGY OF DEEP SPACE PROBE PROPULSION SYSTEM HEALTH DETECTION PROTOTYPE

Abstract

The deep space probe is most sensitive to the fault of the propulsion system. When the propulsion system is abnormal or faulty in the deep space exploration mission, it is impossible to get judgment and instructions form ground in time due to the long distance and the task complexity, which will have a fatal impact on the completion of the deep space exploration mission. It is an urgent and challenging research focus of deep space exploration mission to improve the reliability by improving the fault diagnosis and reconstruction capability of propulsion system, and it has become a development trend to apply artificial intelligence technology such as machine learning to fault diagnosis on propulsion system of deep space probe.

Based on the propulsion system scheme of a deep space probe, this paper carries out research on the fault diagnosis technology of the propulsion system health detection prototype to verify its fault diagnosis and reconstruction capability. For the propulsion system of the deep space probe, based on the principle of functional similarity, the health detection prototype of the propulsion system is designed by using pressurized gas to simulate the thruster ignition. Using Labview software, the detection system software is designed to diagnose the fault of the prototype, which provides the basis for the fault diagnosis and reconstruction scheme of the propulsion system. The decision tree theory of machine learning is used to train the fault diagnosis process, optimize the decision tree and judgment criteria, and establish the fault diagnosis model. Seven kinds of faults, such as cylinder leakage fault, were introduced in tests. The detection system software of the health detection prototype quickly and accurately detected the occurrence of different faults. The test results show that: 1) the health detection prototype has good fault diagnosis ability, and the diagnosis results prove the effectiveness of the algorithm. 2) according to the fault characteristics, some faults have achieved functional reconstruction.