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A HEALTH ASSESSMENT METHOD FOR SPACECRAFT THERMAL CONTROL SYSTEM BASED ON MULTI-TIERED INFORMATION FUSION

Abstract

The spacecraft has the characteristics of long mission cycle, complex state, and high requirements for operational stability and reliability, and its thermal control system realizes the thermal control and management of its working equipment and environment, which is essential for the stable operation of the spacecraft and the safety of personnel. At present, the health assessment of spacecraft thermal control system is mainly adopts threshold-based interpretation and monitoring, and there is a lack of comprehensive evaluation methods. In order to obtain the health status of the spacecraft thermal control system in a timely and accurate manner, this paper proposes a health assessment method for the spacecraft thermal control system based on multi-level information fusion(MTIF), including metrics-level assessment, component-level assessment and system-level assessment. Among them, the evaluation method based on a class of support vector machines and thresholds is used for metrics-level evaluation, the fuzzy evaluation method is mainly used for component-level evaluation, and the adaptive weight method is used for system-level evaluation. The MTIF method was preliminarily applied in the ground test process of China space station, and the effectiveness of the evaluation method is verified by using 18 typical fault data and normal data obtained under five different working conditions based on the ground thermal test and fault simulation. The results show that the method can effectively evaluate the health status of the space station thermal control system, and realize the transformation from qualitative judgment to fine-grained quantitative evaluation of the overall health level of the thermal control system, so as to provide guidance for the maintenance of the thermal control system of the space station and improve the safety and sustainability of the space station.