IAF SPACE OPERATIONS SYMPOSIUM (B6)
Ground Operations - Systems and Solutions (1)

Author: Mr. Hongzheng Fang
China Aerospace Science and Industry Corporation (CASIC), China

Ms. Rui Li
China Aerospace Science and Industry Corporation (CASIC), China
Mr. Yi Xiong
China Aerospace Science and Industry Corporation (CASIC), China

DESIGN AND IMPLEMENTATION OF SPACECRAFT GROUND HEALTH MANAGEMENT VERIFICATION SYSTEM BASED-ON DFPC MULTI-DIMENSIONAL EVALUATION MODEL

Abstract

Prognostic and Health Management (PHM) technology can reduce the unexpected risk of various types of spacecrafts in orbit, and has become a key technology to improve the reliability, maintainability, test capability and safety of spacecraft. As the core of the entire spacecraft PHM, the spacecraft ground PHM system mainly provides spacecraft technicians with services such as data analysis, diagnosis, and prediction in the process of spacecraft testing, operation and management. At present, due to the difficulty in obtaining the spacecraft failure mechanism, insufficient failure verification environment, and lack of unified verification methods and performance indicators, it is difficult to effectively verify and evaluate the research results of spacecraft PHM. In this paper, the design and implementation technology of spacecraft ground health management verification system based on DFPC multi-dimensional evaluation model is deeply studied. Firstly, the requirements of spacecraft ground health management system are analyzed, and a design idea of a spacecraft ground PHM system based on big data is proposed; Secondly, a multi-dimensional PHM evaluation indicator system based on "design-function-performance-cost" (DFPC) model, and verification method are proposed, which overcomes the limitation of traditional PHM system verification that only focuses on algorithm performance evaluation, and helps to solve the current problems such as unclear verification requirements and irregular verification workflow of spacecraft ground PHM system. On this basis, a spacecraft ground PHM verification system (SGPHMVS2020) based on simulation and test is designed and implemented. The effectiveness of the proposed design method for the ground health management verification system is verified through fault simulation and on-orbit historical data, based on the cases of power panel tracking solar fault diagnosis and solar array output power decline prediction of a typical navigation satellite. At present, the SGPHMVS2020 has been used in the ground health management system construction of a navigation satellite, a remote sensing satellite, China space station and other types of spacecrafts to verify its capability. The preliminary results show that it meets the test requirements of the spacecraft ground health management system well, and will be able to provide services and support for the ground health management system of space exploration, LEO constellation and other types of spacecrafts.