Paper ID: 71660
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29th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Interactive Presentations - 29th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (IP)

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DESIGN AND FAULTY DIAGNOSIS FOR MICROSATELLITE ATTITUDE CONTROL SYSTEM

Abstract

As one of the core subsystems of satellites, the normal operation of attitude determination and control system (ADCS) guarantee the overall function of the satellite. With the development of microsatellites, mass, size, power consumption and reliability are the important factors to be considered when designing ADCS. In addition, the ADCS may have various faults during the whole mission, which will cause serious effect to the entire satellite and even lead to mission failure. Under the research background of the Lancang-Mekong Cooperation Pu'er microsatellite (LM-1), this paper conducts program design and algorithm simulation of the attitude control subsystem. The main tasks are summarized as follows. According to the input conditions and functional indexes of the attitude control system provided by the specific mission requirements, this paper proposes reasonable and effective attitude control strategies to ensure the completion of the flight mission. The core modes include rate damping, sun capture, three-axis stability and attitude maneuvering modes. The latter two modes are designed to satisfy the requirements of remote sensing imaging. After modeling the attitude control system, this paper designs the attitude estimation algorithm based on the combination of star sensor and gyroscope ,and the dual-vector attitude algorithm based on the combination of sun sensor and three-axis magnetometer. Subsequently, corresponding algorithms are designed for each operating mode of attitude control strategy, and the effectiveness of the algorithms is verified by simulation. Unlike traditional fault diagnosis method, this paper uses a fault diagnosis method base on BP neural network to detect various fault conditions occurring in the microsatellite attitude control subsystem. The output of ADCS in Virtual ADAPT platform serves as learning, cross validation and test data for neural network model. The accuracy of the algorithm is verified by confusion matrix. The test results show that the algorithm has high precision, and can be used to detect and classify the faulty mode of the microsatellite attitude control system. Genetic algorithm is used to optimize the neural network, which further improves the accuracy of fault diagnosis. In summary, this paper completes the design and verification of the attitude control system scheme for LM-1 microsatellite, providing relatively complete scheme for the subsequent research work of microsatellite.