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Author: Mr. Xurui Zhao
Beihang University (BUAA), China, zhaoxurui1126@126.com

DEPLOYABLE MECHANICAL SYSTEM DEVELOPMENT FOR A MICRO-SATELLITE

Abstract

There is an ongoing 30kg micro-satellite with the configuration of a main-sat and a sub-sat, which are connected by deployable coilable mast. The coilable mast is compressed with the length of 10cm during the launching phase and deploys to 2m after the satellite entering the orbit, forming the gravity gradient stable configuration. Due to the requirement of low power budget, lanyard and damper are applied to achieve the passive smooth deployment. Lock-release module is designed to keep the coilable mast in compressed state before deployment and release it while necessary. During the process of deployment, measurement module monitors the deployed length of coilable mast to judge the success of mission. Coilable mast, lock-release module and measurement module make up the deployable mechanical system of the satellite. In this paper, several aspects are optimized based on the preliminary design. Hinge, the core component of coilable mast, is redesigned to reduce the mass and simplify the assembly process; memory alloy pin-puller is applied to replace the original explosive device, which greatly reduces the impact load and protects the nearby equipment; rotary encoder with simple and reliable synchronous serial interface (SSI) is adopted to measure the rotation angle of the lanyard roller, which could be used to calculate the deployed length of coilable mast. To verify the mission execution process in orbit, the testing platform is also developed, integrating the whole mechanical system together. In the test, after receiving the command of the on-board computer, pin-puller unlocks normally and successfully releases the compressed coilable mast. Under the influence of damper and lanyard, coilable mast deploys smoothly to the expected length in reasonable time. Rotation angle is collected all the time by encoder and the variation of calculated length well reflects the deployment process of coilable mast. The test result verifies that all the modules of deployable mechanical system work successfully to complete the flight mission of the satellite in accordance with the established procedures.