Paper ID: 64730
student

IAF ASTRODYNAMICS SYMPOSIUM (C1)
Interactive Presentations - IAF ASTRODYNAMICS SYMPOSIUM (IP)

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ATTITUDE DYNAMICS AND CONTROL OF RIGID-FLEXIBLE COUPLING MICROSATELLITE WITH A COILABLE MAST

Abstract

The APSCO-SSS project is initiated by the Asia-Pacific Space Cooperation Organization (APSCO). This project consists of 1 micro-satellite (SSS-1) and 2 cube-satellites (SSS-2A and SSS-2B), and it is implemented for different missions, such as the demonstration of the deployment of the coilable mast, the ADS-B technology and the remote sensing. In this project, SSS-1 is formed by a main-sat and a sub-sat joined by a coilable mast and it belongs to the multiple interconnected rigid and flexible bodies, and accordingly, the flexible vibration of the coilable mast brings great difficulties and challenges to the attitude control. In terms of the dynamics, the coilable mast is normally viewed as a flexible appendage in recent researches and simplified to a Euler-Bernoulli beam with the bending mode only. However, the microsatellite end is equipped with a large mass element (sub-sat); therefore, the mathematical model of the rigid-flexible coupling microsatellite needs to be improved. Regarding the control strategy, it is necessary to stabilize the attitude of the satellite and suppress the vibration of the coilable mast at the same time. In this paper, an improved mathematical model of the rigid-flexible coupling microsatellite with a coilable mast is established; moreover, the vibration characteristics of the coilable mast are analyzed. Finally, a novel robust attitude control method is proposed to solve the attitude control and vibration suppression control problems.