Paper ID: 14000
oral
student

MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Structures - Dynamics and Microdynamics (3)

Author: Dr. Yao Zhang
Beijing Institute of technology(BIT), China, zhangyao@bit.edu.cn

VIBRATION ISOLATION PLATFORM OF CMGS APPLICATION ON SATELLITES WITH THE FLEXIBLE APPENDAGES

Abstract

Control Moment Gyroscope (CMG) is used as the actuator of attitude control for modern spacecraft. Because of static and dynamic imbalances of rotor and bearing disturbances, the CMG becomes one of main vibration sources on spacecraft. In some spacecraft having an ultra-precise pointing capability requirement, such as in a space telescope or in a high resolution remote sensing satellite, it is necessary to reduce the vibration caused by the CMG.

Generally, it is common to use one multi-degree-of-freedom vibration isolation platform to interface the cluster of CMGs with the satellite bus, such as Worldview I, Worldview II and Pleiades-HR. And the jitter performance using the vibration isolation system of spacecraft were predicted in some missions, such as The Space Interferometer Mission (SIM), Terrestrial Planet Finder Coronagraph (TPF-C), the GONES-N spacecraft and Solar Dynamics observatory (SDO). In these literatures, the structures of spacecraft are all modeled using finite element method, where some use the vibration isolation system consisting of 6 decoupled 2nd-order low-pass filters to approximate the effect of a passive fly wheel mount. These accurate finite element models are necessary to predict the jitter performance of the spacecraft. However, the analysis method using finite element models has some limitations: The spacecraft structure should be well known, the dynamic coupling cannot be obtained, and the finite element model is not suitable for attitude controller design based on modern control theory for instance.

In previous research, an integrated satellite dynamic model including vibration isolation platform and pyramid configuration CMGs is built. And the influence of the vibration isolation system on the attitude control system of the satellite is also analyzed in detail. However, the dynamic model of the satellite ignores the flexible appendages. Actually, some researches show that these flexible appendages like solar arrays do affect the vibration isolation platform characteristics and the attitude control system stability. Therefore, in order to manufacture a vibration isolation platform of CMGs with satisfaction, it is necessary to analyze the influence of flexible solar arrays on vibration isolation platform and these on stability of attitude control system.

In this paper, an integrated satellite dynamic model including vibration isolation platform, pyramid configuration CMGs and the flexible appendages is built. Then the transmissibility matrix of the vibration isolation platform is obtained. The influence of the flexible appendages on the performance of the vibration isolation platform and on the stability of the attitude control system is analyzed in detail.