Paper ID: 10185
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

PARAMETERS DESIGN OF VIBRATION ISOLATION PLATFORM FOR CONTROL MOMENT GYROSCOPES

Abstract

The Control Moment Gyroscope (CMG) is widely used as the actuator of attitude control for modern satellites. Because of the rotor's static and dynamic imbalance and the bearing disturbances, the CMG becomes one of the main vibration sources on satellites. In order to provide an ultra quiet environment for the optical payloads, it is necessary to reduce the vibration caused by the CMG. To solve this problem, vibration isolation is one of the widely used techniques.

Generally, the several Control Moment Gyroscopes (CMGs) employed on a satellite are in some kind of configuration, which makes it costly to isolate them separately. Therefore, a multi-degree-of-freedom vibration isolation platform is often used to interface the cluster of CMGs with the satellite bus. And this isolation scheme has been used on some optical imaging satellites, such as Worldview-I, Worldview-II and Pleiades-HR.

The vibration isolation platform for CMGs can not only isolate disturbances, but also transfer the effective torques to the satellite in order to realize attitude control. Previous research proved that when it is used, the attitude control system is conditionally stable. Therefore the parameters of the platform not only have to satisfy the requirement of vibration isolation, but also should take into account their interaction with the attitude control system. Until now, many researchers focus on how to improve the performance of vibration isolator element and have designed some vibration isolators: D-Strut, $\mathrm{D-Strut}^{\mathrm{TM}}$, 1.5Hz D-Strut, Adaptable $\mathrm{D-Strut}^{\mathrm{TM}}$, Hybrid D-Strut for instance. However, the research on the parameters design of vibration isolation platform, taking into account the influence of them on the attitude control system, is rare.

In this paper, the parameters design of vibration isolation platform for CMGs considering their influence on the attitude control system is discussed. Firstly, the influence of the vibration isolation platform on the attitude control system is analyzed. And the appropriate corner frequencies of the vibration isolation platform are selected. Secondly, considering the geometric configuration of the vibration isolation platform, the appropriate corner frequencies are assigned to the vibration isolator elements of the platform. What's more, optimum design of the stiffness coefficients and the damping coefficients of the vibration isolator is performed. Thirdly, using the parameters which are obtained, the performance of vibration isolation platform on the satellite is testified by integrated simulation. The simulation results show that the parameters design of vibration isolation platform for CMGs is reasonable.