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INFLUENCE ANALYSIS OF THE IMPACTS AND FRICTIONS OF THE JOINTS OF THE VIBRATION ISOLATION PLATFORM FOR CONTROL MOMENT GYROSCOPE

Abstract

In the process of space missions, such as Earth observation, space exploration and other tasks, the high accuracy and stabilization of the attitude control are required to realize the high quality observation and imaging. The high frequency vibrations are able to induce the jitter of the attitude and affect the imaging quality. Control moment gyroscope (CMG) is the common actuator for attitude control. The rotor of the CMG will cause high frequency vibrations when it is rotating in a high speed because of the manufacturing errors. These vibrations will directly affect the accuracy and stability of the attitude control. The common solution is to install vibration isolation platforms, such as Stewart platform or octo-strut platform studied by Harbin Institute of Technology.

The vibration isolation struts of the vibration isolation platform are assembled between the base platform and the payload platform. The isolation struts are connected to the payload platform with the spherical hinge and connected to the base platform with the universal joint. In the common research, the clearances of the joints are usually neglected in the dynamic analysis. But the clearances of the joints could generate some extra vibrations when the payload platform suffers from external and internal vibrations of the CMG cluster in the engineering practice. When the amplitude of the vibration source is quite small, the extra vibrations generated by the clearances of the joints could not be neglected, and it will have an influence on the parameters design of the isolation struts.

In this paper, the author would focus on the impacts and frictions of the clearances of the spherical hinges and universal joints of the isolation struts. To analysis characteristics of the impacts and frictions, a dynamic model considering the spherical hinges and universal joints of the isolation struts was built, the pattern of the impacts are analyzed, and the kinematics analysis of the spherical hinges and universal joints are done. The differences between the complex model and the traditional isolation strut model are compared, and the simulation results shown that the differences are quite small in the low and middle frequency range, and the extra vibration generated by the clearance of the joints could not be neglected in high frequency. Based on that, the dynamic model of the Stewart platform assembled with these isolation struts are built, and the time domain and spectral performance of the vibration isolation are analyzed.