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SPACE ANTENNA STRUCTURE VIBRATION SUPPRESSION VIA A NOVEL ELECTROMAGNET SHUNT DAMPING METHOD

Abstract

Generally, the space antenna suffers a largr bandwidth frequency load during launch period. The vibration load can be defined by: (1) transient vibration ¡80Hz, (2) random vibration 20 to 2000Hz, and pyrotechnic shock 100 to 10000Hz. The above-mentioned vibration environments will induce resonance vibration and generate irreversible damage to the space antenna. Therefore, the vibration suppression or reducing method should be developed to make the antenna to be survived.

In recent years, piezoelectric actuator, Macro-Fiber Composite actuator, and electromagnetic structure that possess a strong electromechanical coupling characteristic have been widely applied for vibration control. These actuators are able to transform the vibration energy into electricity. Electromagnetic shunt damping is a kind of novel vibration control techniques which can dissipate the transformed vibration energy into a shunt circuit. In this work, a kind of the negative resistance electromagnetic shunt damping is proposed to reduce the vibration of the antenna structure. In detail, the negative resistance can cancel the inherent resistance of the coils, so that the total impedance of the circuit can be decreased which improves the vibration control effectiveness.

Based on the above analysis, the main contributions of this study are as follows. First of all, a kind of the electromagnetic transducer is built up, the schematic of the negative resistance shunt controller is developed and the corresponding vibration control principle of the shunt is illustrated theoretically. Secondly, the ground experimental system of the antenna struture is setup. The responses of the antenna under the sweep sine, sine and semi-sine excitation are tested. The results demonstrates that the proposed vibration control method can tremendously isolate the vibration of the space antenna. The electromagnetic shunt damping method does not need any other sensoring and feedback system compared to the active one. Thus it has great application potentials in space engineering.