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SPACE TRANSPORTATION ORIENTED VIBRATION SUPPRESSION DESIGN METHOD OF INTELLIGENT COMPOSITE SUPPORT MODULE STRUCTURE

Abstract

According to the analysis of the time-frequency characteristics of the low-frequency vibration of space transportation rocket in flight condition, it is shown that the vibration amplification from the bottom of the support module to the coupling surface between the satellite and the rocket is obvious, and the maximum amplitude appears at 40 Hz frequency input. Therefore, the vibration reduction and suppression of the support module have important theoretical and engineering application values. According to the experimental data, compared with the aluminum alloy support module, the composite support module has higher material damping and reduces the coupling interface response by 20 %. In order to further explore the design of intelligent vibration suppression structure, the research of composite intelligent vibration suppression structure based on piezoelectric branch circuit is carried out in this paper. Based on the generalized Hamilton principle, laminated plate theory and equivalent model of piezoelectric circuit, the electromechanical coupling dynamic model of composite panel is established, in which the composite structure model and piezoelectric ceramic model are connected by penalty function. The resonant branch circuit is connected with piezoelectric ceramics to form a special damping, and then the vibration response characteristics of composite panel are studied. The vibration suppression mechanism of the piezoelectric branch circuit for the target mode is revealed. The influence law of the parameters of the piezoelectric loop on the damping and vibration suppression effect is analyzed. The effectiveness of the suppression design is verified by the composite panel test and numerical simulation, which will provide a theoretical basis for the intelligent vibration suppression design of composite support module.