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A NEW IDENTIFICATION METHOD FOR MULTI-DOF DYNAMIC INTERFACE FORCES

Abstract

Structural tests are to gain confidence in the analytical predictions which support spacecraft development, and ultimately to support the qualification and flight acceptance of the spacecraft system. Based on envelops of real-time launch vehicle data or simulation results, the input level of vibration test is calculated with some certain safety margin. This conventional approach of vibration test may lead to over-testing problems, which will severely harm the spacecraft at resonance frequencies. Force limited control, which measures and limits the interaction forces between the test spacecraft and the shaker at the same time, has been developed and implemented in NASA, ESA, et al. In order to elaborate the appropriate force input, Multi-DOF dynamic interface forces during the lift-off must be measured. The force sensor, which must be placed between the spacecraft and launch vehicle, is apparently not a good strategy, because it changes the connecting stiffness and strength of the interface between spacecraft and launch vehicle. Accordingly a new identification method for dynamic interaction force, which is based on the strain status of the spacecraft adapter ring, is proposed in current study. Some special observation points are selected along the surface of the adapter ring, on which strain rosettes are pasted to measure the local normal and shear strain. During the lift-off, the telemetry strain signal will be gathered to estimate Multi-DOF forces by theoretical analysis combined with ground test results. Based on some examples of satellite ground vibration test, the results of axial force, transverse shear force and bending moment are obtained, and the accuracy of these results have been verified. It is a promising method for the future application.