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STRUCTURAL DYNAMIC MODIFICATION FOR SHOCK RESPONSE SPECTRA TEST OF A FIXTURE BASED ON SENSITIVITY ANALYSIS OF ANTI-RESONANCE FREQUENCY

Abstract

The SRS (shock response spectra) test is usually used to replicate the far-field pyroshock environment. The fixture for SRS tests, which transmits the shock energy generated by the SRS machine, connects the specimen to the machine table through several screw bolts. In one SRS test, the shock energy could not be transmitted to the liquid rocket engine by the fixture near the corner frequency of reference SRS. While the engine responses near the corner frequency are important when qualifying the engine. In order to remove the under-tests near the corner frequency, the anti-resonance frequencies are calculated for the SRS test fixture. The anti-resonance frequencies are local characteristics and depend on the particular input vector and resonance points. The under-tests at anti-resonance frequencies cannot be compensated by adjusting the parameters of the SRS test machine after all. Therefore, structural dynamic modification of fixture is required in redesign stage of fixture. In the paper, firstly the theory of the sensitivity analysis of anti-resonance frequency is presented. Secondly, the under-test SRS test fixture with the SRS test table is modeled by the finite element analysis. The acceleration responses of the control points on the fixture in the SRS test are calculated, while the force is applied on one side of the SRS test table as input. Finally, the structural dynamic modification of the SRS test fixture by sensitivity analysis of the anti-resonance frequencies is done in order to adjust the anti-resonance near the corner frequency. Height and bottom diameter of the fixture are used as design variables. Numerical results show that the anti-resonance frequency near the corner frequency can be adjusted to prevent under-test by the proposed approach.