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A RESEARCH ON SHOCK PREDICTION METHOD CORRELATED WITH FORMOSAT-2 SATELLITE PYRO-SHOCK TEST RESULTS

Abstract

At the beginning of a satellite development program, the system engineers have to define the prospective component environmental specifications based on the selected launch environments for the successive flight component designs or procurements. A stricter specification normally means more budgets for the program. Thus, how to reasonably define the component environmental specifications is a critical task for system engineers.

Shock or pyro-shock is one of the important specifications for shock sensitive components. In a launch vehicle user's guide, the shock environment is normally expressed by shock response spectrum (SRS). The SRS generally has high g (gravity) value in the range of high frequencies. For a component shock specification, the difficulties are how to derive the shock response on the different locations from the shock source.

Nowadays there is no simple and easy way to predict shock propagation on a satellite structure. Heritage, experience, or scaling from similar structures are methods that are often used to define the shock specification at the beginning of a satellite program. This paper proposes an analysis method that can be used to predict shock specifications when conceptual design is done and only limited information about a satellite, such as, primary structure configuration and total mass is known. The method transfers SRS to time history as the input then use LS-DYNA as the analysis tool to predict the shock at the positions that are interested on the satellite structure. The whole process is applied on the FORMOSAT-2 satellite (which is the 2nd satellite of NSPO, National SPace Organization of Taiwan, ROC, launched in 2004) and the predicted SRS curves are compared with FORMOSAT-2 satellite pyro-shock test data to validate the accuracy of predictions. This method is not a rigorous mathematical analysis, but an engineering approach to provide system engineers immediate and more accountable information for the component shock environment definition.

When the whole process is accomplished, several "representative SRS curves" are created. Those curves represent the shock responses on the selected regions of a structure, which can be directly used on the definition of the component shock specification.