Paper ID: 51893
oral

IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Structures I - Development and Verification (Space Vehicles and Components) (1)

Author: Dr. Marcello Remedia
Surrey Space Centre, University of Surrey, United Kingdom

Prof. Guglielmo Aglietti
Surrey Space Centre - University of Surrey, United Kingdom
Mr. Andrew Kiley
United Kingdom
Mr. Matteo Appolloni
ESA, The Netherlands
Mr. GianLuca Casarosa
AOES Group BV, The Netherlands

A CONDENSATION APPROACH FOR VIRTUAL SHAKER TESTING PROCEDURES

Abstract

In the last few years, in the context of spacecraft vibration testing, a new technique was developed to aid both the decisional process happening before the test and the post-test correlation activity. This technique, named Virtual Shaker Testing (VST), consists in introducing into the structural analysis "verification cycle" not only the satellite finite element model (as it is normally done), but also the models of the shaker, the control system and all the other environmental factors which can affect the test results during the real/physical test campaign. Doing this avoids making assumptions (e.g. "infinitely" stiff boundary and inertial properties of the shaker) which are not correct and could lead to erroneous predictions. Brief applications of the technique showing the main advantages will be shown in this article, using the ESA shakers QUAD (electrodynamic shaker for longitudinal tests), LLST (lateral tests) and HYDRA (6-DOF hydraulic shaker able to test simultaneously along all six degrees of freedom). This shows, on one side, how significant the differences are when looking at the analytical results from two different perspectives (standard Finite Element Analysis and VST implementation) in terms of post-test correlation: correlation methods are used for both procedures and results show significant improvements when the satellite Finite Element Model undergoes the VST approach. On the other side, it highlights the importance of doing pre-test virtual testing computations, which allow predicting unexpected dynamic behaviours of the spacecraft under test. One of the main issues related to VST is linked to the intellectual property, as models of the various components (e.g. shaker, and control system) coming from different organizations need to be put together into the same computational process. An alternative to the original methodology where both the control system and the shaker are condensed into one single model and cannot be accessed by the general user is presented here. The QUAD shaker is used again together with the TEDY mass dummy to prove the concept and validate the procedure.