Paper ID: 15047
oral
student

MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Structures - Dynamics and Microdynamics (3)

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A GENERAL METHODOLOGY TO STUDY THE TRANSMISSION OF MICRO-VIBRATIONS IN SATELLITES

Abstract

In the recent years, micro-vibrations have been an issue of growing importance, due to the high-stability requirements imposed by the modern payloads. These low level mechanical disturbances, occurring at frequencies from sub hertz up to 1000 Hz, are created by different sources in the spacecraft (e.g. reaction wheels) and how to model the micro-vibration environment is currently under investigation. In this paper, a methodology is presented, involving analyses techniques such as FEA (reliable at low frequencies), Statistical Energy Analysis (SEA, suitable for high frequency ranges) and Hybrid FE-SEA, which aims to cover the whole frequency range. Other methods are also here introduced, like Monte Carlo Simulation, precise but still computationally demanding and time consuming, and Modal Hybridization, a Stochastic Finite Element Method which involves perturbation of modes and natural frequencies and will be used to refine the general methodology. The various modelling techniques also require a particular attention when dealing with micro-vibrations. For instance, mechanical equipment typically on board a spacecraft (such as harness, thermal straps etc.) affects the response caused by low level disturbances and a FEM which models them with simple non-structural mass appears to be not accurate enough. A testing campaign concerning this issue followed by a modelling investigation will be here presented. All the methods described above will be applied to a bench work model represented by the satellite platform SSTL 300 (the relative testing campaign will be also described in this paper) and comparisons between the experimental and the computational results will be performed using criteria such as MAC or FRAC.