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

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INSPECTING THE CHARACTERISATION OF MICROVIBRATION SOURCES

Abstract

In the last decades, satellite microvibration and related issues have become a major concern in the design of satellites requiring high platform stability (e.g. spacecraft carrying the new generations of high resolution optical instruments). The first step towards satellite microvibration analysis is to characterise the potential disturbance sources. Among the various sources on satellites, reaction wheel assemblies are often considered as one of the most important and due to their complex dynamics, their microvibration characterisation is often difficult to perform.

The coupled dynamics when a source is assembled with its supporting structure can be reproduced considering the apparent mass (or its inverse, the accelerance) of the source and the driving point accelerance of the supporting structure. Current experimental methods to retrieve the accelerance coefficients are quite challenging in terms of experimental set up, time consuming, and are performed in static condition, without considering the gyroscopic effect. From a mathematical viewpoint, all the methods found in literature are subject to limitations.

Here a methodology to cope with current project needs is presented. Firstly, the need to produce a mathematical model to precisely predict source-structure dynamic behaviour including gyroscopic effect and covering a wide frequency range; secondly, the constant necessity to reduce the costs derived from the test campaign; finally the constant need to quicken the analysis speed without affecting the accuracy of the results.

In addition, validation of the wheel-speed dependent apparent mass analysis method and the reaction wheel assembly disturbance model with full excitations (harmonics and broadband noise) are presented. The coupled loads between a reaction wheel assembly and a structural panel estimated using the mathematical model are compared with experimental test results (retrieved using an interface load transducer). Moreover, indications of the level of accuracy that can be expected are also given herein.