Paper ID: 53187
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IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Structures - Dynamics and Microdynamics (3)

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MICROVIBRATION ENGINEERING – A KEY TO HIGH-PERFORMANCE SPACE MISSIONS

Abstract

The term Microvibration or Optical/Line-of-Sight Jitter refers to mechanical oscillations beyond the bandwidth of the Attitude Control System (ACS), which occur during the satellite in-orbit operations and thus affect, for example, its pointing performances. The topic is of particular interest for space missions with optical payloads and their growing performance demands.

Microvibration is a systems engineering topic, involving various disciplines such as mechanical design & analysis, mechanism engineering, payload design, operations and the ACS. This leads to a high complexity which requires an iterative engineering process in order to achieve a robust system design against microvibration while still fulfilling further system requirements.

This paper deals with the definition of the iterative engineering process. The definition of this process was started in a dedicated technology research project and then further refined throughout the first project applications at OHB. One key element of this process is the microvibration analysis, which is the foundation upon which design decisions within the process are taken. Thus, particular focus will be given to an assessment of different methodologies for analyzing microvibration.

An overview of different analysis techniques in frequency-domain and time-domain will be shown. The advantages and disadvantages of both domains are discussed. Some more information will be provided on simulation in time-domain. The suitability of the different techniques for analyses in the different project phases will be evaluated, considering different types of sources and different stages of maturity through the project development cycle. The goal here is to develop a "tool-suite" including the different techniques needed and to map the application of the different tools on the various types of sources and the project development cycle.

One major aspect related to microvibration analysis is the uncertainty that is present in many of its elements. In order to make the analysis a robust foundation of the overall engineering process, this uncertainty needs to be understood and a margin philosophy must be put in place accordingly. At OHB, the uncertainty is treated with a statistical analysis approach, where the margins are connected to the parameter variation.