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A COMPARISON OF METHODS FOR MICROVIBRATION ANALYSIS IN FREQUENCY- AND TIME-DOMAIN

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 subjects such as mechanical design analysis, mechanism engineering, payload design, operations and the ACS. The accurate prediction of microvibration disturbances on the mission performances is thus a complex multidisciplinary field aiming to design and implement a robust – but not too conservative – system.

Such analyses, in particular at system level, are at the limit of numerically feasible, as they involve high-frequency structural dynamics and high-performance noise source disturbance models. While typical microvibration performance requirements are formulated in the time-domain (e.g. Pointing errors on confidence intervals), microvibration analyses are often carried out in the frequency-domain. It has been observed in ongoing programs that the accuracy of such predictions suffers from conservatism introduced in the analysis process, in particular in the conversion from the frequency-domain to the time-domain.

In this paper, the traditional method of microvibration simulation in the frequency-domain is compared to simulations in the time-domain. The aim of this activity is to derive analysis tools, which allow accurate predictions of microvibration in a numerically efficient manner. The applied methodology for simulations in the time-domain is explained. In addition, guidelines are derived in order to achieve more realistic analyses in the frequency-domain.