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IDENTIFICATION METHOD FOR GRAVITY CAUSED EFFECTS DURING THE CHARACTERIZATION OF MICRO-VIBRATION SOURCES

Abstract

Observation payloads, communication systems or micro-gravity research platforms are applications that usually need a very disturbance-free environment to accomplish their operational goals. The success of these missions can be endangered by tiny disturbances and accelerations, also called micro-vibrations, caused by equipment that rely on movable parts or onboard motors. Failing to identify the micro-vibration behavior of mechanisms can lead to degradation, or even failure, of the whole payload or other onboard systems. Therefore, the early identification of disturbance sources and understanding their behavior is critical to avoid delays and cost increases at later project stages.

The characterization of micro-vibration sources is generally performed during ground tests, either with the individual equipment fixed on a dynamometer, or once already integrated on a spacecraft when few to none orientation changes are anymore allowed. As such, the effect of gravity during the characterization of components for their micro-vibration nature may change the measured output disturbance; this is the case, for example, of bearing noise or other strongly non-linear behaving elements caused by material-, geometric- or constraint caused nonlinearity.

In this study we show an identification method to preliminarily estimate the impact of gravity while characterizing the micro-vibration profiles caused by spacecraft mechanisms. More specifically, the method foresees the rotation of the component with respect to the gravity vector, thus enabling the observation of gravity-caused effects for small and medium sized components. Furthermore, it allows the refinement of already developed numerical models, i.e. in Finite Element Analysis verification. As a result, characterizing gravity influence may show that requirement changes are needed, e.g. at component level, or that new containment measures at the spacecraft-system level have to be added. Lastly, the method can provide some insight into the root cause of the disturbance within its source and lead to additional studies, which can be tailored based on the component's individual operational nature.