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Microgravity Experiments from Sub-Orbital to Orbital Platforms (3)

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ENHANCING SPACECRAFT PERFORMANCE THROUGH IN-SPACE MICROVIBRATION MEASUREMENTS

Abstract

This paper introduces significant advancements and applications to the cost-effective MEMS-based microvibration measurement system (MVMS) developed at the City University of Applied Sciences Bremen utilizing Commercial Off-The-Shelf components. The initial system was designed to detect and analyze microvibrations from spacecraft components, such as reaction wheels, which adversely affect the spacecraft performance. Subsequent test campaigns conducted at the ZARM GraviTower Bremen Pro have led to iterative enhancements of the MVMS, optimizing its functionality for spaceborne operations. At present, there is no system to measure microvibrations and their effect on satellite performance in orbit. Therefore, the refined system is now integrated into the VIBES Pioneer 3U CubeSat, serving as its primary payload. This integration represents a pivotal step towards operational deployment, with VIBES Pioneer being scheduled for launch aboard the second flight of RFA One towards the end of 2024. The integration of the MVMS into the VIBES Pioneer 3U CubeSat will make it possible for the first time in Europe to monitor where and how microvibrations occur and affect the pointing performance during the entirety of the mission utilizing modern digital technologies similar to the MEMS sensors used in smartphones.
The paper details the enhancements made to the MVMS, focusing on its adaptation for the VIBES Pioneer spacecraft, and discusses the anticipated contributions to improving spacecraft performance through in-orbit microvibration monitoring and mitigation.