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THE MICROGRAVITY VIBRATION ISOLATION SUBSYSTEM PERFORMANCE RESULTS FOR THE EUROPEAN SPACE AGENCY'S FLUID SCIENCE LABORATORY

Abstract

Building on the successes of the Canadian Space Agency's Microgravity Vibration Isolation Mount technology aboard both the U.S. Space Shuttle and the Russian MIR space station, the Microgravity Vibration Isolation Subsystem (MVIS) is the third MIM technology generation. Integrated within the European Space Agency's (ESA) Fluid Science Laboratory (FSL), the MVIS is designed to actively isolate the FSL's Facility Core Element (FCE) from vibrations in the International Space Station (ISS).

The FSL facility is designed to study the dynamics of fluids in the absence of gravitational forces and houses individually developed Experiment Containers (EC). The ECs can utilize the standard FSL utilities and diagnostics along with the MVIS for a reduction in the vibratory environment. This isolation from the surrounding vibrations is important for many experiments including the study of multi-phase flows and diffusion-controlled heat/mass transfer in crystallization processes. CIMEX-1, which will study dynamics of evaporating liquids, is the first EC slated to utilize the isolation capabilities of MVIS.

MVIS is designed to isolate experiments from vibratory accelerations greater than 0.01 Hz. The MVIS isolation performance is directly related to the FSL umbilical stiffness, the bias forces required to maintain the FCE in a centered position, the FCE disturbances along with the presence of umbilical dynamics. The FSL umbilicals, the electrical harnesses and air/fluidic cooling lines connecting the isolated FCE to the FSL are the subject of this analysis. An extensive effort has been undertaken to identify the FSL umbilical stiffness and bias. This includes the creation of a simulated umbilical model using FSL design data, the creation of numerical models, 6DOF ground based testing of the FSL flight model and simulated umbilical model using custom designed balancing beams and test rigs along with parabolic flight testing of the simulated umbilical model on the ESA Zero-G Airbus A300. The MVIS performance is then estimated using the ground test results paired with a high fidelity MVIS simulation. This information is compared to on-orbit data obtained during the first two phases of MVIS commissioning.

This paper will give an introduction to the MVIS system, present the findings of the system identification and performance testing, summarize the activities undertaken and recommended to reduce the FSL umbilical stiffness and improve isolation performance, and provide an overview of the on-orbit ac-

tivities used in the identification and commissioning of MVIS. The MVIS isolation performance and FCE acceleration levels obtained during commissioning will also be presented.