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MICROGRAVITY SCIENCES AND PROCESSES (A2)
Microgravity Experiments from Sub-orbital to Orbital Platforms (3)

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DESIGN AND OPERATING LIMITS OF THE PLATFORM FOR ACQUISITION OF ACCELERATION DATA (PAANDA)

Abstract

The platform for acquisition and analysis of acceleration data (PAANDA) is an instrument built to measure the acceleration of a rocket launched microgravity platform during its flight. Specifically, PAANDA was designed to precisely measure possible residual accelerations on the 10^{-6} g scale during the microgravity phase of flight.

PAANDA uses three Honeywell QA2000-010 accelerometers mounted orthogonally on a frame and integrated into three independent acquisition modules, each composed of an outstanding temperature stable resistor, connected in series to the accelerometer signal output, which determines the scale factor, and an integrating analog-to-digital (A-D) conversion circuit, which reads the acceleration-proportional-voltage signal over the resistor. The system can operate with two acceleration scales by relay-connecting another resistor in parallel, automatically switching between ±1.05 g and ±18.00 g full scale, covering all vehicle acceleration envelope, including launch.

The acquisition module is optimized for precisely reading very small values of acceleration around zero. Its low scale of operation has a resolution limited to 10^{-6} g at 10 Hz. The sensor manufacturer states its resolution limit is below 10^{-6} g. Its operation in a microgravity environment, reading small values in a region around to the sensor's resolution, avoids most errors common to pendular accelerometers. It also avoids the errors related to the sensor's scale factor, leaving mostly offset related errors to be corrected. The same strategy is used for the acquisition module, where values in the region above 10^{-5} V in a full scale of 10 V must be read. This minimizes its non-linearity problems and scale factor temperature dependence, but the acquisition system must have a very low noise characteristic to reach this desired resolution. It also must have low offset temperature error in the instrument's microgravity operating range (0 °C to 70 °C). Due to outstanding thermal characteristics of the A-D conversion circuit employed, no temperature correction technique was used. Only the manufacturer provided temperature correction model provided for each accelerometer was implemented, using their temperature signals.

We describe the PAANDA design and experiment details to some extent. Specifically, we focus on its data acquisition system performance in light of Cumã II mission's data. We also discuss the design characteristics of the instrument and its relation to performance. We show that it was possible to reach the instruments design resolution limit for near zero g measurements, but the accuracy will only improve by temperature modeling the system's critical components.