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VIBRATIONAL QUALIFICATION OF A CUSTOM MULTISPECTRAL IMAGER FOR LUNAR ROVER APPLICATIONS

Abstract

We are developing a Multispectral Imager (MSI), which is one component of the Canadian Space Agency (CSA)-funded Integrated Vision System prototype. The instrument consists of both the MSI and a multispectral LIDAR to be mounted on the mast of a future lunar rover. Western University's MSI is designed to image the lunar surface in multiple spectral bands from 400-1700 nm, including the short-wave infrared (SWIR) band not found on previous rover-based imagers. This will allow the characterization of geologically important minerals, support scientific understanding of lunar geology, rover navigation, and the return of humans to the Moon.

Here we present work done on the vibrational analysis and qualification of the MSI prototype to ensure that it will withstand the structural loads of launch. As a prelude to space qualification of the full MSI design, the vibration characteristics of the system's printed circuit boards (PCBs) were predicted through comprehensive finite element analyses and experimentally validated at the CSA's David Florida Laboratory (DFL). The NASA Goddard GEVS (General Environmental Verification Standard) random vibration profile was used as a first-order approximation to flight-like loading, in absence of further information about final instrument casing design.

We will introduce the MSI instrument and vibration testing, then explain analysis practices, predictions, experimental methodology, and correlation between theoretical and experimental results. It will also include lessons learned for PCB vibration analysis. Three key PCBs of the MSI of varying shapes, sizes, and laminations were studied. The vibration study was initiated with harmonic analysis of the boards without components. The FR4-copper laminate was modelled as a continuous, linear-elastic, isotropic material. Damping is predicted using empirical correlations. This was followed by a random vibration analysis using the GEVS profile and modelling of the major circuit components.

Vibration testing of the PCBs was performed at DFL. They were subjected to random vibrations using the GEVS profile, and structural changes were assessed using pre- and post-sine sweeps. Strategically

placed accelerometers were used to measure the acceleration responses of the boards to the base excitation. The analysis of these results and an assessment of test performance will be presented at IAC 2022.

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