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Space Debris Detection, Tracking and Characterization - SST (1)

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LARID: CHARACTERIZING AN IN-SITU SPACE DEBRIS DETECTOR'S RESPONSE TO NOISE

Abstract

The measurement of space debris in orbit has been a subject of study since the beginning of the space age. The high speeds in orbit give even small debris enough energy to pose a risk to spacecraft. The smaller end of the space debris population can only be assessed with either returned objects or in-situ measurements. Ground-based detection systems are currently unable to observe sizes below a few millimeters. In-situ systems offer the potential to give a fuller picture of the space debris environment and help improve particle models. The previous in-situ detectors, however, have seen challenges with noise clouding the measurements and reducing the observable range of impactors. This paper describes the LArID detector being developed at Fraunhofer EMI and the efforts to limit and characterize the possible noise sources, as well as assess the environmental robustness.

The LArID detector combines different physical measurements to assess the properties of impact events starting at 0.1 mm in size. Acoustic waves of the impact through a thin foil are triangulated, providing a location and time of impact. This is then followed by an impact on a second foil that has thousands of 100 m wide copper traces running through it in an orthogonal pattern; giving a second location, the size of the impactor, and the time of impact. The flash of the impact is also measured, giving a second independent physical measurement of both times of impact. Combining these measurements of size and velocity with the spacecraft's orbital location and attitude will allow for a much more detailed picture of the space debris environment.

Each of the sensor types will be investigated for noise that may hide or confuse impact signals. For the acoustic sensors, vibrations from the spacecraft bus, and thermal crack and creep are expected to be the main contributions. These will be approximated using a reaction wheel mounted to the detector's base plate; as well as applying heat locally and listening for the structure to respond with the acoustic sensors. The optical measurements will also be subject to the stray light from the sun through a small hole in the first foil. With these noise sources experimentally investigated, the results will be compared to the sensor responses during a hypervelocity impact test conducted on the detector. This will allow for improved confidence in the measured events and allow for a more robust determination of the space debris environment.