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

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ROCKET BODY TUMBLING ASSESSMENT THROUGH RADAR, OPTICAL TELESCOPE, AND IMAGING

Abstract

The tumbling of intact derelicts, especially rocket bodies due to their typically larger aspect ratio creates challenges to active debris removal (ADR) solutions. However, it is unclear how quickly (i.e., tumble rate) and in what modes (i.e., flat spin, end-over-end, or multi-axis) rocket bodies might be tumbling. This parameter is important for prioritizing ADR targeting sequences.

This project captures measurements on five rocket bodies using four diagnostic measurement modes. The rocket bodies identified for this experiment are distributed across low Earth orbit (LEO) and are of US and Japanese origin. The four diagnostic measurement modes include (1) optical telescope approximations of the objects' tumble rates/modes, (2) variations of S-band radar cross-section (RCS) data, (3) imagery from a space-based earth observation system, and (4) time history of positional uncertainty derived from radar measurements.

The characterization of the objects' tumble rate can be used to both assess difficulty of ADR grappling/detumbling processes and examine correlation to positional uncertainty that will directly affect probability of collision calculation integrity. The challenging need to measure these different dynamic modalities over a short timeframe is balanced by examining five potential targets. If this experiment is successful, it may be used as a prototype for high confidence tumble rate assessment for objects in LEO.