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Space Debris Detection, Tracking and Characterization (1)

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BIOMETRIC INSPIRED SATELLITE CHARACTERIZATION USING HYPERTEMPORAL PHOTOMETRY

Abstract

The research presented shall aid the characterization effort of Resident Space Objects. The proposed paper shall describe the development and application of a new photon counting detector developed at the University of Texas at Austin, that collects satellite light curves at sampling rates of 50 kHz. The detector specifications, as well as the calibration process and examples of the single-photon resolution light curves will be presented. The detector is scheduled for tests at the Astronomical Institute at the University of Bern (AIUB) where the hypertemporal light curves of targets of interest will be collected. AIUB's ZIMLAT and ZimSMART electro-optical sensors shall be utilized to coordinate, plan, and execute a data collection campaign on the target objects from various orbital regimes and representing a range of physical characteristics. Analysis on some test targets that have previously been studied using high rate photometry, such as Ajisai, and TOPEX/Poseidon shall be presented. The magnitude limits of the detector shall also be tested by analyzing empirical data collected on the spinning objects in higher orbits, such as the constellation of 40 defunct GLONASS satellites and faint GEO debris. The computational tools for the post-processing, modeling and simulation of the hypertemporal light curves will be developed and used for innovative RSO characterization that generates a unique fingerprint ID for each object based on the satellite reflective properties. The paper will explain in more details the concept of satellite "fingerprinting" and its application in RSO identification using an enrollment, verification, and validation approach with the high sampling rate photometry data. The observed and simulated satellite fingerprints will be presented, along with a discussion on possible techniques to analyze such ID patterns. The different variables that will effect this fingerprinting process – such as the object Bidirectional Reflectance Distribution Function (BRDF), will be identified.