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Orbital Safety and Optimal Operations in an Increasingly Congested Environment (Joint Astrodynamics/Space Debris Session) (10-C1.7)

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AUTOMATED NEAR REAL-TIME VALIDATION AND EXPLOITATION OF OPTICAL SENSOR DATA FOR IMPROVED ORBITAL SAFETY

Abstract

There is a growing need to supplement the existing space surveillance sensor networks with additional sensors to support tracking and management of the ever-increasing population of both active and inactive Earth orbiting objects in and near the geosynchronous Earth orbit (GEO) belt. A globally distributed network insures timely and persistent monitoring of the space environment to help insure safe use of space for communications, commerce, defense and scientific Earth resources monitoring. There is a need for rapid validation and near real-time data integrity monitoring to facilitate rapid incorporation of new or upgraded sensors into a network.

This paper presents results of a research initiative, funded by the European Office of Aerospace Research and Development (EOARD), to develop an automated near real-time validation and data integrity processing towards rapid integration and evaluation of sensors. A baseline set of optical sensor data, which included known reference objects, was analyzed to establish a test data set for the automated real-time implementation. A dynamic filter implementation was developed which incorporates a near real-time estimation of noise and bias characteristics and includes facilitation of near real-time reference object generation. Sensitivity to unmodeled error sources via Covariance Analysis is also examined. The performance results are demonstrated with data from a single sensor (Starbrook), with limitations, and improvements to results when multiple sensors are available. The fusion of multiple data types and sources will enable the distinction between filter "artifacts" due to data quality and anomalies versus dynamic anomalies of the tracked objects.

Categorization of filter processing "artifacts," due to both man-made and natural phenomena, will support future research on Machine Learning methods that can be used to learn previously unknown

physical effects contributing to epistemic uncertainty and unsupervised learning of system behavior which lend themselves to learning optimal modes of operation specific to user needs and objectives.