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SMALL SATELLITE CONSTELLATION FOR SPACE SITUATIONAL AWARENESS

Abstract

The number of Resident Space Objects (RSOs) orbiting Earth is growing disproportionately to the number of sensors used to detect them and perform Space Situational Awareness (SSA). Acquiring more effective, efficient and capable SSA sensors is critical to solving the SSA problem. Performing accurate and precise SSA is important for many reasons, including collision avoidance and safeguarding space assets of national interest. Although there are many ground-based electro-optical and radar surveillance sensors which support global SSA efforts, the number of Space-Based Space Surveillance (SBSS) systems is limited. The advantages of space-based sensors compared to ground-based include the absence of atmospheric viewing obscurities, capability to observe spatially diverse regions of interest in short time spans, and independence of the day-night cycle.

This paper outlines the mission design and analysis for a Low-Earth Orbit (LEO) cube-satellite constellation, with the aim of adding a low cost SBSS platform to the global SSA effort. Of particular interest are RSOs in Geostationary Earth Orbit (GEO), which have a combined value greater than assets in other orbits. As such, the constellation is optimised for observation of GEO RSOs. Cases considered include the continuous detection of a single GEO RSO, and the ability to detect objects in any region of GEO at any time. Optimal constellation configurations are presented for multiple and for single orbital plane cases. The platform power requirements, ground segment and payload design are also analysed.

The analysis presented in this paper suggests that a small constellation of cube-satellites could enhance the global SSA network by providing improved tracking of GEO RSOs. The sufficiently different system properties and capabilities of the constellation complements and extends the existing ground and space-based SSA effort.