Data/Information Fusion for Advanced Space Situational Awareness of Resident Space Objects

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Abstract

Space situational awareness (SSA) is a term used to describe the knowledge and real-time awareness of resident space objects (RSOs), including those manmade (e.g. satellites) and naturally occurring (e.g. meteoroid), including events and behaviors in space and their interrelationships, as well as predictions of such events and behaviors in the future. Further, the connotation of SSA implies a particular emphasis on the discrimination and identification of events and behaviors involving space-borne assets. US space-borne assets are vulnerable to a multitude of threats, occurring from both intentional and unintentional actions, including conjunction with other operational satellites, debris caused by satellite breakups and the intentional placements of harmful objects by adversaries. Proper SSA of RSOs is vital to mitigate these threats.

This presentation will focus on research activities performed at the University at Buffalo (UB), along with its non-for-profit entity CUBRC, on recent advancements to improve SSA of both manmade and naturally occurring RSOs. First, new advancements using lightcurve data, provided from passively-collected electro-optical astrometric and photometric measurements by telescopes, will be shown that include shape estimation, mass estimation, albedo area estimation and solar panel offset estimation. Then, other lightcurve approaches will be shown that can be used to determine an attitude maneuver of an active RSO in near real-time. Next, a new method that estimates the magnitude and time occurrence of an RSO thruster maneuver in real-time will be shown. This will then be extended to show that the time and magnitude of the maneuver can be estimated even though the maneuver occurs during a sensor blackout period. A vital component for effective SSA is data association of RSOs. A new method that builds upon star tracker pattern recognition approaches for improved data association with closely-spaced RSOs will be shown. Finally, recent new work on fusing soft (e.g. human intelligence) and hard (e.g. sensor) day will be discussed. An overview of the satellites being built at UB's Nanosatellite Laboratory will also be given.