SPACE DEBRIS SYMPOSIUM (A6)
Space Debris Detection and Characterisation (6)

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PERFORMANCE ASSESSMENT OF UPDATED TWO-LINE ELEMENT SETS IN SUPPORT OF NASA GEO ORBITAL DEBRIS STUDIES

Abstract

An informal agreement was established in 2006 between NASA and the U.S. Air Force Space Command (AFSPC) whereby a set of near Geosynchronous (GEO) High Area-to-mass Ratio (HAMR) objects – Analyst Satellites tracked by AFSPC GEODSS network – would be made available to the NASA/JSC Orbital Debris Program Office to support debris studies. A process was established whereby optical tracking data for the debris objects would be provided as inputs to an orbit determination "update" process established at the Boeing Company, and the resulting updates propagated through the planned observing periods using the updated orbital state and high fidelity force models. The MODEST telescope, located in Chile, is used for some of NASA's orbital debris studies. The debris object visibility from MODEST is computed to determine which of these would be candidates for observing. Two-line Element Sets (TLEs) for the candidates are then derived from the high fidelity predictions around the observing periods and passed to NASA for use for object acquisition and photometric data collection.

The availability of long-term data sets for the HAMR object allows the acquisition and tracking performance of the "updated" TLEs to be assessed after the fact. The orbit determination process uses an Extended Kalman Filter/Smoother to estimate the 6 orbital elements, plus the area-to-mass ratio (AMR) which dictates the solar radiation pressure perturbations on the orbital trajectories. In addition to allowing the characterization of the long-term behavior of the AMR, subsequent tracking data that was obtained covers past observing periods, and so can be used to establish a pseudo-truth trajectory to which can be compared to the previously derived TLEs used for acquisition and tracking. In addition to providing an measure of acquisition accuracy, the data also provide a means for assessing the affects of the time-variation of the AMR, and how best to accommodate that un-modeled affect to improve acquisition and tracking performance.

The work to be presented summarizes the update process, assesses past acquisition and tracking performance based on selected data for selected objects covering 2006-2010, and looks at the long-term AMR histories and examines effect of AMR time variations on the updated TLE acquisition accuracy.