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CLOSE APPROACH ANALYSIS FOR SENSOR TASKING

Abstract

The Space Environment Research Centre (SERC) Ltd. is implementing a closed loop system that will use close approach assessment results to inform sensor scheduling. Within the system, object states are propagated to identify potential future collisions. Risk objects are then handed over to the Collision-Likelihood Assessment Module (CLAM) which performs a detailed analysis. Its output is a quantified valuation of the situation which feeds into the sensor scheduling and is used to prioritize objects for orbit update/refinement.

The structure of the paper follows the steps within CLAM that are taken to produce a quantified valuation of an arbitrary predicted close approach. Before an assessment is started, orbital states as well as uncertainties of the involved objects are required. To take advantage of an efficient test for Gaussianity that operates exclusively on the sigma-states of the unscented transform (UNO), uncertainties are delivered in the form of the sigma-states, propagated to the expected time of closest approach. As efficient methods for collision likelihood estimation typically rely on a number of basic assumptions, a pre-assessment is performed. Herein, a rough estimate of the collision likelihood is obtained using an efficient random particle approach. The encounter duration is then estimated and the normality of the uncertainties in Cartesian space is evaluated. This information, along with estimates for the encounter velocity and miss distance from the pre-filter is used to decide on an applicable efficient method. If none are implemented, the random particle method may be applied. The sample size required to obtain a predefined accuracy given a tolerated residual error is determined based on the Dagum bound. Once more accurate, informative values have been calculated, a weighting parameter is determined which influences the priority for updating or refining the orbits of the involved objects. Within the paper, the methods and considerations that go into each of the outlined steps are described and exemplified.

The novelty of the work being described is the automated selection of appropriate collision-likelihood methods and its making use of a recently published method for the detection of Gaussianity.