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Author: Mr. Sven Kevin Flegel
Space Environment Research Centre Ltd. (SERC), Australia

TOWARDS STATE UNCERTAINTY ACCURACY REQUIREMENTS FOR ACTIONABLE GEO COLLISION RISK ASSESSMENTS

Abstract

Safe operations in the near-Earth orbit environment require spacecraft operators to have access to actionable information regarding potential collisions between their spacecraft and other objects. Typically, conjunctions in low Earth orbits have high relative velocities and short encounter times. In the geostationary orbit region, conjunction scenarios are more disparate. Closing velocities with active spacecraft are typically low – especially when drifting or librating objects are involved – while objects on geostationary transfer orbits lead to larger closing speeds.

The paper begins with a classification of collision types for collisions which involve active spacecraft in the protected geostationary orbit region. The importance to spacecraft operators is assessed based on, for example, the frequency of the event in conjunction screenings. Subsequently, appropriate conjunction risk metrics are identified for each characteristic collision type for active geostationary spacecraft. The metrics include miss distance, encounter time and probability of collision. They are then assessed with respect to their robustness against incorrectly modelled orbital state uncertainties. The results are exemplified by simulating conjunction approaches using Monte-Carlo integration. These findings are analysed to identify possible implications for state uncertainty accuracy requirements at the predicted encounter time. The investigation closes with an assessment of the potential usefulness of the identified metrics in assisting the decision process for conjunction avoidance manoeuvres in GEO.