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REAL-TIME CONJUNCTION ASSESSMENT AND MANEUVER PLANNING IN SPACEMAP

Abstract

The busy orbital space is getting busier in the New Space Age. This phenomenon increases the probability of collisions between resident space objects (RSOs) rather rapidly. As RSOs fly at the speed of several times of bullet, e.g. 7 to 8 km/s or higher than 27,000km/h, the consequence of the collision is catastrophic. However, an accurate and efficient prediction of conjunctions has long been a challenge even with the space catalogue of moderate size. It will remain so with the catalogue of anticipated extreme size in the New Space Age due to many launches and enhancement of measurement technology in addition to the Kessler syndrome. Here we present a web server called SpaceMap which can solve conjunction assessment based on both miss distance and collision probability and maneuver planning in (near) real-time. SpaceMap reports the conjunctions of an object-of-interest (OOI) in real-time and can report the optimal maneuver plan of a predicted conjunction from a set of user-supplied alternatives in near real-time. A consensus is that optimal maneuver planning is computationally hard because objects fly extremely fast and a walkaround object necessarily causes side-effects called secondary and tertiary conjunctions. What causes computational challenge is the tertiary conjunction which may be defined between OOI and other fast-flying RSOs in the neighborhood. Using conventional algorithms, this will almost probably take a significant amount of time even if the powerful computational resources are used. SpaceMap, however, takes advantage of computationally powerful, new geometric theorems called Voronoi diagrams and facilitates near real-time efficiency. In addition, SpaceMap runs on AWS. Its computational efficiency and accuracy might enable it as a potential platform for constellation planner and evaluator. Currently, SpaceMap uses the TLE data from Space-track. Incorporating other data types such as telemetry data (e.g. GPS), measurement data (e.g. radar), etc. is rather straightforward.