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EVALUATION OF LEO CONJUNCTION RATES USING HISTORICAL FLIGHT SAFETY SYSTEMS  
AND ANALYTICAL ALGORITHMS

**Abstract**

In Low Earth Orbit (LEO), satellite operators typically assess the need for a collision avoidance maneuver based upon when one of their satellites is expected to come within 1 kilometer of another space object. In this paper, we compare normalized conjunction statistics extracted from the SOCRATES and Space Data Center historical conjunction assessment archives with a volumetric encounter algorithm characterization to explore historical trends and project future requirements for collision avoidance maneuvers.

The first of these historical archives is the Satellite Orbital Conjunction Reports Assessing Threatening Encounters in Space (SOCRATES) that COMSPOC Corporation hosts on its CelesTrak site, where conjunction risks have been identified as a free public since 2005.

The second historical archive data source is the Space Data Center (SDC), operated by COMSPOC for the Space Data Association (SDA) since 2010. The SDA is a non-profit international organization that brings together major satellite companies to contribute towards the safety of space operations and maintaining the integrity of the space environment. The SDC ingests comprehensive spacecraft operator data, normalizes it, and compares it with U.S. government orbit solutions for the rest of the tracked space object population to assess conjunction risks and warn satellite operators. Historical SDC data was incorporated into this study for the period 2016 to 2021.

We then compare these historical results with analytical estimates generated using our volumetric encounter algorithm combined with both the current space catalog as well as a size breakdown using the ESA MASTER Database.

Based upon these comparisons, we found that SDC and SOCRATES data indicate that in 2017, LEO spacecraft likely came within 1 kilometer of other objects an average of 2,000 times per month. Now, it's closer to 4,000 average monthly conjunctions. For certain orbit regimes and satellite operators, conjunction alerts may be increasing even faster.