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Author: Mr. Daniel Oltrogge
Analytical Graphics, Inc., United States, oltrogge@centerforspace.com

Dr. Salvatore Alfano
Analytical Graphics, Inc., United States, salfano@centerforspace.com

COLLISION RISK IN LOW EARTH ORBIT

Abstract

Knowing the collision risk of satellites operating in Low Earth Orbit (LEO) is of great importance and interest to the global community and the operators of LEO spacecraft. This is especially true in LEO due to the relatively high "density" of Resident Space Objects (RSO) which reside in, or cross, the LEO altitude range (from 0 to 2000 km), as well as the importance of maintaining the safety and commercial viability of the LEO orbit regime for the new "large constellation" operators as well as the increasingly popular low thrust ascent through LEO to get to MEO and GEO regimes. Yet for all of its importance, a comprehensive assessment of LEO collision risk has not been accomplished to date. This is likely due to the complexities involved, including: (1) unknown/unpredictable operator operations and collision avoidance strategies; (2) the lack of methods suitable to estimate long-term encounter rates independent from our Space Situational Awareness knowledge; and (3) the lack of a good representative RSO catalog down to smaller object sizes than those currently tracked. New methods for developing a representative catalog and for determining typical encounter rates for small spacecraft sizes offer ways to address these technical complexities. In this paper, we employ these new methods to estimate LEO collision risk for both current and planned large constellations. These results indicate that collision risk in LEO is fairly high when examined in the context of a satellite constellation's lifetime.