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EFFECT OF CUBESATS ON COLLISION AVOIDANCE WARNINGS AND LONG-TERM DEBRIS GROWTH IN NEAR-EARTH ENVIRONMENT

Abstract

CubeSats are becoming an increasingly popular way of launching small payloads into orbit. Rideshare ing on existing launches allows for small inexpensive satellites to reach orbit for a fraction of the cost of larger, launch-vehicle-dedicated missions. However, one potential downside of this approach is that CubeSats often do not get to select the final orbit they are left in. As a consequence, the deployed CubeSats will be spread throughout the Low Earth Orbit (LEO) environment. This in turn could increase both the number of collisions (leading to an increasing debris environment) and collision alerts (leading to increased operator response workload) that other operators will have to face. An examination was performed regarding the number of collisions and collision alerts that could be expected from future CubeSats. A CubeSat model was selected to deliver approximately 1670 CubeSats per year to Earth orbit; this would amount to 20 CubeSats per launch if all public launches deployed CubeSats and is roughly equivalent adding enough objects every two years to mimic another Fengyun 1-C event. Rideshares were assumed for all CubeSat deployments (i.e., rocket body upper stages from larger missions were the originating body for the CubeSats with slight random differences applied to the orbit elements to simulate physical deployment). The deployed CubeSats were grouped into 3 categories: those launched to LEO and complying with the 25-year decay rule; those launched to LEO but not complying with the 25-year rule, and those launched on missions to GEO (i.e., leaving the CubeSats in highly elliptical geosynchronous transfer orbits that also do not comply). It was found that the CubeSat collision rate varies with time with few collisions initially but growing to significant levels within 10-20 years. However, it was found that the non-compliant portion of the population dominated the build-up of the long-term debris. These results imply that future deployment strategies of CubeSats need to take into consideration the decay time of the vehicles in order to mitigate growth in Earth-orbiting debris. The final paper will discuss both the operational impact of increased CubeSat constellations and the expected growth in the debris environment caused by collisions involving these vehicles.