Paper ID: 32568
oral
student

14TH IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Operations in Space Debris Environment, Situational Awareness (7)

Author: Mr. Jason Reiter
Pennsylvania State University, United States

Prof. David B. Spencer
Pennsylvania State University, United States

TRADING SPACECRAFT FUEL USE AND MISSION PERFORMANCE TO DETERMINE THE OPTIMAL COLLISION PROBABILITY IN EMERGENCY COLLISION AVOIDANCE SCENARIOS

Abstract

For many spacecraft missions, even the slightest change in the orbit of the spacecraft may significantly affect its ability to perform to the desired specifications. With the high volume of debris in orbit, debris-creating events could occur with no advanced notice, making emergency collision avoidance scenarios a real possibility. Care must be taken to ensure that any potential collision is avoided while minimizing the effect of the maneuver on the spacecraft's mission performance. Assuming that the possible collisions occur at high relative velocities and perfect knowledge of the states of all objects, the required thrusting time to achieve a desired maximum collision probability can be found. Varying the desired collision probability, the resulting changes in the required thrust duration time (and, thus, fuel use) can be observed, providing options for trading the fuel use and likelihood of a collision. Additionally, both of these variables contribute directly to the ability of the spacecraft to perform to the desired mission specifications. As the maximum collision probability and required burn time increase, the mission performance decreases with it. The level of robustness necessary in the mission specifications can be used to limit the desired maximum collision probability. This is accomplished by determining the time and fuel required to perform the collision avoidance maneuver to the desired probability level and analyzing the effect of the time spent away from the mission orbit and the quantity of fuel required to perform the maneuver on the mission performance. Such analysis would prove significant in determining an optimal maximum collision probability (typically a subjective variable) for emergency collision scenarios.