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STUDY OF DISPOSAL OPTIONS FOR REDUCING THE FUTURE DEBRIS ENVIRONMENT IN MEDIUM EARTH ORBIT

Abstract

Disposal guidance in the Inter-Agency Space Debris Coordination Committee (IADC) debris mitigation guidelines currently treats medium Earth orbit (MEO) (altitude range from 2,000 km to 35,586 km) as an unrestricted region for storage disposal orbits. A previous study showed that consistent usage of MEO storage disposal orbits will result in quadratic growth of the MEO debris population. This growth trend occurs because the majority of MEO storage disposal orbits resulting from missions as they are currently planned do not decay.

In the current study, two disposal options for reducing the growth rate of the MEO debris population were considered. In Disposal Option 1, missions are designed to avoid leaving upper stages on MEO storage disposal orbits. In Disposal Option 2, eccentricity growth of MEO constellation disposal orbits is used to reduce collision risk and, if possible, cause eventual atmospheric reentry. Both options are achievable if they are considered during early mission design.

An analysis was performed to determine the effectiveness of these disposal options. The Aerospace Debris Environment Projection Tool (ADEPT) was used to simulate the future debris environment down to 1 cm over 500 years for three disposal scenarios. The extended projection time was chosen to fully examine the effects of eccentricity growth. In Scenario 1, 100

Results of the study for Scenario 1 confirm quadratic growth of the MEO collisional debris population. Results also show an average reduction in collisional debris in the GNSS altitude region by approximately one-third in Scenario 2 and by approximately two-thirds in Scenario 3. The paper discusses the details of the simulation setup, plots of simulated collision events vs. altitude and time, and on-orbit collisional debris population count vs. time. The collision avoidance frequency for the GNSS operational satellites in all three scenarios is presented.