SPACE DEBRIS SYMPOSIUM (A6)
Modelling and Risk Analysis (2)

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THE EFFECT OF PASSIVE ELECTROSTATIC CHARGING ON NEAR-GEOSYNCHRONOUS HIGH AREA TO MASS RATIO OBJECTS

Abstract

In 2004 T. Schildknecht detected a new group of space debris objects in near-geosynchronous orbits. Research to date seems to indicate that these objects have apparent high area-to-mass ratio (HAMR) of over a square meter per kilogram, which is several orders of magnitude higher than that of intact artificial space objects. Measurements suggested that part of the apparent HAMR object population is comprised of multi-layer insulation (MLI), possibly as a result of delamination from space-aging. Because these apparent HAMR objects are very light and have a large surface as compared to their inferred mass, they are likely to be very sensitive to non-conservative forces and torques impressed by the local space environment. Moreover, this sensitivity would lead to highly coupled orbit and attitude motion. As a main non-conservative perturbation source specific to these objects, direct solar radiation pressure has been established. But little attention has been given to additional sources of perturbation. This paper investigates the possible influence of the Earth magnetic field and hypothesized passive electrostatic charging on the orbit and attitude motion of these HAMR objects in the context of a variety of types of MLI; several different near-geosynchronous orbits and object characteristics are investigated. The trajectory prediction perturbations resulting from electrostatic charging are assessed, along with direct and indirect attitude dependent effects, and their magnitudes compared to other relevant perturbations. The quantification and characterization of electrostatic charging will allow appropriate treatment in the trajectory estimation and prediction processes, thus improving re-acquisition performance.