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

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ORBITAL EVOLUTION OF HIGH AREA-TO-MASS RATIO DEBRIS UNDER THE INFLUENCE OF THE RADIATION PRESSURE AND GRAVITATIONAL EFFECTS

Abstract

This paper analyses dynamical evolution of high area-to-mass ratio debris in high orbit ($a > 10000$km), especially geosynchrous orbit. The analysis first provides a Hamiltonian formulation of the eccentricity and inclination under the perturbation of the radiation pressure and J22 term, and is based on the expansion in powers of the eccentricity and inclination. This part of the study is a continuation of the paper of Valk et al (2008). According to the result when the secular rates of the eccentricity vector and of the solar ecliptic longitude are close, the resonant phenomena occurs in the orbital evolution, and it can cause the debris to evolve to an orbit with big eccentricity even if the area-to-mass is not very large. The formula fits well with the numerical simulation in case of small eccentricity and inclination, but it cannot explain the orbital evolution when the condition is not satisfied. As a result, the second part of the paper uses another method, quasi-mean-element which is based on Kozai's method (Kozai 1959), to make further analysis to the evolution of the eccentricity. The results suggest the relation between the initial eccentricity vector and the maximum value of the eccentricity in the debris evolution under the influence of the radiation pressure and gravitational effects. At last the paper provides impact of different perturbation on the evolution of high area-to-mass ratio debris by numerical simulations.