ASTRODYNAMICS SYMPOSIUM (C1)
Orbital Dynamics (2) (7)

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STUDY OF RESONANCES DUE TO THIRD BODY PERTURBATIONS IN THE DYNAMICS OF MEOS

Abstract

The dynamics of Medium Earth Orbits sees nowadays a renewed interest because of the development of satellites constellations, that raises the problem of parking orbits for satellits at end of life. Numerical evidence shows that the resonances related to the presence of a third body can affect the stability of MEO orbits. However understanding how these resonances act on MEOs is still an open problem. The goal of our work is the study of the stability of MEO orbits on long or very long term (hundreds of years), with the aim of a coherent choice of parking orbits for dismissed constellation satellites. For orbits above 20,000 km altitude, the perturbation due to a third body cannot be neglected; then, the set of the possible resonances is larger than in the case of geopotential perturbations alone. The resonance conditions are related to the frequencies and thus to the secular evolution of the angular variables of the motion. We extend the equations for the evolution of the node and the perigee of satellite orbits, including the secular effects due the perturbation of the Moon or the Sun. We show that in this case the resonant inclination is a function of the satellite eccentricity; we use these secular effects to estimate the evolution of the resonant inclination numerically, with special attention to the resonance associated to the inclination i = 56 deg, which is the operational inclination of the Galileo satellites. Since this kind of resonance can lead to dramatic increases of the eccentricity, we study the equations ruling the long period evolution of the eccentricity.