Paper ID: 63452
oral
student

IAF ASTRODYNAMICS SYMPOSIUM (C1)
Orbital Dynamics (1) (6)

Author: Dr. Tao Nie
Technion – Israel Institute of Technology, Israel, hitnt2010@gmail.com

SHORT-PERIODIC CORRECTIONS OF THE SEMIMAJOR AXIS FOR REDUCING INTER-SATELLITE DRIFT

Abstract

The J_2 perturbation effects on the long-term evolution of satellite relative motion have been studied extensively. However, much less attention has been given to other perturbations, in particular sectoral and tesseral perturbations. Different from the J_2 perturbation, sectoral and tesseral effects on orbital elements are periodic for non-resonant orbits. The sectoral and tesseral harmonics do not induce secular changes on orbital elements for non-resonant orbits, but they may cause long-term distance drift among satellites.

In this work, an analytical method for calculating the averaged relative inter-satellite distance in is developed to evaluate differential perturbation effects on the long-term evolution of inter-satellite relative motion. Different from previous works, not only can the secular effects of perturbations be captured, but also the periodic effects of perturbations can be detected in the averaged relative distance. Based on the averaged relative distance, it is observed that differential sectoral and tesseral perturbation effects can induce a secular inter-satellite drift through the differences of short-periodic corrections between osculating elements and mean elements. It is proven that the term related to periodic corrections between the osculating semi-major axis and mean semi-major axis is several orders of magnitude larger than other orbital elements. In other words, correcting the short-periodic variation for semi-major axis can mitigate the main drift induced by differential sectoral and tesseral perturbation effects.

A simple method for calculating the periodic corrections relating the osculating semi-major axis and mean semi-major axis considering sectoral, tesseral and zonal perturbations is proposed for mitigating differential perturbation effects on the relative motion. Numerical simulations validate that incorporating short-periodic corrections of the semi-major axis can mitigate the inter-satellite distance drift induced by sectoral and tesseral perturbations.