

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

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ORBIT DYNAMICS IN THE VICINITY OF ASTEROIDS WITH SOLAR PERTURBATION

Abstract

Orbital dynamics with solar gravity perturbation in the vicinity of the irregular asteroids is studied in this paper. This study is conducted under the following assumptions: (1) the density of the asteroid is uniform; (2) the asteroid rotates around the principal axis of the largest moment of inertia; (3) the motion of a point mass is affected only by the gravitation of the asteroid and the sun. The polyhedral approach is used to model the shapes of the asteroid and analytical formulae of uniform-density polyhedron gravitational field are derived. The dynamical equation of a point mass under the effects of gravitations of the asteroid and the solar gravity perturbation is obtained. The motions in the gravity fields of 216 Kleopatra and 433 Eros, and the periodic orbits around the asteroid with perturbation of solar gravitation are analyzed. The periodic orbits in the vicinity of 216 Kleopatra with perturbation are calculated and a new family of periodic orbits of 216 Kleopatra is found. It is also found 12 families of periodic orbits around 433 Eros and their topology and stability are studied in some details. A bounded non-periodic orbit of Eros is found in this process. This paper shows that solar gravitation has little effect on the positions of asteroids equilibria in the body-fixed frame while that the non-spherical gravitation of the asteroid affects the motion of a mass point on the equilibria a lot. The solar gravitation is not strong enough to increase or decrease the families of periodic orbits, nor is it able to change the stabilities of periodic orbits. For unstable orbits, it will not lose its periodic characteristics as long as the original orbits can keep the characteristics in the vicinity of asteroids before solar gravitation is added and it is easier for orbits with larger Jacobi constant to keep its periodic characteristics, which provides the possibility of making use of unstable orbits to probe asteroids.

Keywords: Asteroid; periodic orbits; 216 Kleopatra; 433 Eros