Paper ID: 18311
student

ASTRODYNAMICS SYMPOSIUM (C1)
Orbital Dynamics (2) (9)

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ORBIT DYNAMICS IN THE VICINITY OF CONTACT BINARY ASTEROIDS

Abstract

A contact binary asteroid is an asteroid, which consists of two lobes that are in contact, have a bimodal mass distribution. It is estimated to constitute 10-20% of all NEAs, Trojans and KBOs. In this paper, the two components are approximated by an ellipsoid and a sphere, respectively, with two free system parameters: the mass ratio μ between the two mass components and the gravitational-centripetal acceleration ratio k=GM/(ω^2 d^3). Various characteristics of the situation for k>1,k=1,k<1 are studied. Firstly, by applying the zero-velocity surfaces, the equilibrium points (EPs) and their linear stabilities are identified as functions of μ and k. Then, the global stable and unstable manifolds associated with these EPs are explored for understanding the motion in the vicinity of the EPs and the patterns of escape and capture trajectories. Thirdly, with the approximate analytical initial condition and traditional differential correction method, the Lyapunov and Halo kind of orbits around the EPs are determined. Their linear stabilities are evaluated through eigenvalues of the monodromy matrix, and their potential for mission orbits is also discussed. Finally, the planar prograde and retrograde periodic orbits far from resonance are searched over wider zones. It is found that the two parameters μ and k have a great influence on the dynamics in the vicinity of the asteroids, and this study can be viewed as the first step to a general study on the dynamical environment around highly bifurcated bodies.