ASTRODYNAMICS SYMPOSIUM (C1)
Orbital Dynamics (1) (8)

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EQUILIBRIUM POINTS IN THE DOUBLY SYNCHRONOUS BINARY ASTEROID SYSTEM?

Abstract

Binary asteroid systems constitute a fraction of small bodies in the Solar system. Current space missions have visited solitary asteroids but not the binary ones. They might be potential targets for future space missions. One end state of the binary asteroid system is that both asteroids are trapped in a state where their rotation is synchronous with their orbital motion, which we usually called as doubly synchronous state. For a binary asteroid system trapped in such a state, in a frame rotating with the two asteroids' mutual orbit, equilibrium points which are dynamically equivalent to the libration points in the corresponding circular restricted three-body problem exist. These points have been extensively studied in many previous studies, in simplified shape models (sphere restricted) or in approximate models truncated at low orders of the mutual potential. These studies generally only consider the gravities of the binary asteroids.

Components of the binary near-Earth asteroids usually have a mutual distance of several to tens of radii of the primary (i.e., the more massive) component. As a result, the equilibrium points usually also have a comparative distance from both asteroids. On the other hand, components of the binary near-Earth asteroids usually have small sizes, which makes their gravity so weak at the equilibrium points that perturbations from the solar radiation pressure (SRP) usually cannot be neglected. This work focuses on the effects of the SRP on the dynamics around these points in the binary asteroid system. Generally, equilibrium points no longer exist. What exists are the so-called dynamical substitutes. Assuming that the binary asteroid system is in a doubly synchronous state, we'll first describe these special dynamical structures by taking the two asteroids as particles. Then we'll study how theses dynamical structures vary by varying the shape of the two asteroids. To simply the studies, only the 2nd order truncation of the mutual potential between the two asteroids will be used.