On the Equilibrium Points of Doubly Synchronous Binary Asteroid Systems

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Doubly synchronous state is an end state of the binary asteroid systems where the tidal dissipation is balanced by the BYORP effect. A fair amount of doubly synchronous binary asteroids (DSBA) is already discovered among the near-Earth binaries and the main belt binaries. With both the primary's and the secondary's spin periods same as the mutual orbital period, the modelling and dynamics of DSBAS are similar to those of the classical circular restricted three-body problem (CRTBP). Positions of equilibrium points in the DSBAs, along with their stability, have already been studied, either by assuming a sphere plus an ellipsoid [1,2] or two ellipsoids [3-7] for the two bodies in the DSBAs.

In this contribution, similar studies have been carried out. We also assume two ellipsoids for the DSBAs. Different from previous works, the mutual potential between the two ellipsoids and the potential between the massless particle and the primary (and the secondary) are truncated at the 4th order [8]. First, equations of motion (EOM) for the massless particle in the synodic frame of the DBSA are given. Then, positions of planar equilibrium points are obtained by finding the intersection points between the two curves $\partial\Omega/\partial x = 0$ and $\partial\Omega/\partial y = 0$ where Ω is the "potential" function in the synodic frame. Last, stability of the equilibrium points is studied by analysing the Hessen matrix of the equilibrium points. The purpose of the current study is to show the role of higher order terms in the potential when the primary and the secondary are highly irregular and close to each other in the DSBAs.

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