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ORIGINAL ARTICLE

Effects of radiation and triaxiality of primaries on triangular equilibrium points in elliptic restricted three body problem

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Abstract This paper studies the motion of an infinitesimal mass around triangular equilibrium points in the elliptic restricted three body problem assuming bigger primary as a source of radiation and the smaller one a triaxial rigid body. A practical application of this case could be the study of motion of a satellite under the effect of Sun and Earth. We have exploited the method of averaging used by Grebnikov (Nauka, Moscow, revised 1986) throughout the analysis of stability of the system. The critical mass ratio depends on the radiation pressure, oblateness, eccentricity and semi major axis of the elliptic orbits and the range of stability decreases as the radiation parameter increases.

Keywords Celestial Mechanics · Dynamical system · Elliptical restricted three body problem · Lagrangian points · Rigid Body

1 Introduction

The study of Restricted three body problem, modelling practical problems is of interest. The motion here is called restricted as the effect of infinitesimal mass does not have any effect on the motion of the primaries. There are mainly two types of problems viz. Circular restricted three body problem (CR3BP) and Elliptic restricted three body problem (ER3BP). The former one is concerned with the motion of an infinitesimal mass under the gravitational influence of two massive bodies, called the primaries. The primaries move in a Circular Keplerian orbit and hence the name Circular restricted three body problem (CR3BP), and they move around their common centre of mass due to their mutual attraction. In Circular restricted three body problem (CR3BP) Synodic reference system is used in which the coordinates are obtained by dividing by the fixed distances of the bodies, and the Hamiltonian does not depend on time explicitly. But, Circular restricted three body problem (CR3BP) has a disadvantage that this formulation cannot treat the long-time behaviour of practically important dynamical systems in Celestial Mechanics. The reason is that significant effects might be expected because of the eccentricity of the orbits of the primaries. If circular orbits are taken into consideration for motion of Trojan asteroids around Jupiter, then it leads to the stability of the asteroids around it. But, multiple weak resonances of asteroids with the Jupiter cause them to behave chaotically and are unstable (Robutal et al. 2005). This significant variations in the result can be explained by taking elliptic orbits for the Jupiter-Trojan asteroid system.

On the other hand, in Elliptic restricted three body problem (ER3BP), the primaries move in an elliptical Keplerian orbit. In this problem, the position of the primaries are fixed and the coordinates are obtained by dividing them by the variable distances between the primaries, the Hamiltonian does depend explicitly on time. The orbits of most of the celestial bodies are elliptical rather than circular, so ER3BP can be used to analyse the dynamical systems more accurately by predicting their behaviour.

The classical problem was generalised by considering the various aspects other than the forces of mutual gravitation such as the shape of bodies, influence of other per-

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