HORSESHOE PERIODIC ORBITS IN THE RESTRICTED THREE BODY PROBLEM

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Abstract   We consider the circular restricted three-body problem (CRTBP) in the synodical system of coordinates for values of the Jacobi constant C in the interval $(3, C_1)$ (where C_1 is the value of C at the collinear equilibrium point L_1). We describe the existence of families of horseshoe periodic orbits when varying the mass parameter and the Jacobi constant. The relation between such orbits and the invariant manifolds of the Lyapunov families of periodic orbits around the collinear equilibrium point L_3 is also analysed.

Keywords: coorbital motion, periodic orbits, restricted three-body problem, invariant manifolds

1.   Introduction

This paper is a natural continuation of a previous one about horseshoe periodic orbits in the CRTBP [3]. Actually the original motivation of this study was to describe the motion of Saturn coorbital satellites Janus (also called 1980S1) and Epimetheus (also 1980S3) in this simple model. More precisely, in [9] we showed the existence of new families of stable horseshoe periodic orbits (in the framework of the CRTBP) closely related to the actual motion of 1980S1 and 1980S3. We described a mechanism of generation of horseshoe periodic orbits for $\mu > 0$ and very small, which inherited the dynamics from the $\mu = 0$ case. Such mechanism gave answer to the natural question about the origin and location of these horseshoe periodic orbits. We also carried out