

Exchange orbits in the general planar five-body problem

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Abstract

Generalizing the well known three body horseshoe orbits of the 3BP we study some doubly-symmetric orbits in the general planar $2n + 1$ body problem. The necessary and sufficient conditions for periodicity of the orbits are discussed. We also study numerically these kinds of orbits for the case $n = 2$. The system under study corresponds to one conformed by a planet and four satellites of equal mass. We determine a 1 parameter family of time-reversible invariant tori, related with the reversing symmetries of the equations of motion. The initial conditions of the orbits were determined by means of solving a boundary value problem with one free parameter. The numerical solution of the boundary value problem was obtained using the software AUTO. For the numerical analysis we have used the value of 3.510^{-4} as mass ratio of some satellite and the planet. In the computed solutions the satellites are in mean motion resonance 1:1 and they librate around a relative equilibria, that is a solution where the distances between the bodies remain constant for all time. We also show numerically the relation between these orbits and some homographic solutions.