Transport orbits in an equilateral restricted four-body problem

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Abstract In this paper we consider a restricted equilateral four-body problem where a particle of negligible mass is moving under the Newtonian gravitational attraction of three masses (called primaries) which move on circular orbits around their center of masses such that their configuration is always an equilateral triangle (Lagrangian configuration). We consider the case of two bodies of equal masses, which in adimensional units is the parameter of the problem. We study numerically the existence of families of unstable periodic orbits, whose invariant stable and unstable manifolds are responsible for the existence of homoclinic and heteroclinic connections, as well as of transit orbits traveling from and to different regions. We explore, for three different values of the mass parameter, what kind of transits and energy levels exist for which there are orbits with prescribed itineraries visiting the neighborhood of different primaries.

Keywords Lagrangian configuration · Four-body problem · Invariant manifolds · Transfer orbits · Homoclinic and heteroclinic connections

1 Introduction

One of the most extensively studied problem in Celestial Mechanics is the restricted three body problem, where one of the bodies is considered massless, so it does not affect the motion of the other two that move in a Keplerian orbit (circular or elliptic trajectory solution of a two-body problem). The restricted four body problem is similar in the sense that the problem