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Research Article

Central configurations of the circular restricted 4-body problem with three equal primaries in the collinear central configuration of the-3 body problem

Jaume Llibre*

Department of Mathematics, Autonomous University of Barcelona, 08193 Bellaterra, Barcelona, Catalonia, Spain

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***Corresponding author:** Jaume Llibre, Department of Mathematics, Autonomous University of Barcelona, 08193 Bellaterra, Barcelona, Catalonia, Spain,
E-mail: jllibre@mat.uab.cat

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Abstract

In this paper we classify the central configurations of the circular restricted 4-body problem with three primaries with equal masses at the collinear configuration of the 3-body problem and an infinitisimal mass.

Introduction and results

The well-known Newtonian n-body problem concerns with the motion of n mass points with positive mass m_i moving under their mutual attraction in R^d in accordance with Newton's law of gravitation.

The equations of the motion of the *n*-body problem are

$$\ddot{r}_i = -\sum_{j=1, j\neq i}^{n} \frac{m_j(r_i - r_j)}{r_{ij}^3}, \quad 1 \le i \le n,$$

where we have taken the unit of time in such a way that the Newtonian gravitational constant be one, and $r_{i\in R}{}^{d}$ $(i=1\ldots,n)$ denotes the position vector of the *i*-body, $r_{ij} = | r_i - r_j |$ is the Euclidean distance between the *i*-body and the *j*-body.

The solutions of the 2-body problem (also called the Kepler problem) has been completely solved, but the solutions for the *n*-body for *n*>2, is still an open problem.

For the Newtonian *n*-body problem the simplest possible motions are such that the configuration formed by the n-bodies is constant up to rotations and scaling, such motions are called the *homographic solutions* of the *n*-body problem, and are the unique known explicit solutions of the n-body problem when *n*>2. Only some special configurations of particles are allowed in the homographic solutions of the n-body problem, called by Wintner [1] *central configurations*. Also, central configurations are of utmost importance when studying bifurcations of the hypersurfaces of constant energy and angular momentum, for more details see Meyer [2] and Smale [3]. These last years some central configurations have been used for different missions of the spacecrafts in the solar system, see for instance [4,5].

More precisely, let

$$M = m_1 + \cdots + m_n, \quad c = \frac{m_1 r_1 + \cdots + m_n r_n}{M},$$

be the *total mass* and the *center of masses* of the *n* bodies, respectively.

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