PERIODIC ORBITS OF A COLLINEAR RESTRICTED THREE-BODY PROBLEM

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(Received: 13 December 2001; accepted: 9 October 2002)

Abstract. In this paper we study symmetric periodic orbits of a collinear restricted three-body problem, when the middle mass is the largest one. These symmetric periodic orbits are obtained from analytic continuation of symmetric periodic orbits of two collinear two-body problems.

Key words: periodic orbits, collinear restricted three-body problem, analytic continuation method

1. Introduction

In the study of any dynamical system and, in particular, in the study of the dynamical systems associated to the n-body problem, it is very important to know the existence, stability and bifurcation of periodic orbits. Over the years many different methods have been used to establish the existence and the nature of periodic solutions of the n-body problem (for instance Poincaré's continuation method, averaging, Lagrangian manifold intersection theory, normal forms, numerical analysis, majorant series, special fixed point theorems, symbolic dynamics, variational methods, ...). In some sense, the analytic study of the periodic orbits of the n-body problem was started by Poincaré in (Poincaré, 1892–1899), when he studied periodic orbits for the planar circular restricted 3-body problem. There is a very extensive literature on the existence of periodic solutions of the n-body problem, especially in the restricted 3-body problems. In Meyer (1999) we find a good discussion on the applicability of the Poincaré's continuation method to different n-body problems.

In this paper we study symmetric periodic orbits of a collinear restricted three-body problem. We consider two primaries m_1 and m_2 moving in an elliptic collision orbit. We fix the primary m_2 at the origin of coordinates, and then we assume that the position of m_1 is on the negative x-axis, see Figure 1. The *collinear restricted three-body problem* that we consider is to describe the motion of an infinitesimal mass $m_3 = 0$ moving on the positive x-axis under the Newtonian gravitational attraction of m_1 and m_2.

Celestial Mechanics and Dynamical Astronomy **86:** 163–183, 2003.