Celest Mech Dyn Astr (2013) 117:263–277
DOI 10.1007/s10569-013-9512-9

ORIGINAL ARTICLE

On the planar motion in the full two-body problem with inertial symmetry

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Received: 5 September 2012 / Revised: 4 July 2013 / Accepted: 30 July 2013 /
Published online: 1 September 2013
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Abstract Relative motion of binary asteroids, modeled as the full two-body planar problem, is studied, taking into account the shape and mass distribution of the bodies. Using the Lagrangian approach, the equations governing the motion are derived. The resulting system of four equations is nonlinear and coupled. These equations are solved numerically. In the particular case where the bodies have inertial symmetry, these equations can be reduced to a single equation, with small nonlinearity. The method of multiple scales is used to obtain a first-order solution for the reduced nonlinear equation. The solution is shown to be sufficient when compared with the numerical solution. Numerical results are provided for different example cases, including truncated-cone-shaped and peanut-shaped bodies.

Keywords Binary asteroids · Full two-body problem · Planar motion

1 Introduction

Since the detection of a natural satellite around the asteroid Ida during the Galileo flyby in 1993, numerous asteroid pairs have been observed in the Solar System. According to a review by Walsh (2009), there are more than 160 known asteroid pairs, making up around 15 % of near-Earth asteroids, 2–3 % of the main asteroid belt, and between 10 and 30 % of the different dynamical groups of the trans-Neptunian objects. A lot of the recent work studies the formation of binary asteroids, such as a report by Pravec et al. (2010) on the formation of asteroid pairs by rotational fission, and a model presented by Jacobson and Scheeres (2011).

A portion of this paper was presented as Paper AAS 12-134 at the 22nd AAS/AIAA Space Flight Mechanics Meeting, 2012, Charleston, South Carolina.

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