Paper ID: 38317
interactive

ASTRODYNAMICS SYMPOSIUM (C1)
Interactive Presentations (IP)

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ANALYSIS OF ORBITS NEAR A BINARY ASTEROID SYSTEM MODELED AS ROTATING MASS DIPOLES

Abstract

Studies in the area of asteroid exploration are challenging, since each asteroid has its own characteristics, such as size, shape, etc, which are often discovered after the spacecraft approaches the asteroid. Therefore, these missions should be planned with flexibility, varying as much as possible the number of parameters, which will be better determined only after the spacecraft approaches the system. In the present work, we will use the equations of motion of the restricted synchronous three-body problem to investigate orbits of a spacecraft around a binary system of asteroids. In this study, we take into account the gravitational forces of the primary bodies and the solar radiation pressure. The main objective of this work is to analyze the orbital dynamics of a spacecraft when released near the less massive body of a binary system of asteroids in order to find stable regions close to the asteroids. What we mean by stable regions are the regions where the orbits of the spacecraft survive for a given time. Several different values will be used for this limit. The two primary bodies will be modeled using the rotating mass dipole method. The initial conditions come from an instantaneous orbit around the smaller body. For this, we vary the semi-axis major and eccentricity of the spacecraft with respect to the smaller body, so getting the initial conditions in terms of position and velocity in the Cartesian system. Once the initial conditions are established, a numerical integration is made where the gravity field of the two asteroids M1 and M2 and the solar radiation pressure are considered. We will perform study various mass ratios for the binary asteroid system, without changing the total mass of the system. We intend to generate figures using a color grid, which relates the semi-major axis and the eccentricity with the duration of the orbit for each mass ratio, to identify regions that can be relevant for space missions that have the intention of analyzing and collecting data from a binary system of asteroids. The color coding grid will show the survival time of a spacecraft when released close to an asteroid modeled as a rotating mass dipole. It is considered that the lifetime of the orbit ends when the spacecraft collides with one of the asteroids or is ejected from the system. The reason for the end of the life of the trajectory is identified in separate plots.