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USING RADIATION PRESSURE TO CONTROL ORBITS AROUND A TRIPLE ASTEROID

Abstract

It is believed that most asteroids keep information about the original composition of the Solar System, so it is of great scientific interest to study those bodies. One of the most interesting candidates for a mission is the asteroid 2001SN263. It is a triple system, which components have radius about 1.30 km, 0.39 km and 0.29 km. Using a reference system centered in the larger body, the second component is in an orbit that has semi-major axis of 16.63 km and eccentricity 0.015, and the third component is in an orbit with semi-major axis of 3.80 km and eccentricity 0.016 (Araújo et al, 2012). Currently, there are several institutions in Brazil studying a mission to this asteroid. This mission is called ASTER and is planned for a one year duration in the asteroid system. The goal of the present paper is to study the forces acting in that system, and then verify the possibility of using the solar radiation pressure to make station-keeping maneuvers. The dynamical model will consider the main forces acting on that system (Prado, 2014), including the gravitational forces of the three bodies of the system, the flattening of the main body and the solar radiation pressure. Other forces will also be analyzed to verify their importance on that problem, like the gravitational forces of the planets, the Moon and the main other asteroids. For a given orbit, the optimal direction of the solar sail attitude along the orbit is found, as well as the size that the solar sail must have in order to compensate the disturbing forces. Optimal solutions will be searched by allowing variations of those parameters. Also, two sub-optimal analyses are considered: one is conceived by choosing a fixed area of the solar sail (assuming several values this area) and the other one considering a fixed area and limitations on the attitude motion. The necessity of a propulsion system to complement the maneuvers will be considered. A large number of orbits will be tested, around the three bodies of the system.

References Araújo, R.A.N., Winter, O.C., Prado, A.F.B.A., Sukhanov, A., Stability regions around the components of the triple system 2001SN263. MNRAS. (423)3058-3073, 2012. Prado, A. F.B.A. Mapping Orbits Around the Asteroid 2001SN263. Advances in Space Research, v. 53, p. 877-889, 2014.