

ASTRODYNAMICS SYMPOSIUM (C1)
Interactive Presentations (IP)

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ORBITAL TRANSFERS AROUND A DOUBLE ASTEROID SYSTEM

Abstract

In recent years, several missions have been proposed to reach asteroids and comets in the Solar System, such as: Aster, Dawn, MarcoPolo-R, NEAR Shoemaker, Osiris-Rex and Rosetta. Those bodies are very important in terms of science, because they keep information related to the origin of the Solar System. It means that it is very important to study those bodies.

In that sense, the present paper focus on finding transfer orbits around an asteroid system, in the restricted three-body problem, considering some perturbations over the transfers. Considering that such bodies, due to its high eccentricity, may have the periapsis near the Sun and the apoapsis farthest, the influence of solar radiation pressure on the a spacecraft may be relevant. Also, with the wide range of asteroid-Sun distances covered during an orbital period, the dynamics becomes more complex.

Besides this, the inclusion of the oblateness of the asteroids may cause a variation in the trajectories of the spacecraft, also changing the final position of the spacecraft. The physical reason for this variation is that the oblateness changes the mass distribution of the body, changing the average distances from each mass element to the spacecraft, which is equivalent to an increase or decrease in the mass of the asteroid, thereby increasing or decreasing the effect of the passage of the spacecraft, depending on the geometry involved.

Transfers among the Lagrangian points and between the Lagrangian points and the asteroids are considered. Previous results show that the radiation pressure has a significant participation in the process, because the gravitational force in an asteroid system is smaller when compared with systems having larger bodies. In the case of an asteroid system, it is possible to find solutions with lower and higher fuel consumption by considering the initial and final position of the spacecraft when the maneuver begins.

The effects of the solar radiation pressure in the trajectory of the spacecraft can be modulated by changing the area/mass of the spacecraft, so it is possible to increase those effects by adding large panels to the spacecraft, if it is interesting for the mission. The idea is not to use the radiation pressure as a control, but just to measure its effects when performing the orbital transfers.