EFFECTS OF SOLAR RADIATION PRESSURE IN AN DOUBLE ASTEROID SYSTEM

Geraldo Magela C. Oliveira [1,2], Antonio F. B. A. Prado [2], Diogo M. Sanchez [2] and Vivian M. Gomes [3]

[1] Federal Center for Technological Education of Minas Gerais (CEFET-MG), Contagem, Brazil, {magela@contagem.cefetmg.br, geraldo.oliveira@inpe.br}
[2] National Institute for Space Research (INPE), São José dos Campos, Brazil, {antonio.prado@inpe.br,diogo.sanchez@inpe.br}
[3] São Paulo State University (FEG/UNESP), Guaratinguetá, Brazil {vivian.gomes@feg.unesp.br}

Introduction: In recent years, several missions have been proposed for asteroids and comets, such as: Aster, Dawn, MarcoPolo-R, NEAR Shoemaker and Rosetta. Considering that such bodies, due to its high eccentricity, may have the periapsis near the Sun and the apoapsis farthest, the influence of radiation pressure on the spacecrafts may become relevant. Also, with the wide range of asteroid-Sun distances covered during an orbital period, the dynamics becomes more complex.

The idea here is to study orbital transfers, in the restricted three-body problem, considering the effects of the radiation pressure in the trajectory of a spacecraft in a bi-impulsive maneuver in an asteroid system. Transfers among the Lagrangian points and between the Lagrangian points and the asteroids are considered. The 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 position of the spacecraft when the maneuver begins. The figure 1 shows a previous result of this work for maneuvers around the double asteroid $1996FG_3$.

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 bi-impulsive transfer.

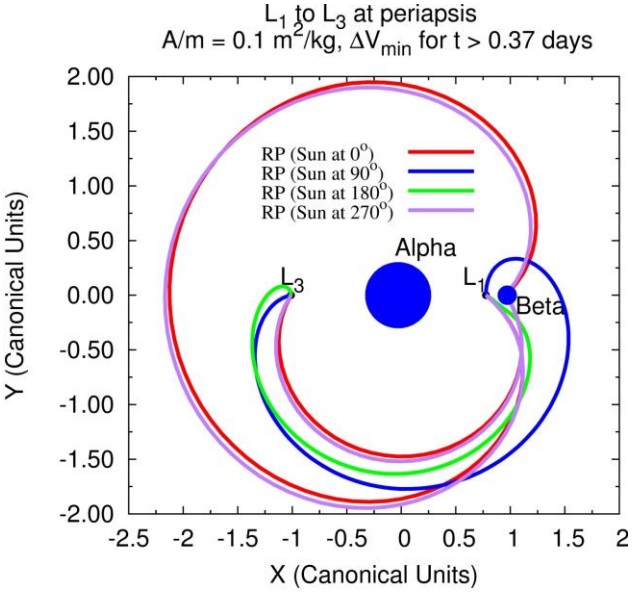

Figure 1. Trajectories between the Lagrange points of the asteroid $1996FG_3$ considering the radiation pressure.

References:

[1] Michel, P. et al. MarcoPolo-R: Near-Earth Asteroid sample return mission selected for the assessment study phase of the ESA program cosmic vision. Acta Astronautica, v. 93, p. 530-538, 2014.

[2] Prado, A.F.B.A., *Orbital maneuvers between the Lagrangian points and the primaries in the Earth-Sun system*. Journal of the Brazilian Society of Mechanical Sciences and Engineering, 28(2), 131-139, 2006.

[3] Scheirich, P. et al. *The binary near-Earth Asteroid (175706) 1996 FG3 - An observational constraint on its orbital evolution*. Icarus, v. 245, p. 56-63, 2015.

[4] Sukhanov, A., Velho, H.F.C., Macau, E., Winter, O.C., The Aster Project: Flight to a Near-Earth Asteroid, *Cosm. Res.*, 48(5), 443-450, 2010.

[5] Szebehely, V., *Theory of Orbits*, Academic Press, New York (1967).