Paper ID: 14431
oral

ASTRODYNAMICS SYMPOSIUM (C1)
Orbital Dynamics (1) (6)

Author: Dr. Ariadna Farrés
Université de Bourgogne, Spain

Prof. Angel Jorba
University of Barcelona, Spain

ORBITAL DYNAMICS OF A SOLAR SAIL NEAR L1 AND L2 IN THE ELLIPTIC HILL PROBLEM

Abstract

It is well known that due to the small gravitational field around asteroids, solar radiation pressure plays an important role on the dynamics of a satellite around them. Hence, the systematic use of the solar radiation pressure via specialised reflecting areas, such as solar sails, to propel a satellite can offer new and interesting mission concepts.

When looking at the dynamics of a satellite close to an asteroid there are two effects that must be taken into account: its gravitational field due to its irregular shape and spin states and the solar attraction and radiation pressure. The first effect becomes relevant when we are within a few radii from the surface of the asteroid, in what is known as the gravity regime. If we are far from the gravity regime, considering the asteroid as a point mass gives a good approximation of the real dynamics. Here effects like the solar radiation pressure and the Sun's gravity must be considered. For realistic models, the fact that an asteroid can follow very eccentric orbit around the Sun must also be taken into account.

Here we consider the Elliptic Hill problem and add the solar radiation pressure due to the solar sail as a model for the dynamics of a solar sail close to an asteroid, and study the non-linear dynamics around the L1 and L2 regions.

We know that the Circular Hill problem has two unstable equilibrium points L1 and L2. When we add the effect of the solar sail, the position of these equilibria can be displace by changing the sail orientation. The linear dynamics around these points is centre x centre x saddle. As for a solar sail in the Restricted Three Body Problem we can find families of planar and vertical Lyapunov orbits around these artificial equilibria.

When we consider the Elliptic Hill problem, we have a periodic time-dependent effect, with the same period as the asteroid orbital period around the Sun (T). Now the equilibrium points are replaced by T-periodic orbits and the periodic orbits are 2D invariant tori. We will compute these invariant objects for different sail orientations and study the dynamics around them.