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# PERIODIC AND QUASI-PERIODIC MOTIONS FOR A SOLAR SAIL IN THE EARTH-MOON SYSTEM

**Abstract**

Solar sailing is an emerging way of spacecraft propulsion with a number of singularities with respect to traditional chemical thrusters. While the acceleration achieved by the sail is much smaller, it is continuous and limited only by the lifespan of the sail. In this work we perform a comprehensive numerical study of the natural motion of a solar sail in the Earth-Moon system. Models for the motion of a solar sail in the Earth-Moon system are not as well studied as in the Sun-Earth case, and, despite there are a few interesting works, none of them takes into account Sun's gravity.

Hence, a model taking into account the Solar radiation pressure plus the gravitational attraction of Earth, Moon and Sun is proposed. In this (restricted) model, we prescribe the motion of Earth, Moon and Sun and focus on the motion of a spacecraft endowed with a solar sail. The described is a dynamical system depending on several parameters representing the efficiency and the orientation of the sail. It is of particular interest the motion near the (Earth-Moon) Lagrangian points.

This model may be regarded as a time-dependent periodic perturbation of the Restricted Three Body problem. Therefore the Lagrangian points are no longer equilibria but they are replaced by periodic orbits with the same period as the periodic perturbation. In a similar manner, the (non-resonant) periodic orbits are replaced by two dimensional invariant tori. Based on the computation of these invariant objects, we present a detailed description of the skeleton of the dynamics, and how it depends of the parameters of the system. This information is very useful for the design of space missions.