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SOLAR SAILING WITH INVARIANT MANIFOLDS IN THE EARTH-SUN SYSTEM

Abstract

Solar sailing is a spacecraft propulsion system, that uses large reflecting surfaces to take advantage of the solar radiation pressure (SRP) to enable a constant acceleration, and therefore a potentially unlimited thrust. The recent successful deployment of a solar sail by IKAROS and NanoSail-D2 has finally validated the concept of solar sailing.

Solar sails are extremely interesting for long interplanetary transfers, but also offer many advantages on Libration Point missions. The extra effect of the SRP allows us, by changing the sail orientation, to artificially displace the classical Lagrangian equilibrium points, $L_{1,\ldots,5}$, as well as the Lyapunov, Halo and Lissajous orbits that appear around equilibria. Most of them are linearly unstable and have stable and unstable invariant manifolds associated to them. In this paper we want to explore the possibilities that these invariant manifolds offer for navigating in a natural way around the system.

We will use the Earth-Sun Restricted Three Body Problem (RTBP) as a model and compute from different sail orientations and energy levels the stable and unstable manifolds associated to the periodic and quasi-periodic orbits in the system. We want to find natural trajectories that allow us to move, in a controlled way, from the region close to L_1 to the one close to L_2 or even L_4 and L_5.