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OPTIMAL LOW-COST TRANSFER TRANSFER TO L4 AND L5 LAGRANGIAN POINTS BASED ON THE G-FAMILY OF PERIODIC ORBITS

Abstract

In this work we present an new low-cost transfer strategy that allows to guide a spacecraft from a LEO around the Earth to a stable orbit around the Lagrangian equilibrium points L4 or L5. This strategy exploit a family or retrograde periodic orbits named as G family that it located around the Lagrangian equilibrium point L1. Lagrangian points L4 and L5 lie at 60 degrees ahead of and behind Moon in its orbit in related to the Earth. Each one of them is a third point of an equilateral triangle with the base of the line defined by those two bodies. These Lagrangian points are stable in related to perturbations. Because of their distance electromagnetic radiations from the Earth arrive on them substantially attenuated. As so, these Lagrangian points represent remarkable positions to host astronomical observatories. However, this same distance characteristic may be a challenge for periodic servicing mission. Here we show how this G family orbits, which are sensitive to small perturbations, can be exploited to provide a gain in energy sufficiently to guide a spacecraft to L4 or L5, allow one to end up into an elliptic orbit about these Lagrangian points. Further, we analyze results and discuss them according to request of energy and the time of flight needed. Our results indicates that this strategy is not only efficient in related to thrust requirement, but also its time transfer is comparable to others known transfer techniques based on time optimization.