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CISLUNAR ESCAPE TRAJECTORIES THROUGH PATCHED SUN-EARTH/EARTH-MOON THREE-BODY PROBLEM

Abstract

In the next decade, the exploitation of the Cislunar environment for both manned and unmanned missions will open the space frontier for human exploration of the Moon, Mars and asteroids. The Lunar Gateway (LOP-G) has been proposed as a potential hub for excursions to Mars and activities in support of exploration and planetary defence. Within this context, in this paper, the problem to design a transfer from the Earth-Moon Libration Points to a destination object outside the Cislunar environment is analysed.

In general, the dynamical environment within the Earth-Moon system is rather complex, and the trajectory design is non-trivial. In this study, a further degree of complexity is introduced by the need to patch the escape trajectory with a heliocentric leg, preserving its epoch-dependence. That introduces a phasing problem within the design of the trajectory, which is considered multi-impulsive. Therefore, the problem is split in two steps. First, families of trajectories escaping the Cislunar environment are characterized, to build-up the understanding of the escape mechanisms. Then, a methodology to select the subset of escape trajectories that best match the departure conditions, depending on the epoch and the V available, is applied;three relevant applicative cases are discussed in the paper to better highligthen the approach flexibility: an asteroid deflection mission, where the impact geometry and the deflection effects are taken into account; an asteroid rendezvous mission and a Mars mission, where the total transfer energy have to be minimized.