Paper ID: 73951
oral

IAF ASTRODYNAMICS SYMPOSIUM (C1)
Orbital Dynamics (2) (9)

Author: Mr. Andrea Pasquale
Politecnico di Milano, Italy

Prof. Michèle Lavagna
Politecnico di Milano, Italy
Dr. Florian Renk
European Space Agency (ESA), Germany

# NEAR-EARTH OBJECTS REACHABILITY ANALYSIS FROM SUN-EARTH/EARTH-MOON LIBRATION POINTS

**Abstract**

The Cislunar environment has gained large attention in the last decade, being the most suitable region to open the space frontier for human exploration of the Solar System. The Lunar Gateway (LOP-G) is being proposed as a potential hub for Lunar exploration, a springboard for excursions to and from Mars and as an outpost for many activities in support of exploration missions.

In this context, transfer strategies from the LOP-G towards the Earth, the Moon and the Sun-Earth Libration Points have been largely analysed in literature. In this paper, instead, the problem to design a transfer from the Libration Points to a destination object outside Cislunar environment is treated. Multi – body trajectory design is a rather complex task and usually requires a dedicated tuning that depends on the specific mission. In this work, a generalized framework consisting of a database – based initial condition generator and a state-of-the-art multiple shooting solver is instead exploited, giving the possibility to work around several pitfalls of the "classical" approach and to automatize the whole optimisation procedure. Different escape databases are constructed and characterized both within the CR3BP and the BCR4BP, based on the geometry, topology and the manoeuvring performed along the trajectory. Three relevant departures options are considered in the analysis: escape from LEO, Earth – Moon L2 and Sun – Earth L2. A synthetic population of NEO is also built, to represent the entire population of objects by a reduced set. Then, the reachability of the synthetic population is characterized by means of a end-to-end optimisation in an high-fidelity environment and the advantages and disadvantages of the different staging options are highlighted and critically discussed. The possibility to exploit the database for more complex interplanetary mission scenarios, including Main Belt asteroid hopping, is preliminary investigated as well.