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TRANSFER AND RENDEZ-VOUS STRATEGIES FOR THE DEPLOYMENT AND THE SERVICING OF AN INHABITED SPACE STATION AT EARTH-MOON L2

Abstract

Next step for human exploration in the solar system could be to deploy an inhabited station at Earth-Moon Libration points (EML), as a gateway for further destinations as Moon (lunar surface settlement), Mars or asteroids, according to International Space Exploration Coordination Group (ISEGC) roadmap and several recent publications. In this context, this paper examines how to design a low cost mission, using the natural dynamics for Station integration, crew rotations, cargo delivery and disposal. Preliminary studies lead us to select a Halo orbit around EML2 to locate the Space station. Then, entire trajectory from the selection of the departure Low Earth Obit to the rendez - vous strategy in EML2, was analyzed with several possible transfers types (direct, indirect, lunar fly-by or weak stability boundaries). Actually, optimization criteria strongly depend on the mission phase. When crew transit is considered, mission duration has mainly to be minimized, while cargo transportation will minimize the global delta-v. This paper presents the results (in term of duration and cost) obtained for the two strategies we selected: lunar fly-by for the crew and weak stability boundaries trajectories for cargo. We considered carefully the constraints for rendez - vous in EML2 and evaluated their impact on the performances. Moreover, we assessed the impacts of the model selection (ephemeris, four bodies versus restricted circular three bodies problem, ...). The main contribution of this project lies in the global optimization of the entire mission from LEO to EML2 and return on both criteria mission duration and delta-v, with a focus on the rendez - vous feasibility in EML2.