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Return to the Moon (02)
Concepts for Robotic and Human Missions to the Moon (3)

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EFFICIENT CIS-LUNAR TRAJECTORIES

Abstract

Twenty years ago, the theoretical notions of low-energy transfers were put the test with the Japanese spacecraft, Hiten. With the successful implementation of the low-energy transfer trajectory discovered by Belbruno, Hiten exposed the available option space for mission designers seeking efficient transfers and planetary captures. The placement of an International Exploration Platform operating within the EML1 EML2 vicinity would have enhanced operational flexibility via the use of these kinds of low-energy transfers. This paper examines the kinds of high and low energy transfers that would need to be performed during the operation of such a facility. Assuming a specific Exploration Platform configuration, we examine the potential trajectories utilized in support of cis-lunar and lunar vicinity mission planning. Specifically, the following trajectories are explored:

- 1) Earth to Earth-Moon Libration Point 2 (EML2)
  2) EML2 to EML1 3) EML2 to LLO
  4) Manifold transfers using chemical propulsion
  5) Size and characteristics of different EML2 orbits

The benefits derived by integrating high and low energy transfers range from system design and support to overall mission design mass savings and re-supply strategies. The Earth-Moon libration system provides not only a challenging environment in which to strengthen our understanding of beyond LEO exploration, but also mitigates risk to crewmembers by maintaining relatively close proximity to Earth. Long-term living in a free-space environment such as the Earth-Moon libration system enables the requisite study for deep space mission architectures, whether using chemical, electric or a hybrid propulsion system. Different transfer design techniques can be explored by mission designers, testing various propulsive systems, maneuvers, rendezvous, and other in-space and surface operations. Understanding the availability of high and low energy trajectory transfer options opens up the possibility of exploring the human and logistics support mission design space and deriving solutions never before contemplated.