14th HUMAN EXPLORATION OF THE MOON AND MARS SYMPOSIUM (A5)
Going beyond the Earth-Moon system: Human Missions to Mars, Libration points, and NEO's (4)

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MISSION ANALYSIS FOR A SPACE MEDICAL CENTER OF AN EXPLORATION GATEWAY AT A LUNAR LIBRATION POINT

Abstract

A next step on a sustainable and flexible path for manned space exploration is a permanent outpost in the Earth-Moon system that can serve as a gateway and test bed for missions to NEOs, lunar surface locations and finally Mars. One crucial challenge in implementing such a gateway is maintaining the astronauts' health by providing medical support reaching from advanced radiation monitoring to quarantine and surgery in this remote environment. At ISAE/Supaero, a concept for a dedicated Space Medical Center (SMC) of an exploration gateway at a lunar libration point (EML) is being developed for a 2075 timeframe. Over the whole work the systems engineering methodology is applied and details of medical and subsystem requirements for the SMC are presented in order to identify key capabilities and design drivers. The present paper gives an outline about the rationales for a space port at a lunar libration point as a gateway to manned space exploration and the results of preliminary design considerations. In a first analysis the properties of EML1 and EML2 Halo and Lissajous orbits are investigated and it is found that a Halo orbit at the translunar EML2 is suited best for reasons of transportation, affordable operations, medical considerations, scientific interest and suitability for exploration missions such as teleoperations on the lunar far side, investigations on the Earth-Moon system, SEL telescope servicing missions or human exploration missions to NEOs and Mars. Secondly, a focus is put on deployment and operational scenarios for the SMC in the year 2075. Based on existing trajectory studies, an overview of trajectories with their corresponding costs and durations was generated. Options for each transportation leg as well as staging strategies are discussed and first results of a figure of merit study for the deployment phase are presented. It is found that the use of weak stability boundary transfers for modules and resupply material as well as indirect fly by trajectories are a vital element of safe and affordable transportation strategies independent of launcher and propulsion technologies considered and evaluated during the study.