Paper ID: 13265
oral

HUMAN EXPLORATION OF THE SOLAR SYSTEM SYMPOSIUM (A5)
Going Beyond the Earth-Moon System: Human Missions to Mars, Libration Points, and NEO's (4)

Author: Ms. Aline Zimmer
University of Stuttgart, Germany, zimmer@irs.uni-stuttgart.de

MISSION ANALYSIS AND CONCEPTUAL SYSTEM DESIGN OF A MODULAR CREW VEHICLE FOR HUMAN EXPLORATION OF NEAR-EARTH ASTEROIDS

Abstract

In April 2010, U.S. President Barack Obama declared missions to Near-Earth Asteroids (NEAs) as the first step in his vision for human exploration of the solar system. Such missions offer a wide range of possibilities for space exploration, scientific research, and technology demonstration, provide a unique opportunity to be the first human expedition to an interplanetary body beyond the Earth–Moon system, and represent a very effective stepping stone towards human exploration of Mars. Hence, the objectives of this study are to develop a sustainable campaign of missions to NEAs and to design a flexible and expandable spacecraft capable of such missions. Based on a previous accessibility analysis, a campaign of NEA missions between 2025 and 2040 is devised. The strategy for this campaign is to gradually increase mission duration along with the time spent in the vicinity of the asteroid in order to induce a constant development of more advanced technologies at a manageable risk, thus paving the way for human exploration missions to Mars. In an effort to reduce mission cost and thus overall campaign cost by lowering the mass required to be launched and the amount of new hardware to be built for each mission, the mission architecture foresees cargo spacecraft, such as habitats, to be stationed in halo orbits at Sun-Earth libration points for reuse throughout the campaign. Furthermore, contingency options for different mission abort scenarios are investigated in order to limit the risk associated with human missions to asteroids. Subsequently, a crewed deep-space exploration vehicle is designed following a system-of-systems approach to accommodate the wide range of requirements of each individual mission with a modular system design. This system concept comprises all relevant subsystems while specifically addressing human factors and considering configurational aspects of the spacecraft. Possible launch and on-orbit assembly architectures are investigated and a campaign schedule is concluded. The results of the analysis will be presented.