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Exploration of Near Earth Asteroids (06)
Human Exploration of NEAs (1)

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HUMAN EXPEDITION TO A NEAR EARTH ASTEROID: REFERENCE MISSION AND TECHNOLOGIES

Abstract

The human exploration of multiple deep space destinations (e.g Cis-lunar, NEAs), in view of the final challenge of sending astronauts to Mars, represents a current and consistent study domain especially in terms of its possible scenarios and mission architectures assessments, as proved by the numerous on-going activities about this topic and moreover by the Global Exploration Roadmap. After exploring and analyzing different possible solutions to identify the most flexible path, a detailed characterization of one out of several Design Reference Missions (DRM) represents a necessity in order to evaluate the feasibility and affordability of deep space exploration missions, specifically in terms of cost, risks and enabling technological capabilities. A human expedition to a NEA, milestone of the GER 'Asteroid Next' scenario, is considered the mission that would offer the largest suite of benefits in terms of scientific return, operational experience and familiarity on human deep space missions, test of technologies and assessment of human factors for future long-duration expeditions (including planetary bodies), evaluation of In-Situ Resource Utilization (ISRU) and, more specifically, opportunity to test asteroid collision avoidance techniques. In the proposed study a DRM of a human expedition to a NEA is characterized in terms of overall architecture, mission elements and modular space system elements. Several solutions and concepts have been considered at the different levels of the reference mission design, and the trade-offs among them have been carried out. Within the paper the different traded options, as well as the final results, for the most relevant and crucial aspects of the mission (e.g. ΔV, Mission Duration, Crew, Operations...) are reported, in order to justify and support the major study choices. Once the space system elements have been identified, an overview of the critical Technological Areas (TA) and the specific enabling key technologies that, at the status of the art, require deeper studies, developments and assessments, is illustrated. The proposed DRM would represent a baseline mission, the result of a detailed and justified process of strategies and scenarios evaluation, and the starting point for the characterization of the mission elements subsystems and the required technologies developments. The final goal is to enable multiple destinations deep space human exploration missions in the next few decades, achieving the globally shared mission objectives.