Paper ID: 10266
oral
student

SPACE LIFE SCIENCES SYMPOSIUM (A1)
Life Support and EVA Systems (6)

Author: Dr. Maria Antonietta Viscio
Politecnico di Torino - Thales Alenia Space Italia, Italy

Dr. Nicole Viola
Politecnico di Torino, Italy
Mr. Eugenio Gargioli
Thales Alenia Space Italia, Italy
Prof. Ernesto Vallerani
International Space Pioneers, Italy

EVA OPERATIONS AROUND A NEAR EARTH ASTEROID

Abstract

The paper deals with the operations around a Near Earth Asteroid (NEA) with particular emphasis on the Extra Vehicular Activities (EVA) performed on the asteroid surface. The operations near the asteroid represent the core of the AENEA (humAn Exploration of a Near Earth Asteroid) mission studied in the framework of the fifth edition of the International Postgraduate Master in "SpacE Exploration and Development Systems". Different scenarios have been considered in order to choose the best strategy for executing the activities around the asteroid. At the end, the trade off dealt with the two alternatives of landing on the surface versus parking next to the Asteroid and approaching it in Extra Vehicular Activity (EVA): the latter turned out to be the best solution. The paper reports the main trade-off analyses performed to substantiate the final decision. The paper describes the NEA proximity operations phases, focusing on the EVA operations. The spacecraft is injected in an asteroid parking orbit and, when the EVA is next to start, it approaches the asteroid up to a safe distance, where the astronauts exit from the airlock and begin their activities. The spacecraft remains at a certain distance from the surface for all the EVA duration and maintains a continuous link with the astronauts; after the completion of the EVA, it approaches the surface again for allowing the astronauts to re-enter. Due to the impossibility to be anchored to the surface, the maneuvers necessary for the EVAs are managed by means of Enhanced Manned Maneuvering Units (E-MMU), which have been designed for an EVA duration of 4 hours and envisaging two modes of operations (nominal and safe mode). The EVA operations phases have been analyzed in terms of duration, ΔV and propellant budget for two kinds of EVA, i.e. polar and equatorial EVA. The paper reports a detailed description of the operating sequence starting from the egress until the ingress into the airlock, showing the sequence of actions for donning and doffing the E-MMU and outlining the activities to be performed on the NEA. The paper illustrates both the applied methodologies and the results, highlighting the main criticalities (e.g. impossibility to be anchored to the surface, high accuracy requirement) and the related key technologies (e.g. E-MMU).