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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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HUMAN EXPLORATION MISSION TO A NEAR EARTH ASTEROID

Abstract

The paper deals with the conceptual design of a humAn Exploration mission to a Near Earth Asteroid (AENEA). It is the result of the Project Work developed during the fifth edition of the International Postgraduate Master in "SpacE Exploration and Development Systems". AENEA mission has been conceived as an intermediate step before going to further destinations. In this respect a mission to a near Earth asteroid offers the possibility to perform technological tests to extend the scientific knowledge and capabilities in space exploration and utilization, necessary for reaching more challenging targets. The following keywords summarise the AENEA mission drivers: popularity, versatility and feasibility. The 1999-RA32 asteroid has been selected as target among many possibilities, since it has the best characteristics meeting the adopted exploration philosophy. The mission will last about 6 months with a crew of four astronauts. The spacecraft will be composed of two transportation modules, a habitation module, a service module and a command module. It will be assembled in LEO, where the several modules will be brought by means of two Heavy Lift Launch Vehicles and a Crew Launch Vehicle. In the paper the sequence of launches and assembly is explained in details, together with a description of the different modules and of their major functionalities. The mission profile has been precisely analyzed in terms of sequence of operations, times and ΔV budget. The mission will start on March 9th, 2025 with the injection of the spacecraft into a transfer orbit toward the asteroid where it will arrive after about 3 months of travel. Some days will be spent around the asteroid performing EVAs on the asteroid surface. During the EVAs, the spacecraft will approach the asteroid for releasing the astronauts, but it will not land on it. This is one of the most critical aspects of this mission and particular attention has been given to it. After the NEA operations period, the spacecraft will start its 3 months travel back to Earth and the mission will end on September 11th, 2025 with a direct re-entry of the command module in the Earth's atmosphere. The paper starts from the motivations of a NEA mission, describes both the applied methodologies and the obtained results. Furthermore, the explanations of the main architecture choices are provided. The conclusions focus on major criticalities (staging, no landing on the asteroid) and key technologies (inflatable technology, radiation shielding, cryogenic technology, Manned Maneuvering Unit).