

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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GOING BEYOND: MISSION AND SYSTEM ANALYSIS OF HUMAN EXPLORATION MISSIONS TO  
NEAR-EARTH OBJECTS

**Abstract**

Missions to Near-Earth Objects (NEOs) offer a wide range of possibilities for space exploration, scientific research, and technology demonstration. In particular, a manned mission to NEOs provides a unique opportunity to be the first human expedition to an interplanetary body beyond the Earth-Moon system and represents the perfect environment to gain experience in deep-space operations, which is an indispensable prerequisite for human missions to Mars. The list of accessible asteroids is narrowed down by taking dynamical properties such as rotation rate as well as structural properties such as size and composition into account. A novel approach is then used for choosing target asteroids based on their orbital parameters. This approach assesses the accessibility of a NEO not by considering its orbital parameters separately but rather by evaluating the combination of orbital parameters as a whole. Mission architectures including missions departing from low-Earth orbit and near-Earth libration points to NEOs are investigated and the associated transfer trajectories and launch opportunities are calculated and examined. For the design of the crew transfer vehicle the environment of the Space Station Design Workshop (SSDW) is used. The SSDW provides exceptional capabilities, methodologies, and tools for conceptual space systems engineering and mission design. During the SSDW 2010, an interdisciplinary group of students and young professionals works in two competitive teams in order to generate different mission and spacecraft concepts. A summary of the results from target asteroid selection as well as mission and spacecraft architecture of the two teams will be presented. As an outlook, the design concepts are merged with similar studies performed at the Institute of Space Systems in order to generate a reference scenario for human exploration missions to NEOs and the operation of a crew transfer vehicle.