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HUMAN EXPLORATION OF THE MOON AND MARS SYMPOSIUM (A5)
Strategies to Establish Lunar and Mars Colonies (1)

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OVERALL SYSTEM DESIGN OF A MANNED MARS MISSION USING CONJUNCTION TRAJECTORY

Abstract

Exploration of Mars will not only increase our knowledge about the solar system's origin and history, but also expand the existence of human being in the universe. A manned mission to Mars is one of the most ambitious objectives for space exploration. It has been studied for more than 50 years and has attracted more scientists' interest in recent years. This paper aims to provide a preliminary system design for manned Mars mission using conjunction trajectory. Firstly, the conjunction trajectory is chosen as the baseline scenario from the consideration of low energy and transfer time requirements. Considering the kinematic law of the Earth and Mars, optimal impulsive transfer trajectories between the two planets are designed. Secondly, some important issues of the mission are analyzed, including the crew size, the option of propulsion system, the recycle of the life support system and the stay duration on the surface of Mars, etc. These options affect the mass of the habitat and the corresponding space transportation system, consequently determine the departure mass in LEO. And the technology maturity of the subsystems influences the mission cost and risk. Finallythe basic architecture of the mission case is discussed. The approaches of split and all up are compared. The former needs pinpoint landing technology on the surface of Mars, and the latter needs multiple assembly technology in LEO. They are most difficult in the two scenarios respectively. The study indicates that human exploration of Mars is a large-scale mission, and even the simplest mission based on very limited functions and capability leads to extremely large and massive vehicles. The IMLEO (initial mass in low Earth orbit) is about 1000 tons and the vehicles require multiple assembles in Earth orbit before departure.