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SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Space Transportation Solutions for Deep Space Missions (8-A5.4)

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ARCHITECTURE DESIGN AND ANALYSIS OF AN REUSABLE CISLUNAR TRANSPORTATION SYSTEM FROM LEO SPACE STATION

Abstract

The design and optimization of system architecture is significance for the successful implementation of lunar exploration mission. A good architecture will improve the safety and reliability of exploration system as well as reduce the research cost and shorten the development cycle. In order to improve the sustainability of lunar exploration mission, the reusable cislunar transportation system from LEO space station is proposed. The system elements and their functions are depicted in detail as well as its whole flight mode. The Reusable Human Spacecraft (RHS) in the proposed transportation system makes it different from the conventional one. It will dock with the LEO space station after the atmospheric deceleration and can be reused after propellant is added in the next exploration mission. The reuse program of RHS is the key to the whole system architecture. The re-entry atmospheric deceleration model of RHS is established. The relationship between re-entry orbit parameters and exit orbit parameters are discussed with different control law of roll angle. The re-entry corridor is calculated which taken the overload, aerodynamic heating, exit velocity into consideration. The RHS will undergo several atmospheric deceleration brakes until the expected exit velocity is reached. After the value range of exit orbit parameter is obtained, the change rule of transfer delta-v from exit orbit to the parking orbit is analyzed. The minimum delta-v is obtained through numerical analysis and simulation. The optimal re-entry orbit parameter can be obtained which validated the feasibility of the proposed transportation system. In order to analysis the efficacy of the transportation system, the IMLEO (Initial Mass in Low Earth Orbit) of the proposed transportation system is calculated. The IMLEO of proposed transportation system is compared with conventional one and the simulation result shows that the proposed system transportation system has advantages in the long-term lunar exploration mission.