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

Author: Prof. Xiaohui Wang
Beihang University, China

Mr. Jianwen Zhao
Beihang University (BUAA), China
Mr. Liheng Mao
Beihang University, China
Mr. Hao Zhang
School of Astronautics, Beihang University, China

MANNED LUNAR LANDING MISSION SCALE ANALYSIS AND FLIGHT SCHEME SELECTION BASED ON MISSION ARCHITECTURE MATRIX

Abstract

At present, the moon is still an unignorable and preferred destination for human beings to visit due to the abundant resources and its potential to be the stepping-stone and platform of deep space exploration in the future. The manned lunar exploration has very important and profound meaning for leading technology innovation and manifesting comprehensive power of a country. Mission scale analysis and flight scheme selection are key problems for top-level projection and are still remaining to be researched systematically and deeply.

This paper focus on the scale analysis of manned lunar landing mission and the optimal selection of flight schemes. At first, the basic configurations and the overall technical specifications of flight vehicle system were presented based on the investigation of traditional vehicles and developing trend of new vehicles. Afterwards, the fundamental elements of flight scheme were defined and the Mission Architecture Matrix was constructed. Based on Mission Architecture Matrix, the scale evaluation method was demonstrated and the mission period design model was also illustrated through flight events planning method. Finally, the qualitative selection model based on trade tree diagramming and the quantitative assessment model based on Analytic Hierarchy Process and Gray comprehensive evaluation method were established, the optimal scheme with economic and technical feasibility was given based on these two models. The validity of all models in this paper was tested and verified by different testing examples. The results show that EOR-LOR architecture is the best flight scheme for a short-period manned lunar exploration mission.

To the best of our knowledge, it is the very first time that the concept of Mission Architecture Matrix was proposed. The reverse calculating algorithm based on Mission Architecture Matrix could improve the efficiency of mission scale analysis and the presented comprehensive evaluation model could make the selection of flight scheme more objective. These models and methods in this paper could be technical references for preliminary design of manned lunar landing mission.