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A NOVEL METHOD FOR MANNED ASTEROIDS LANDING MISSION SCALE ANALYSIS BASED ON MISSION ARCHITECTURE MATRIX

Abstract

Architecture design and mission scale analysis are of great importance and essential for determining the requirements of manned asteroids landing mission. In recent years, many architectures for manned Moon or Mars mission are proposed, and we believe that hundreds architectures of manned asteroids landing mission would be available with further development. Traditionally, an architecture is described and displayed by a flowchart which is not a mathematical expression and thus cannot be recognized by computer and inconvenient to quantify, however, few works have been done to set up the generic mathematical model of manned asteroids landing mission architectures, bringing about many difficulties in efficiency of scale analysis of various architectures. This paper focused on the Mission Architecture Matrix, a brief mathematical description model of mission architectures and mission scale analysis method based on this model. We briefly introduced the flight vehicle system and illustrated the main transportation nodes of manned asteroids landing mission at first. Based on these nodes, the basic flight phases of future manned asteroids landing mission were defined. As for a certain flight phase, some flight events which specifically explain the condition of flight vehicle system will happen. Afterwards, we defined a 13-dimensional row vector to describe a flight event. Finally, combined all of the row vectors that are used to represent all of the flight events together, the Mission Architecture Matrix was constructed. Then the scale evaluation method based on Mission Architecture Matrix was demonstrated. What's more, to calculate the scale of a complex mission which can be decomposed into several simple mission sections, matrix of these sections can be multiplied under specific rules and we can get the Mission Architecture Matrix of the entire mission and then estimate its scale. The presented Mission Architecture Matrix is a precise mathematical description model for various mission architectures which provides a powerful and standardized tool for rapid scale analysis of manned asteroids landing mission as well as other deep space exploration missions such as Moon or Mars exploration. Keywords: mission architecture matrix; architecture description; mission scale analysis; manned asteroids landing mission