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CONCEPTUAL DESIGN OF A MULTIFUNCTIONAL MODULAR LUNAR TRANSPORTATION SYSTEM

Abstract

As lunar exploration continues, to meet the large-scale transportation demands of future lunar activities, a multifunctional modular transportation system has been proposed. The system consists of multiple payload cabins and power modules which include flight, wheeled, and orbital configurations. The payload modules adopt a standardized cabin structure design, equipped with energy, scientific research, and life support facilities. These different functional cabins can be assembled with power modules according to mission requirements to form combined vehicles, supporting transportation tasks from short distances to thousands of kilometers. With this functional design, the multiple cabins can be interconnected to build fixed long-term lunar bases or multi-module heavy transportation systems. Meanwhile, based on the existing launch capabilities, Earth-Moon transportation and lunar surface construction schemes have been designed. Furthermore, an energy management scheme to support the operation of the transportation system has been elaborated. This includes the construction framework of an integrated power management system composed, space-based solar power station systems, laser transmission systems, and electric energy storage systems. This achieves a coupled design of power production, transmission and transportation system applications. Moreover, the transportation of energy resources such as water and fuel has been explained. Finally, the construction and operation of the transportation system under human-machine coordination have been further discussed. The modular transportation system provides a flexible transportation solution for the interaction of humans, materials, and energy. It will enhance the efficiency of future lunar missions and possesses excellent scalability and upgradability.