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MANNED MARS EXPLORATION PLAN BASED ON MULTI-PROPULSION SCHEME

Abstract

Exploration of Mars has been a hot topic in the last few decades. It is believed that Mars was once quite capable of hosting ecosystems and might still be an incubator for microbial life today. Uncrewed spacecrafts such as Mars Pathfinder by the US and "Tianwen-1" by China are designated to be the frontiers. The future missions will involve crewed spacecrafts to establish routine flights to Mars to enable further exploration even colonization. In this paper, an architecture of the future Mars exploration system is proposed based on the investigation of the current undergoing programs run by several countries. A problem of manned Mars exploration using traditional propulsion scheme is that the scale is too large, in order to maximize the system performance, cargos and astronauts are supposed to be transferred respectively due to different requirements and constraints. Nuclear thermal propulsion has a high specific impulse, but for safety reasons, it is not suitable for human detection. On the other hand,the liquid hydrogen and liquid oxygen propulsion is suitable for manned spacecraft, as it has large thrust, and the propellant is non-toxic and harmless. Therefore the architechture is designed for two types of spacecrafts: cargo and crewed. For the cargo spacecrafts, nuclear thermal propulsion system is employed. For the crewed spacecrafts, liquid-hydrogen propulsion is designed. Mission phases, flight trajectories and key components are also planned, designed and discussed for this manned Mars exploration system.