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CRITICAL ANALYSIS AND REVIEW OF CURRENT MARS MISSION SCENARIOS FOR SPACEX
STARSHIP

Abstract

Human space exploration is currently aiming at the lunar environment in the frame of the ARTEMIS program, including the Lunar Orbital Platform Gateway and also lunar landings. In addition, there are mission plans by most prominently Space-X for establishing a human exploration of Mars utilizing SpaceX Starship, a two-stage heavy launch vehicle and spacecraft for transfer to and landing on Mars. The currently discussed scenario includes landing on Mars, setting up of in-situ resource utilization (ISRU) for propellant generation and resupply of Starship for the return to Earth. Such a mission would not only be a huge step forward in human development, but would also require technological advances beyond what is currently possible. This paper analyses the currently available information about SpaceX mission plans for Mars based on Starship, extrapolates requirements, necessary technology developments and based on key figures evaluates the feasibility of these mission plans. Key figures are launch mass, payload mass and unloaded mass, technology readiness and costs. It is shown that two major parts of the mission scenarios, i.e. power supply and ISRU propellant production have low technology readiness, which is driving costs, mass and volume and timeframes expected to close technological gaps are not fitting SpaceX mission plans. System elements which require smaller technological advances, but are still critical include power supply for Starship during transfer and elevator technology to reach the ground after landing. Overall, the analysis shows that current plans are not feasible and therefore recommendations are made to achieve feasibility for Mars missions using Starship.