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AN ANALYSIS AND SIMULATION OF INTERPLANETARY TRAJECTORIES FOR THE JESSE OWENS NUCLEAR THERMAL PROPULSION SPACECRAFT

Abstract

Nuclear thermal propulsion (NTP) has the potential to improve the current state of deep space exploration by reducing interplanetary transit time, abating threats from radiation and other hazards, and providing mission design robustness via larger windows for launch opportunities and more direct, higher energy trajectories. The *Jesse Owens* NTP mission architecture is an example of a developing concept that utilizes this emerging technology, consisting of two NTP engines capable of providing up to 25,000 pounds of thrust with a specific impulse of approximately 850 seconds. By developing and utilizing a time-based computational model using MATLAB and Simulink, various mission architectures for a round trip Earth-Mars mission utilizing the *Jesse Owens* NTP spacecraft have been analyzed and simulated. The computational model discussed in this paper places the spacecraft into a three-dimensional model of the solar system, taking into account the perturbative effects of celestial bodies other than Earth and Mars, including the Sun and Jupiter. Additionally, the computational model accounts for the elliptical and non-coplanar nature of the planetary orbits around the Sun. All of the mission architectures discussed in this paper use five engine burns of up to 25 minutes each, plus an additional reserve burn, to achieve a trajectory that puts the spacecraft on an outbound journey to Mars from an Earth parking orbit, inserts the spacecraft into a Martian parking orbit, and then on a trajectory towards Earth. This study aims to provide relevant information to improve the accessibility of deep space destinations and provide a starting point upon which further NTP mission analyses, both manned and unmanned, can be performed.