DESIGN AND OPTIMIZATION OF A MARS SAMPLE RETURN MISSION WITH NUCLEAR THERMAL ROCKETS

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ABSTRACT

Nuclear thermal propulsion (NTP) is recognized as the only solution to human exploration of the near planets during the next several decades, but NTP currently receives little funding for development. In order to foster interest in the technology, a mission architecture is presented that develops and flight-proves NTP on NASA's planned 2018 Mars sample return mission with a relatively low cost of $100 million. In order to facilitate the planning of such round-trip Mars missions, a Differential Evolution (DE) trajectory optimization program is constructed. DE tuning parameters are systematically studied in order to characterize DE performance and find the best parameter configurations for constrained and unconstrained trajectories. A highly-tuned version of the algorithm is found to globally optimize Mars missions in less than three minutes for 30-year launch windows and less than two minutes for 3-year launch windows.