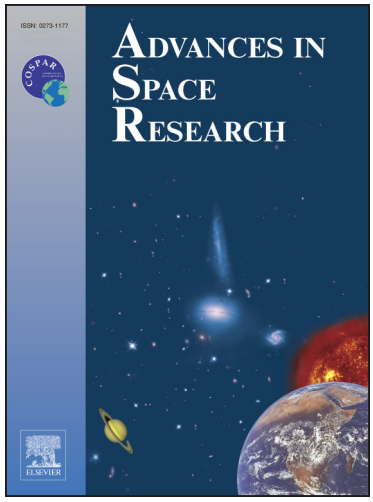

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Initial Three-Dimensional Low-Thrust Trajectory Design

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Abstract

This paper presents a method for rapid generation of three-dimensional low-thrust trajectories that utilizes Fourier series for shaping the position vector. The generated trajectories are feasible with respect to the given thrust acceleration constraints. An objective function is defined representing the overall mission cost, i.e. minimum ΔV. Four missions from Earth to Mars, the near Earth asteroid 1989ML, comet Tempel 1 and asteroid Dionysus are considered for assessing the performance of the algorithm. The selected missions present a range of various difficulties with different levels of thrust acceleration constraints. The Fourier series technique is flexible in generating various shapes rather than using one global shape. The proposed method is capable of rapid generation of sub-optimal feasible trajectories that are totally different from and comparable to the solutions of the state-of-the-art three-dimensional shape-based methods. This feature is quite favorable at the preliminary stages of low-thrust mission designs where various trajectory alternatives are required. The results also show that the obtained trajectories can be used as initial guesses for high fidelity optimal control tools.

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