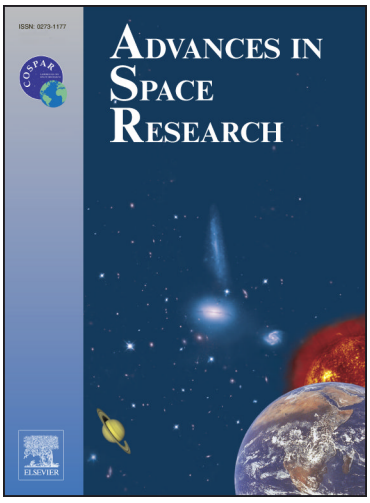

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Shaping Low-Thrust Trajectories With Thrust-Handling Feature

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Abstract

Shape-based methods are becoming popular in low-thrust trajectory optimization due to their fast computation speeds. In existing shape-based methods constraints are treated at the acceleration level but not at the thrust level. These two constraint types are not equivalent since spacecraft mass decreases over time as fuel is expended. This paper develops a shape-based method based on a Fourier series approximation that is capable of representing trajectories defined in spherical coordinates and that enforces thrust constraints. An objective function can be incorporated to minimize overall mission cost, i.e., achieve minimum ΔV. A representative mission from Earth to Mars is studied. The proposed Fourier series technique is demonstrated capable of generating feasible and near-optimal trajectories. These attributes can facilitate future low-thrust mission designs where different trajectory alternatives must be rapidly constructed and evaluated.

Keywords: Trajectory optimization; Thrust-handling; Low-thrust; Shape-based; Fourier series

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