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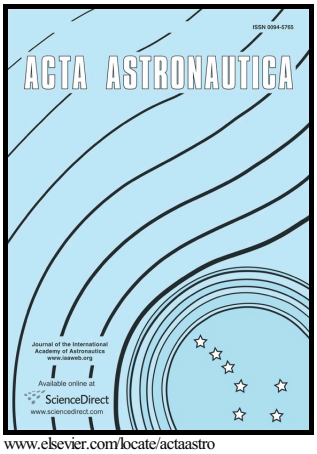

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Solving Fuel-Optimal Low-Thrust Orbital Transfers with Bang-Bang Control Using a Novel Continuation Technique

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Accepted manuscript

Abstract

We have developed a novel continuation technique to solve optimal bang-bang control for low-thrust orbital transfers considering the first-order necessary optimality conditions derived from Lawden's primer vector theory. Continuation on the thrust amplitude is mainly described in this paper. Firstly, a finite-thrust transfer with an "On-Off-On" thrusting sequence is modeled using a two-impulse transfer as initial solution, and then the thrust amplitude is decreased gradually to find an optimal solution with minimum thrust. Secondly, the thrust amplitude is continued from its minimum value to positive infinity to find the optimal bang-bang control, and a thrust switching principle is employed to determine the control structure by monitoring the variation of the switching function. In the continuation process, a bifurcation of bang-bang control is revealed and the concept of critical thrust is proposed to illustrate this phenomenon. The same thrust switching principle is also applicable to the continuation on other parameters, such as transfer time, orbital phase angle, etc. By this continuation technique, fuel-optimal orbital transfers with variable mission parameters can

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