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NOVEL DIRECT METHOD FOR CONTINUOUS THRUST TRAJECTORY OPTIMIZATION

Abstract

Classical methods for continuous thrust trajectory optimization include indirect method, direct method, and hybrid method. Indirect method has the ability to converge to fuel optimal solutions, however the convergence is very sensitive to initial guess. Direct method can converge easily, however direct method hardly converges to fuel optimal solutions, due to the reason that the thrust sequence and thrust vector is usually assumed by experience.

In this paper, a novel direct method for continuous thrust trajectory optimization is proposed. Firstly, mathematical model of multiple impulse fuel optimal transfer is derived, and multiple impulse fuel optimal trajectory is obtained using global optimization method. Then the thrust sequence of continuous thrust trajectory is obtained from that of optimal impulse trajectory; the direction of optimal impulse delta-v is used as initial guess for the thrust vector of continuous thrust trajectory. Finally, nonlinear programming is applied to transform optimal impulse trajectory into optimal continuous trajectory;

Numerical simulation shows that fuel optimal multiple revolution continuous thrust trajectory can be generalized efficiently through the proposed method. In case that the transfer time constraint is not very strict, the proposed method could obtain fuel optimal continuous thrust trajectory which is consistent with that indirect method.