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MARS ATMOSPHERIC ENTRY TRAJECTORY OPTIMIZATION WITH PARAMETER UNCERTAINTIES

Abstract

Trajectory optimization is an integral part of reference tracking guidance. There are larger state errors and parameter uncertainties in the course of Mars atmospheric entry, which will lead to the degradation of reference tracking guidance. This paper addresses the issue of Mars atmospheric entry trajectory optimization utilizing the desensitized optimal control and hp-adaptive Radau pseudospectral method. Firstly, desensitized optimal control methodology is adopted to reduce the sensitivity of terminal state variables with respect to uncertainties and perturbations along the trajectory, in addition to optimizing the original performance index. Then, hp-adaptive Radau pseudospectral method is used to transform the optimal control problem into Nonlinear Programming (NLP) problem which can be easily solved using the SNOPT software package. Monte Carlo simulations of error analysis show that the sensitivity of terminal state variables with respect to uncertainties and perturbations is significantly reduced, leading to improved entry precision.