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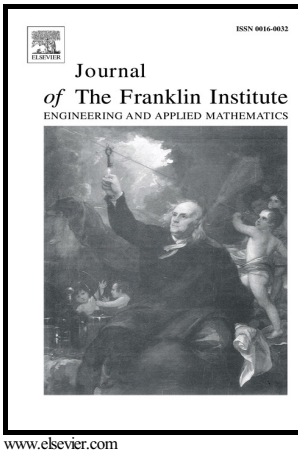

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Finite-Time Super-Twisting Sliding Mode Control for Mars Entry Trajectory Tracking

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Abstract

The robust tracking control problem for Mars entry vehicles subject to parameter perturbations, external disturbances and initial state errors during the entry phase is investigated in this paper. A new finite-time super-twisting (FTSTW) control law is proposed by designing a nonsingular terminal sliding mode (NTSM) surface for Mars entry trajectory tracking. The proposed FTSTW controller exhibits not only strong robustness against parameter perturbations, external disturbances and initial state errors but also the property of finite-time convergence of tracking error. Moreover, compared with traditional sliding mode control method, the control input (namely, the bank angle) of the proposed control approach is continuous which effectively avoids high-frequency switching and sharp change of control action. The merits of the proposed method are validated by implementing simulation studies on Mars entry vehicle system with disturbances and uncertainties. The results of a 500-run Monte Carlo simulation show that the proposed controller provides a promising solution for high-precision Mars entry trajectory tracking.

Key words: Mars entry trajectory tracking, Super-twisting algorithm, Continuous sliding mode control, Finite-time tracking.

1 Introduction

With a sequence of great success of sending vehicles such as Viking 1 and Viking 2, Mars Pathfinder, Spirit (Mars Exploration Rovers A) and Opportunity (Mars Exploration Rovers B), Phoenix and recently Curiosity (Mars Science Laboratory) to Mars, Mars exploration missions have attracted ever-increasing interests. Due to the harsh and complex Mars surface environment (such as rocks, craters, dust and terrain patterns), the pin-point Mars landing is

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