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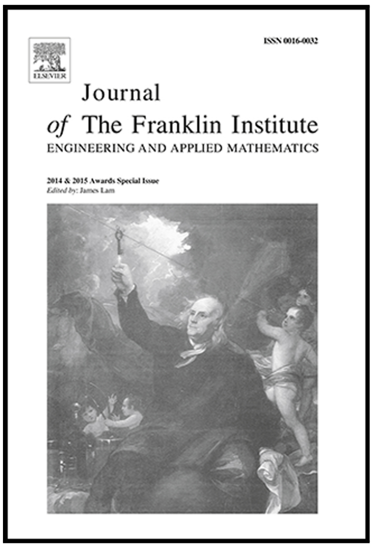

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Finite-time sliding mode attitude control for rigid spacecraft without angular velocity measurement

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Abstract: The continuous finite-time nonsingular terminal sliding mode (NTSM) attitude tracking control for rigid spacecraft is investigated. Firstly, a finite-time attitude controller combined with a new adaptive update law is designed. Different from existing controllers, the proposed controller is inherently continuous and the chattering is effectively reduced. Then, an adaptive model-free finite-time state observer (AMFFTSO) and an angular velocity calculation algorithm (AVCA) are developed to estimate the unknown angular velocity. The unique feature of the proposed method is that the finite-time estimation of angular velocity is achieved and no prior knowledge of quaternion derivative upper bound is needed. Next, based on the estimated angular velocity, a finite-time attitude controller with only attitude measurement is developed. Finally, some simulations are presented and the effectiveness of the proposed control scheme is illustrated.

1. Introduction

Attitude control of a rigid body is an important and practical issue. The interest is motivated by its key role in many space missions such as satellite surveillance, space station docking and installation, and spacecraft formation flying. Various of methods have been intensively investigated during the last decades to deal with the issue [1-5]. Among these methods, sliding mode control (SMC) is a key choice in addressing the aerospace control problems.

The application of SMC to spacecraft attitude control was firstly studied in [6], since then a variety of SMC controllers have been proposed by researchers. In [7-10], linear sliding mode (LSM) control laws were designed to achieve attitude tracking and synchronization for spacecraft system. To improve convergence rate and enhance robustness, terminal sliding mode (TSM) was further proposed. Some TSM variants such as nonsingular TSM (NTSM), fast TSM (FTSM) and nonsingular FTSM were

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