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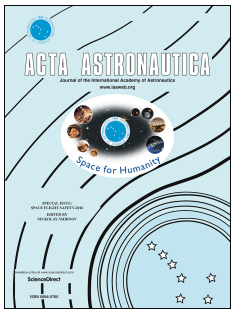


Fixed-time attitude tracking control for spacecraft without unwinding

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# Fixed-time attitude tracking control for spacecraft without unwinding

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**Abstract:** This paper investigates the fixed-time attitude tracking control problem for rigid spacecraft based on rotation matrix. Two anti-unwinding control schemes are developed such that the desired attitude can be tracked with bounded convergence time regardless of the initial conditions. The first controller is established on basis of a novel sliding mode surface without considering the external disturbance. In addition, the explicit description of the settling time can be provided under this controller. By revising the sliding mode surface and utilizing an adaptive law, the fixed-time stability can still be achieved under the second controller even in the presence of external disturbance. Theoretical analysis and numerical simulations are presented to demonstrate the validity of the proposed controllers.

***Keywords:*** fixed-time stability, attitude tracking control, rotation matrix, unwinding, robust control

## 1. Introduction

Recently, attitude control of spacecraft has attracted considerable attention from control community for its broad application in space missions, such as deep space exploration, rendezvous and docking and earth observation [1-8]. However, it is difficult to design controllers for spacecraft due to the highly nonlinear dynamics of itself, complex environment of space and increasingly challenging requirement of orbit activities. Even so, fruitful research achievements still emerge to address this issue [9-11]. Without considering the external disturbance and system uncertainties, a nonlinear PID control scheme was proposed to stabilize the attitude of spacecraft in [9,10]. In order to handle the perturbations, a sliding mode controller was employed so that the global fast-tracking manoeuvre for

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