Adaptive nonsingular fixed-time attitude stabilization for quadrotor UAVs with multiple disturbances and uncertainties

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Abstract

This article proposes an adaptive fixed-time attitude stabilization control scheme for quadrotor UAVs in the presence of multiple disturbances and uncertainties. Firstly, a novel nonsingular fixed-time terminal sliding mode (NNFTSM) surface is proposed. The dynamic surface guarantees non-singularity and fixed-time convergence so that the setting time is independent of the initial states. Secondly, using the proposed NNFTSM surface and adaptive technique, an adaptive nonsingular fixed-time terminal sliding mode controller (ANFTSMC) is designed for UAVs attitude stabilization. It yields exponential convergence of the attitude tracking errors to zero without requiring a priori knowledge of the upper bounds of the multiple disturbances and uncertainties. Then, the stability of the closed-loop control system is validated by the candidate Lyapunov function, and the upper bound of the convergence time is given. Finally, the parameter design criteria and the convergence time comparison are analyzed in detail. Comparative performances for quadrotor UAV attitude stabilization are presented, and the effectiveness and superiority of the proposed controller are illustrated over the existing method.

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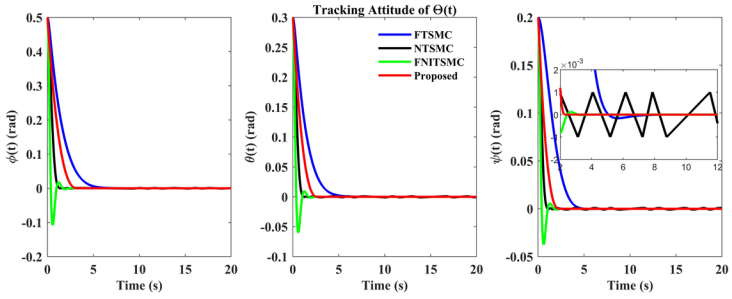

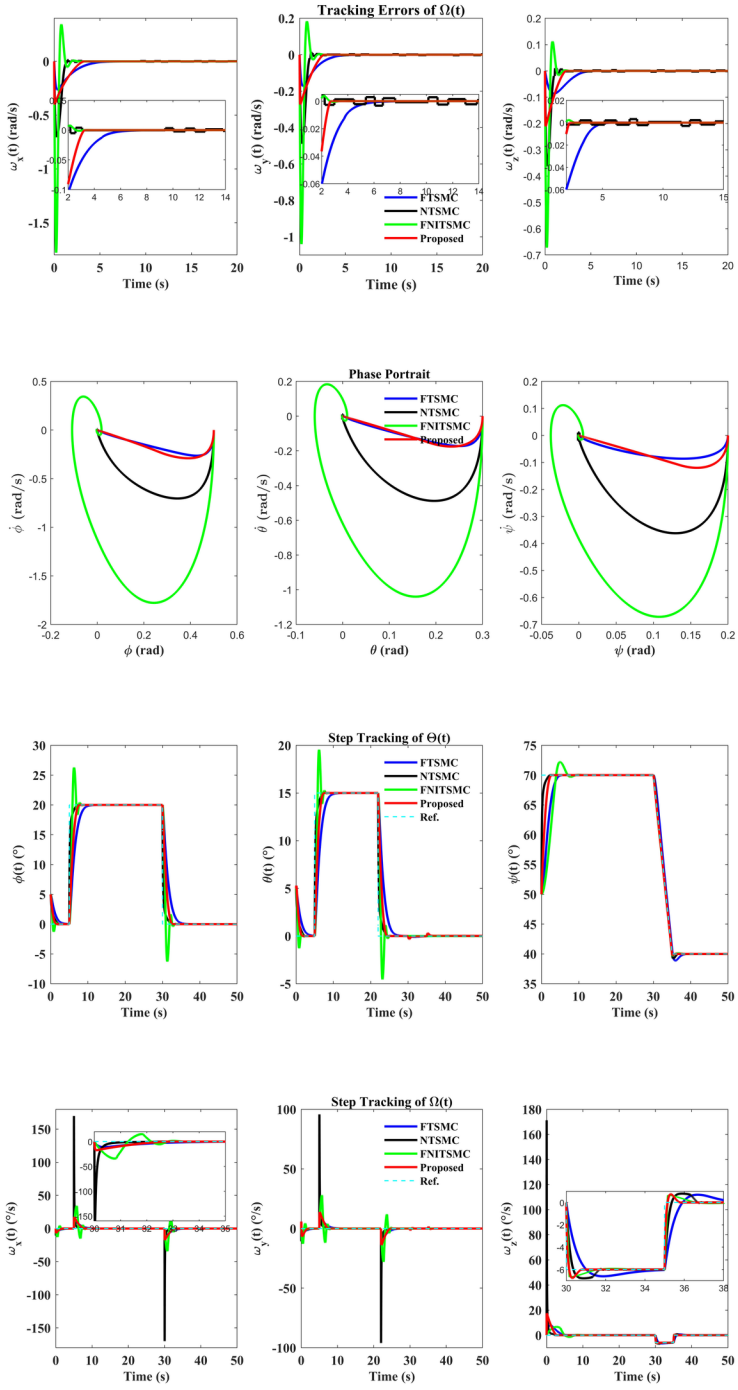

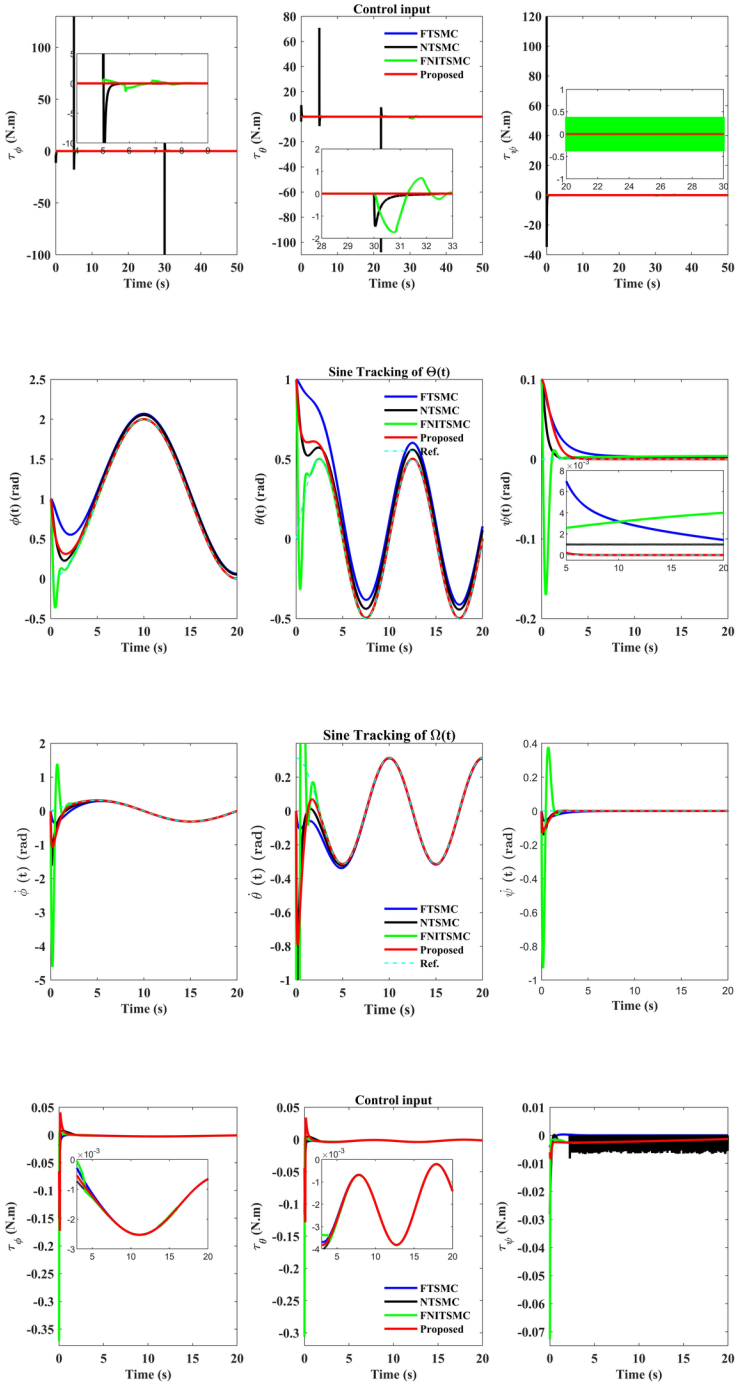

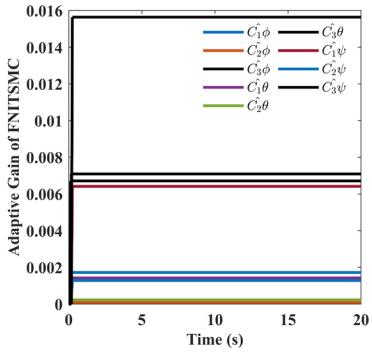

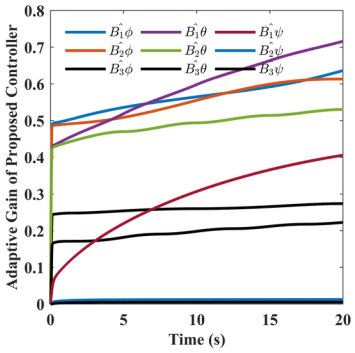

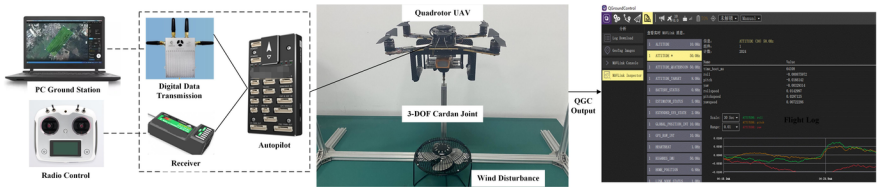

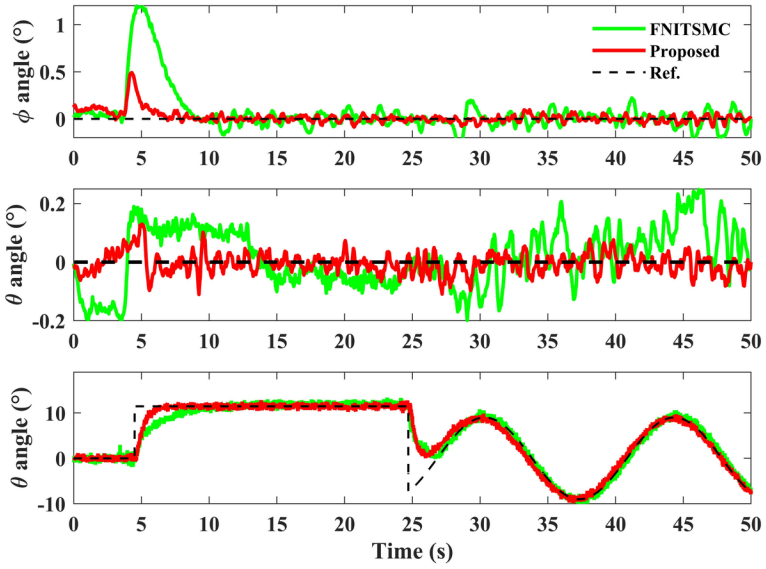

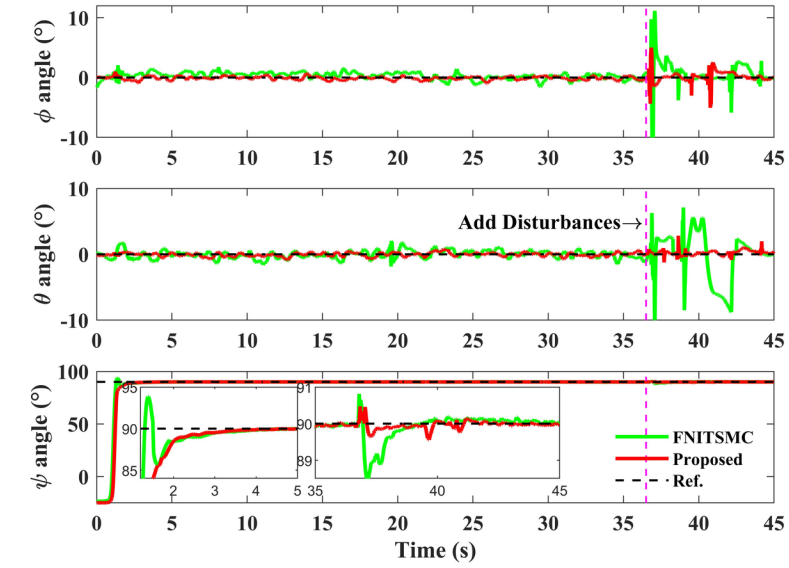

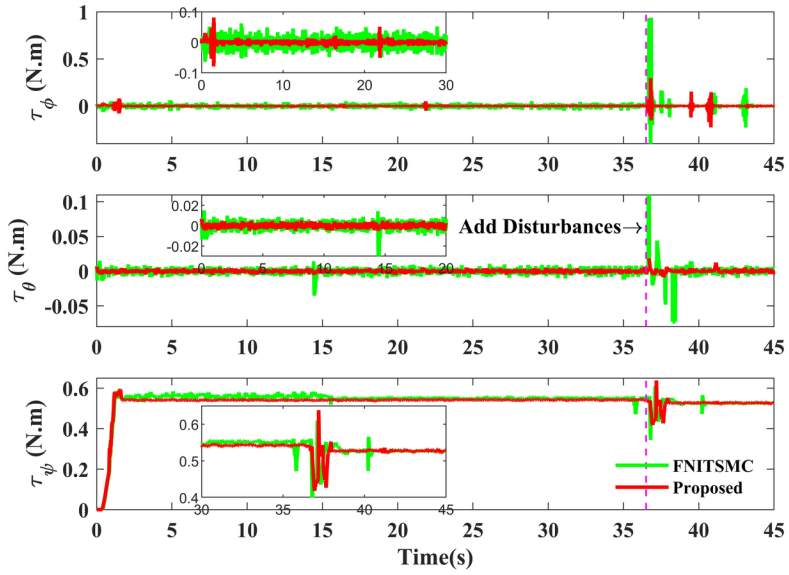

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