Quadrotor Fuzzy Sliding Mode Control Based on Variable Exponential Power Reaching Law and High-Gain Observer: A Postprint

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Abstract

Aiming at the problems of slow tracking, low precision, and strong model coupling in quadrotor aircraft under unknown disturbances, a fuzzy sliding mode control strategy based on variable exponential power reaching law and high-gain observer is proposed. First, an adaptive variable exponential power reaching law is designed, wherein the interaction between the power reaching term and the exponential reaching term enables the system to achieve faster reaching time and reduced steady-state error; second, in the position subsystem, a high-gain observer is employed for state estimation to suppress coupling; finally, the variable universe concept is introduced into adaptive fuzzy control, and a fuzzy approximation coefficient with a scaling factor is designed in the switching control term to compensate for the effects of the high-gain observer. Simulation results demonstrate that the proposed control strategy can effectively attenuate chattering and exhibits favorable dynamic performance and control precision; even under complex external disturbances, the quadrotor aircraft can still rapidly perform trajectory tracking as required.

Full Text

Preamble

The theoretical framework of this work is established through a comprehensive series of mathematical definitions that formalize the core concepts under investigation. These definitions provide the rigorous foundation upon which our methodology and analysis are constructed. Foundational concepts build upon prior research in the field, extending existing theoretical understanding to address the novel challenges considered in this study. The subsequent sections develop the detailed methodology and empirical analysis based upon these preliminary definitions, culminating in a comprehensive evaluation of our proposed

approach.

Note: Figure translations are in progress. See original paper for figures.