

# Decentralized Fuzzy Sliding Mode Control With Chattering Elimination for the Stabilisation of a Quadrotor Helicopter Attitude

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## Keywords

sliding mode, fuzzy sliding mode, chattering, quadrotor UAV, attitude stabilisation.

## Abstract

This paper presents a decentralized control strategy for the stabilization of a Quadrotor helicopter attitude, based on the combining of the fuzzy logic control and sliding mode control (SMC). The main purpose of this work is to reduce the chattering phenomenon. To achieve our purpose we have used a fuzzy logic control to generate the discontinuous part of control signal in SMC, the results of our simulations indicate that the control performance of the stabilization of the Quadrotor are satisfactory and the proposed fuzzy sliding mode control (FSMC) can achieve favorable performance.

## I. INTRODUCTION

The utilization of unmanned aerial vehicle (UAV) has prompted attention in a variety of military and civil applications. The UAVs have shown applications in different areas including search and rescue (SAR), meteorological studies, infrastructure inspection, homeland security and traffic surveillance.

Rotating wing (or helicopter) UAVs have the advantage above fixed wing UAV that they are able to perform vertical take-off and landing (VTOL), and hovering at a fixed point. One very successful design for smaller UAV is a helicopter with four horizontal rotors with no tailrotor, or called Quadrotor.

Many methods have been proposed to control a Quadrotor vehicle, such as linear quadratic regulator (LQR) control [1], proportional-integral-derivative (PID) control [2], sliding mode control [3], fuzzy logic (FL) control [4] and backstepping control [5].

In this paper, the fuzzy sliding mode technique has been successfully used for the attitude stabilization of a Quadrotor UAV. The choice of sliding mode control scheme is due to there is a significant number of works on this nonlinear control approach, because its robustness against the uncertainty and external perturbation. However, this controller has a major problem, the chattering phenomena. The main object of proposed FSMC is to eliminate this problem, this work is organized in five sections starting with an introduction, in section two, the mathematical model of the Quadrotor is introduced, Then, the proposed SM and FSMC control methods are developed in section three, and in section four, the Simulation results are showing for each controller. And finally a short conclusion.