World Academy of Science, Engineering and Technology
International Journal of Economics and Management Engineering
Vol:18, No:09, 2024

Trajectory Tracking of Fixed-Wing Unmanned Aerial Vehicle Using Fuzzy-Based Sliding Mode Controller

Authors : Feleke Tsegaye

Abstract : The work in this thesis mainly focuses on trajectory tracking of fixed wing unmanned aerial vehicle (FWUAV) by using fuzzy based sliding mode controller(FSMC) for surveillance applications. Unmanned Aerial Vehicles (UAVs) are general-purpose aircraft built to fly autonomously. This technology is applied in a variety of sectors, including the military, to improve defense, surveillance, and logistics. The model of FWUAV is complex due to its high non-linearity and coupling effect. In this thesis, input decoupling is done through extracting the dominant inputs during the design of the controller and considering the remaining inputs as uncertainty. The proper and steady flight maneuvering of UAVs under uncertain and unstable circumstances is the most critical problem for researchers studying UAVs. A FSMC technique was suggested to tackle the complexity of FWUAV systems. The trajectory tracking control algorithm primarily uses the sliding-mode (SM) variable structure control method to address the system's control issue. In the SM control, a fuzzy logic control(FLC) algorithm is utilized in place of the discontinuous phase of the SM controller to reduce the chattering impact. In the reaching and sliding stages of SM control, Lyapunov theory is used to assure finite-time convergence. A comparison between the conventional SM controller and the suggested controller is done in relation to the chattering effect as well as tracking performance. It is evident that the chattering is effectively reduced, the suggested controller provides a quick response with a minimum steady-state error, and the controller is robust in the face of unknown disturbances. The designed control strategy is simulated with the nonlinear model of FWUAV using the MATLAB® / Simulink® environments. The simulation result shows the suggested controller operates effectively, maintains an aircraft's stability, and will hold the aircraft's targeted flight path despite the presence of uncertainty and disturbances.

Keywords : fixed-wing UAVs, sliding mode controller, fuzzy logic controller, chattering, coupling effect, surveillance, finite-time convergence, Lyapunov theory, flight path
Conference Title : ICLM 2024 : International Conference on Leadership and Management
Conference Location : Vancouver, Canada
Conference Dates : September 26-27, 2024

Open Science Index, Economics and Management Engineering Vol:18, No:09, 2024 publications.waset.org/abstracts/184695.pdf