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Design of a Cooperative Neural Network, Particle Swarm Optimization (PSO) and Fuzzy Based Tracking Control for a Tilt Rotor Unmanned Aerial Vehicle

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Abstract : Tilt Rotor UAVs (Unmanned Aerial Vehicles) are naturally unstable and difficult to maneuver. The purpose of this paper is to design controllers for the stabilization and trajectory tracking of this type of UAV. To this end, artificial intelligence methods have been exploited. First, the dynamics of this UAV was modeled using the Lagrange-Euler method. The conventional method based on Proportional, Integral and Derivative (PID) control was applied by decoupling the different flight modes. To improve stability and trajectory tracking of the Tilt Rotor, the fuzzy approach and the technique of multilayer neural networks (NN) has been used. Thus, Fuzzy Proportional Integral and Derivative (FPID) and Neural Network-based Proportional Integral and Derivative controllers (NNPID) have been developed. The meta-heuristic approach based on Particle Swarm Optimization (PSO) method allowed adjusting the setting parameters of NNPID controller, giving us an improved NNPID-PSO controller. Simulation results under the Matlab environment show the efficiency of the approaches adopted. Besides, the Tilt Rotor UAV has become stable and follows different types of trajectories with acceptable precision. The Fuzzy, NN and NN-PSO-based approaches demonstrated their robustness because the presence of the disturbances did not alter the stability or the trajectory tracking of the Tilt Rotor UAV.

Keywords : neural network, fuzzy logic, PSO, PID, trajectory tracking, tilt-rotor UAV
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