Tuning of PID Controllers for Quadcopter System using Hybrid Memory Based Gravitational Search Algorithm – Particle Swarm Optimization

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Abstract

Quadrotors are coming up as an attractive platform for unmanned aerial vehicle (UAV) research, due to the simplicity of their structure and maintenance, their ability to hover, and their vertical take-off and landing (VTOL) capability. With the vast advancements in small-size sensors, actuators and processors, researches are now focusing on developing mini UAV’s to be used in both research and commercial applications. This work presents a detailed mathematical nonlinear dynamic model of the quadrotor which is formulated using the Newton-Euler method. Although the quadrotor is a 6 DOF under-actuated system, the derived rotational subsystem is fully actuated, while the translational subsystem is under-actuated. The derivation of the mathematical model was followed by the development of the controller to control the altitude, attitude, heading and position of the quadrotor in space, which is, based on the linear Proportional-Derivative- Integral (PID) controller; thus, a simplified version of the model is obtained. The gains of the controllers will be tuned using optimization techniques to improve the system’s dynamic response. The standard Gravitational Search Algorithm (GSA) was applied to tune the PID parameters and then it was compared to Hybrid Memory Based
Gravitational Search Algorithm – Particle Swarm Optimization tuning, and the results show improvement in the new algorithm, which produced enhancements by (40.126%) compared to the standard algorithm.

References

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Index Terms

Computer Science

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Keywords

Quadcopter, PID, UAV, Flying robot, GSA, MBGSA-PSO.