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IMPROVEMENT OF QUADROTOR PERFORMANCE WITH FLIGHT CONTROL SYSTEM USING PARTICLE SWARM PROPORTIONAL-INTEGRAL-DERIVATIVE (PS-PID)

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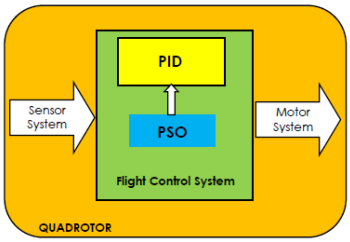
Graphical abstract



Abstract

The rapid development of microprocessor, electrical, sensors and advanced control technology make a quadrotor fast expansion. Unfortunately, a quadrotor is unstable and impossible to fly in fully open loop system. PID controller is one of methodology that has been proposed to control the flight control system. Unfortunately, adjustment of PID parameters for robust control performance is not easy and still problems. The paper proposed a flight controller system based on a PID controller. The PID parameters are tuned automatically using Particle Swarm Optimization (PSO). Objective of this method is to improve the flight control system performance. Several experiments have been performed. According to these experiments the proposed system able to generate optimal and reliable PID parameters for robust flight controller. The system also has 41.57 % improvement in settling time response.

Keywords: Quadrotor, Flight Control System, PID, PSO, Performance Improvement

1.0 INTRODUCTION

A quadrotor aircraft can take off and land in limited spaces, even hover over a target and fly through narrow space and stay in limited-speed motion object easily. With these advantages, the quadrotor has received a strong of attention in the last period [1]. However, a quadrotor is unstable and impossible to fly in fully open loop system [2]. Performance improvement expected from the new generation of quadrotor is possible through derivation and implementation of specific control techniques incorporating limitations related to sensors and actuators [3]. Different methodologies have been proposed to control the flight control system for a quadrotor [4]. The following approaches have been used for improving the flight control system performance are PID control, backstepping control, sliding mode control, linear quadratic regulator (LQR) control, fuzzy logic (FL) control, neural network and hybrid of them [5].

PID has become one of the selected solutions for many practical control designs such as electronics devices, robotics, and chemical process. There are some researches have been performed to design the flight control using PID [6], [7], [8]. PID controller is used here in order to get adequate performances of quadrotor such as fast response, zero steady-state error, and minimum overshoot/undershoot. PID is used here because it can be designed based upon the system parameters can be estimated precisely.

However, there is problem for implementing of PID controller. In order to achieve robust control performance, parameters adjustment or tuning

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