Performance comparisons between PID and adaptive PID controllers for travel angle control of a bench-top helicopter

ABSTRACT

This paper provides a comparative study on the performances of standard PID and adaptive PID controllers tested on travel angle of a 3-Degree-of-Freedom (3-DOF) Quanser bench-top helicopter. Quanser, a well-known manufacturer of educational bench-top helicopter has developed Proportional Integration Derivative (PID) controller with Linear Quadratic Regulator (LQR) for all travel, pitch and yaw angle of the bench-top helicopter. The performance of the PID controller is relatively good; however, its performance could also be improved if the controller is combined with adaptive element. The objective of this research is to design adaptive PID controller and then compare the performances of the adaptive PID with the standard PID. The controller design and test is focused on travel angle control only. Adaptive method used in this project is self-tuning controller, which controller's parameters are updated online. Two adaptive algorithms those are pole-placement and deadbeat have been chosen as the method to achieve optimal controller's parameters. Performance comparisons have shown that the adaptive (deadbeat) PID controller has produced more desirable performance compared to standard PID and adaptive (poleplacement). The adaptive (deadbeat) PID controller attained very fast settling time (5 seconds) and very small percentage of overshoot (5% to 7.5%) for 10° to 30° step change of travel angle.

Keyword: Adaptive control; bench-top helicopter; Self-tuning control; Deadbeat; Pole-placement