FPGA-based adaptive PID control of a DC motor driver via sliding-mode approach

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Abstract

The proportional-integral-derivative (PID) controller has been extensively applied in practical industry due to its appealing characteristics such as simple architecture, easy design and parameter tuning without complicated computation. However, the PID controller usually needs some a priori manual retuning to make a successful industrial application. To attack this problem, this paper proposes an adaptivePID (APID) controller which is composed of aPID controller and a fuzzy compensator. Without requiring preliminary offline learning, the PID controller can automatically online tune the control gains based on the gradient descent method and the fuzzy compensator is designed to eliminate the effect of the approximation error introduced by the PID controller upon the system stability in the Lyapunov sense. Finally, the proposed APID control system is applied to aDCmotordriver and implemented on a field-programmable gate array (FPGA) chip for possible low-cost and high-performance industrial applications. It is shown by the experimental results that the favorable position tracking performance for the DCmotordriver can be achieved by the proposed APID control scheme after learning of the controller parameters.

Keyword：PID control, Adaptive control, DC motor driver, FPGA chip