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# OPTIMAL PID CONTROLLERS DESIGN OF PWM FEEDBACK TIME-VARYING SYSTEMS USING ORTHOGONAL-FUNCTIONS APPROACH AND GENETIC ALGORITHM

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Abstract. *The optimal PID (proportional-integral-derivative) controller design problem for a class of PWM (pulse-width-modulation) feedback time-varying systems by fusing the orthogonal-functions approach (OFA) and the genetic algorithm is studied in this work. Based on the OFA, the optimal PID controller design problem for a class of PWM feedback time-varying systems is transformed into a static-parameters optimization problem represented by algebraic equations. Then for the static optimization problem, the hybrid Taguchi-genetic algorithm (HTGA) is employed to find the optimal parameters of the PID controllers for the PWM feedback time-varying systems under the criterion of minimizing a quadratic integral performance index. The proposed integrative method, which fuses the OFA and the HTGA, is non-differential, non-integral, straightforward, and well-adapted to computer implementation. The computational complexity can therefore be reduced remarkably. Two illustrated examples for the PWM feedback time-varying system are given to show that the proposed method is an effective approach.*
**Keywords:** Time-varying systems, Genetic algorithms, Orthogonal functions, PID, PWM

1. **Introduction.** The pulse-width-modulation (PWM) has been widely used in the electronic and electrical systems including attitude control systems, adaptive control systems, signal processing, power control systems, and so forth [1]. The reasons for the wide applicability of pulse-width-modulators are that (i) the control variable has only two or three values such that the realization of PWM control is simple, and (ii) the pulse-width-modulators can process large signals with high efficiency and low sensitivity to noise. The PWM feedback systems belong to the field of power electronics having mixed features of continuity and jumps. The rather unique and inherent nonlinear and discontinuous characteristics make the design task of power electronics field much more difficult [2,3]. Besides, the PID (proportional-integral-derivative) controller is the most common form of feedback in use today, and is successfully used for a wide range of application: process