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Active vibration control of a flexible beam using system identification and controller tuning by evolutionary algorithm

Abstract

This paper presents a new approach of proportional-integral-derivative (PID) controller tuning via an evolutionary algorithm that optimally suppresses the vibration of a flexible beam system using a piezoelectric actuator. The system's dynamic model is identified based on autoregression with exogenous input (ARX) structure using recursive least square. The input-output data were obtained experimentally. This ARX model represents the physical system and is used for the controller optimization process. Evolutionary algorithms such as differential evolution (DE) and genetic algorithms (GA) were applied to optimize and tune the controller parameters offline based on a defined performance index, i.e. mean square error of the vibration signals. The optimum PID parameters were validated experimentally. The performance of PID tuned by DE and GA are compared with conventional PID tuning (using Ziegler Nichols method). Experimental study showed that PID tuned by DE and GA offer a better transient response than the conventional tuning method.

Keywords; Differential evolution; Evolutionary algorithm; Flexible beam; Genetic algorithm; PID controller; Vibration control