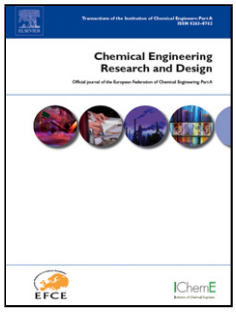

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A One-Step Tuning Method for PID Controllers with Robustness Specification Using Plant Step-Response Data

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Abstract

This paper presents a novel method for proportional-integral-derivative (PID) controller tuning directly using the step response data of the process without resorting to a process model. The required process data are collected from a one-shot step test that can be conducted under either closed-loop or open-loop conditions. The proposed method derives the PID parameters so that the resulting control system behaves as closely as possible to the prescribed reference model. Two structures of the reference model are considered for general design and improved disturbance rejection, respectively. A simple one-dimensional optimization problem is formulated to determine an appropriate reference model for the controlled process. Moreover, the proposed PID tuning method includes a robustness specification based on the maximum peak of sensitivity function that enables the user to explicitly address the trade-off between performance and robustness. Simulation examples are provided to illustrate the superiority of the proposed method over existing (model-based) tuning methods.

Keywords: Process control; PID controller tuning; Model-reference control; Closed-loop tuning; System robustness.

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