

SIMPLE TUNING OF PID CONTROLLERS USED WITH OVER DAMPED SECOND-ORDER PROCESSES

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ABSTRACT

PID controllers are used for decades in controlling processes in linear feedback control systems. Their use requires accurate and effective tuning to satisfy an acceptable performance for the control system.

Large number of processes are classified as or approximated by a second order model. They may be under damped, critically damped or over damped. This paper presents the tuning of PID-controllers used with second order over damped processes. The process damping ratio is from 1 to 10 and its natural frequency is from 2.5 to 15 rad/s. The tuning technique depends on minimizing the integral of square of error (ISE) between the time response of the system to a unit step input and its steady-state response. It was possible to achieve a PID-controlled system with controllable overshoot and settling time. The tuning results are listed in tables for direct use depending on process damping ratio and natural frequency.

The tuning approach is reduced to only one set of controller parameters to simplify the tuning process used with any process approximated by a second-order over damped model. The tuning results are compared with controller tuning using standard forms showing better performance of the control system using the proposed tuning in the present work regarding the maximum percentage overshoot and settling time of the control system using both exact and simple tuning parameters of the PID-controller.

KEYWORDS: Over Damped Second Order Processes, PID Controllers, Simple Controller Tuning, MATLAB Optimization Application