

## ON SIMPLE TUNING OF PID CONTROLLERS FOR UNDERDAMPED SECOND-ORDER PROCESSES

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### ABSTRACT

Large number of industrial processes exhibit oscillation nature in its time step-response and can be approximated by second-order underdamped dynamic system.

This paper presents the tuning of PID-controllers used with underdamped second-order - like processes. The process damping ratio is from 0.05 to 0.90 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. The tuning results are tabulated to assist direct use by control engineers and technicians depending on process damping ratio and natural frequency.

The tuning technique of the PID controller is reduced to only one set of controller parameters to practically simplify the tuning process of the PID controller when used with second-order underdamped processes. The tuning results are compared with controller tuning using standard forms showing the better performance of the proposed tuning in the present work regarding the maximum percentage undershoot of the control system.

**KEYWORDS:** PID-Controllers, Under Damped Second-Order Processes, Simple Controller Tuning