Comparison of PID Controller Tuning Methods

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Abstract

Proportional, Integral and derivative (PID) controllers are the most widely-used controller in the chemical process industries because of their simplicity, robustness and successful practical application. Many tuning methods have been proposed for PID controllers. Our purpose in this study is comparison of these tuning methods for single input single output (SISO) systems using computer simulation. Integral of the absolute value of the error (IAE) has been used as the criterion for comparison. These tuning methods have been implemented for first, second and third order systems with dead time and for two cases of set point tracking and load rejection.

Key Words: PID Controller; Tuning Method; Set Point Tracking; Load Rejection

Introduction:

During the 1930s three mode controllers with proportional, integral, and derivative (PID) actions became commercially available and gained widespread industrial acceptance. These types of controllers are still the most widely used controllers in process industries. This succeed is a result of many good features of this algorithm such as simplicity, robustness and wide applicability. Many various tuning methods have been proposed from 1942 up to now for gaining better and more acceptable control system response based on our desirable control objectives such as percent of overshoot, integral of absolute value of the error (IAE), settling time, manipulated variable behavior and etc. Some of these tuning methods have considered only one of these objectives as a criterion for their tuning algorithm and some of them have developed their algorithm by considering more than one of the mentioned criterion. In this study we have compared the performances of several tuning methods. For simulation study first, second and third order systems with dead time have been employed and it was assumed that the dynamics of system is known. Simulation study has been performed for two cases of set point tracking and load rejection.

Tuning Methods:

The PID controller tuning methods are classified into two main categories

- Closed loop methods
- Open loop methods

Closed loop tuning techniques refer to methods that tune the controller during *automatic state* in which the plant is operating in closed loop. The open loop techniques refer to methods that tune the controller when it is in *manual state* and the plant operates in open loop. The closed