PID Control Technology

Learning Objectives
1.1 Basic Industrial Control
1.2 Three-Term Control
1.3 PID Controller Implementation Issues
1.4 Industrial PID Control
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Learning Objectives

PID control is a name commonly given to three-term control. The mnemonic PID refers to the first letters of the names of the individual terms that make up the standard three-term controller. These are P for the proportional term, I for the integral term and D for the derivative term in the controller.

Three-term or PID controllers are probably the most widely used industrial controller. Even complex industrial control systems may comprise a control network whose main control building block is a PID control module. The three-term PID controller has had a long history of use and has survived the changes of technology from the analogue era into the digital computer control system age quite satisfactorily. It was the first (only) controller to be mass produced for the high-volume market that existed in the process industries.

The introduction of the Laplace transform to study the performance of feedback control systems supported its technological success in the engineering community. The theoretical basis for analysing the performance of PID control is considerably aided by the simple representation of an Integrator by the Laplace transform,

\[
\frac{1}{s}
\]

and a Differentiator using \( s \). Conceptually, the PID controller is quite sophisticated and three different representations can be given. First, there is a symbolic representation (Figure 1.1(a)), where each of the three terms can be selected to achieve different control actions. Secondly, there is a time domain operator form (Figure 1.1(b)), and finally, there is a Laplace transform version of the PID controller (Figure 1.1(c)). This gives the controller an \( s \)-domain operator interpretation and allows the link between the time domain and the frequency domain to enter the discussion of PID controller performance.

This chapter concentrates on some basic structural features of the controller and reports on some industrial and implementation aspects of the controller.

The learning objectives for the chapter are to:

- Explain the process background for control loop components and signals
- Introduce the forms of the three terms in the PID controller
- Discuss the engineering implementation of the different PID terms
- Examine current industrial PID control technology

### 1.1 Basic Industrial Control

As can be seen from the typical industrial control loop structure given in Figure 1.2, even simple process loops comprise more than four engineering components.

The main components can be grouped according to the following loop operations: