Chapter 1
Optimization of PID Controller: A Brief Overview

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ABSTRACT

Tuning the PID (proportional-integral-derivative) controller is one of the most important tasks to achieve accurate control. Many methods have been developed to tune the values of P, I, and D; however, classical methods showed limitations. During the last decade, many works addressed the problem as an optimization problem and showed that nature-inspired optimization techniques are prevalent, such as genetic algorithms and particle swarm optimization. This chapter provides a brief overview of applying nature-inspired optimization techniques to PID control optimization.

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INTRODUCTION

The process, a general term referring to a set of devices and intended to obtain a given product, is characterized by means of one or more measurable physical quantities to be mastered which will allow controlling the fixed objective. The objective of a regulation is to ensure the operation of a process according to criteria predefined by a specification that defines qualitative criteria to be imposed that are usually translated by quantitative criteria as stability, precision, and rapidity. The regulators are components intended for specific applications and relations between input and output whose coefficients are definitively fixed to define their regulation functions; however, an industrial regulator is a device whose parameters of its transfer function are adjustable and adaptable to the process to be controlled.

This chapter illustrates a brief literature review of PID controllers. The remainder of the document is organized as follows. Section 2 provides an overview of the control system. Section 3 discusses the performance of a servo system. Section 4 defines the PID controller, and the last section concludes the chapter.

CONTROL SYSTEM

Definition

A control system is a combination of equipment that manages, organizes, directs, or regulates the actions of other devices or systems in order to achieve a specific goal (Bongiorno & Park, 2020; Kondratenko & Chikrii, 2019). A control system does this by using control loops, which are procedures designed to keep a process variable at a specific set point. We can also define it as a system, which controls the output to produce the desired response. A control system involves sensors, actuators, reference input, and the system itself. The process or plant to be controlled is called

Figure 1. Block diagram of a control system