Introduction to PID Controller

Introduction to PID Controller

Intuitive Explanation of PID Controller

A **PID Controller** (Proportional-Integral-Derivative) is a control loop feedback mechanism widely used in industrial control systems. It helps manage a process by continuously calculating the error value as the difference between a desired setpoint and a measured process variable. To control the output, a PID controller uses three specific parameters:

1. Proportional (P)

This part reacts to the current error. The larger the error, the larger the proportional response. If your target temperature is 100°C and your current temperature is 90°C, the proportional part will suggest a larger heating output to reduce the error.

2. Integral (I)

This component accumulates the error over time. It addresses previous errors that are not corrected by the proportional part. For example, if you consistently fall short of your target temperature, the integral part will keep increasing the output gradually to reduce this ongoing offset.

3. Derivative (D)

This part predicts future errors based on the rate of change of the error. It dampens the system response. For example, if the temperature is rising rapidly towards the setpoint, the derivative action will decrease the heating output to prevent overshooting the desired temperature.

Explanation in Context

Imagine you're driving a car:

- When you want to reach a certain speed (the setpoint), the Proportional part helps you accelerate directly in relation to how far you are from that speed.
- The Integral part adjusts the throttle gradually if you're not quite reaching that speed over time (maybe due to a steep hill).
- The Derivative part helps you ease off on the throttle if you're accelerating quickly to prevent overshooting your desired speed.

In essence, a PID controller combines these three actions to create a balanced control that responds smoothly and accurately to changes, ensuring tasks like maintaining temperature, speed, or position happen efficiently.

Downloaded Papers

1. **DiffLoop: Tuning PID Controllers by Differentiating Through the Feedback Loop (2021)**

    - Download Link

2. **A Rolling PID Control Approach and its Applications (2016)**

    - Download Link