Introduction
Analog and Digital formulations
Implementations
PID Tuning

Analog Implementation
Digital Implementation

Outline

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Digital Implementation

The difference equations are typically implemented in a microcontroller or in an FPGA (field-programmable gate array) device:

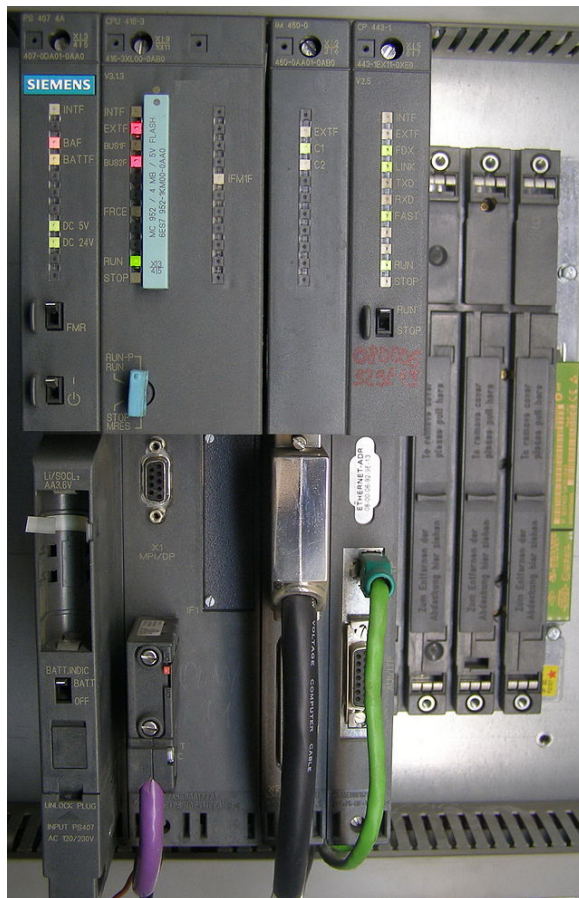$$u[k] = K_p e[k] + \frac{K_d}{T_s}(e[k] - e[k-1]) + u_i[k]$$

$$\text{with } u_i[k] = u_i[k-1] + K_i T_s e[k]$$

Pseudocode

```
previous_error = 0
integral = 0
Start:
error = setpoint − measured_value
proportional = KP ∗ error
integral = integral + Ki∗sampling_time∗error
derivative = Kd∗(error−previous_error)/sampling_time
output = proportional + integral + derivative
previous_error = error
wait (sampling_time)
goto Start
```

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PLC with a digital PID module:

Digital PID:

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PLC

A **P**rogrammable **L**ogic **C**ontroller (PLC) is a digital computer used for automation in process industry.