

Homework #11: ECE 461/661

Digital PID Control. Due Monday, November 18th

PID Control

Assume $T = 0.1$ seconds:

$$G(s) = \left(\frac{2331}{(s+2.6338)(s+30.2062)(s+53.7896)} \right)$$

1) Design a digital I controller

$$K(z) = k \left(\frac{z}{z-1} \right)$$

that results in 20% overshoot in the step response.

Simulate the step response of the closed-loop system (VisSim or Simulink preferred with $K(z)*G(s)$)

2) Assume $T = 0.1$ seconds and

$$G(s) = \left(\frac{2331}{(s+2.6338)(s+30.2062)(s+53.7896)} \right)$$

Design a digital PI controller

$$K(z) = k \left(\frac{z-a}{z-1} \right)$$

that results in 20% overshoot in the step response.

Simulate the step response of the closed-loop system (VisSim or Simulink preferred with $K(z)*G(s)$)

3) Assume $T = 0.1$ seconds and

$$G(s) = \left(\frac{2331}{(s+2.6338)(s+30.2062)(s+53.7896)} \right)$$

Design a digital PID controller

$$K(z) = k \left(\frac{(z-a)(z-b)}{z(z-1)} \right)$$

that results in 20% overshoot in the step response.

Simulate the step response of the closed-loop system (VisSim or Simulink preferred with $K(z)*G(s)$)

Meeting Design Specs

4) Assume a sampling rate of $T = 0.1$ seconds and

$$G(s) = \left(\frac{2331}{(s+2.6338)(s+30.2062)(s+53.7896)} \right)$$

Design a digital controller that results in

- No error for a step input
- 20% overshoot for the step response, and
- A 2% settling time of 1 seconds

Simulate the step response of the closed-loop system (VisSim or Simulink preferred with $K(z)*G(s)$)

5) Assume

$$G(s) = \left(\frac{2331}{(s+2.6338)(s+30.2062)(s+53.7896)} \right)$$

Design a digital controller with $T = 0.05$ seconds that results in

- No error for a step input
- 20% overshoot for the step response, and
- A 2% settling time of 1 seconds

Simulate the step response of the closed-loop system (VisSim or Simulink preferred with $K(z)*G(s)$)

Note: Changing the sampling rate is a big deal: it means a complete redesign of $K(z)$