SE 380 Introduction to Feedback Control

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HOMEWORK 5

Due date: November 19, 2023

Note: You may use the `Python Control Systems Library` to solve the problems. If you do, in addition to explaining the design process, include also code snippets and figures (such as Bode plots with stability margins and step response with static and dynamic performance highlighted) to support your answers.

1 Design a lead-lag compensator $C(s)$ to control the system

$$G(s) = \frac{1}{(1+s)^3},$$

such that $L(s) = C(s)G(S)$ has

- Steady-state gain greater than 100
- Crossover frequency greater than 5
- Phase margin greater than 60°

Hint: In order to achieve large steady-state gains, crossover frequencies, and phase margins, you may consider cascading multiple lead and lag compensators.

2 Design a proportional controller for the system

$$G(s) = \frac{100(s+1)}{(s-1)(s^2+5s+10)}$$

such that

- The closed-loop system is stable
- The damping of the complex-conjugate poles of the closed-loop systems is greater than 0.45