ROB311 Quiz 2

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Contents

1 Bode Plots

1.1 Bode Plots

Process:

1.1.1 Constant Gain

1.1.2 Pole or Zero at $\omega = 0$

1.1.3 Non-Zero Pole or Zero

1.1.4 Complex Conjugate Poles

1.2 Robustness Margins

Motivation: Approximate the GM and PM from the Bode plot:

- $L(s)$ is a strictly proper rational fn.
- $L(s)$ has no poles in $\mathbb{C}^+$ (no open loop variable poles)

1.2.1 Gain Margin

Definition:

$$|L(j\omega_{gc}) = 1| \iff |L(j\omega_{gc})|_{dB} = 0$$

1.2.2 Phase Margin

Definition:

$$|L(j\omega_{gc})| = 1 \implies |L(j\omega_{gc})|_{dB} = 0$$

2 Robustness Margins

3 Root Locus, Bode, and Nyquist

4 Control Design in the Frequency Domain

4.1 Proportional Derivative (PD) Controller

Definition:

$$C(s) = K(T_d s + 1) \tag{1}$$

4.2 Proportional Integral (PI) Controller

Definition:

$$C(s) = K\left(1 + \frac{1}{T_I s}\right) = K\frac{T_I s + 1}{T_I s} \tag{2}$$

4.3 Proportional Integral Derivative (PID) Controller

Definition:

$$C(s) = K(T_D s + 1)\left(1 + \frac{1}{T_I s}\right) = K_p + \frac{K_I}{s} + K_D s \tag{3}$$

- $K, T_I, T_D > 0$