Homework

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Final Project

Problem 2

The computed deficiency angle is $90°$.

Solution 1

One solution is to choose a pole-zero pair that cancels a pole at the origin: $G(s) = \frac{s+0}{s+2} \times \frac{1}{s^2}$. This corrects the angle deficiency as follows: $135 + 135 + 45 - 135 = 180$.

Solution 2

Another (and better) solution is $G(s) = \frac{s+0.5}{s+3} \times \frac{1}{s^2}$. This corrects the angle deficiency as follows: $135 + 135 + 30 - 120 = 180$.

Root-loci plots

Both solutions pass through $s = -1 \pm j$.

System Responses

- Unit-step response:

$$\lim_{s\to 0} s \times \frac{1}{s} \times \frac{s+0}{s+2} \times \frac{1}{s^2} = \infty$$

$$\lim_{s\to 0} s \times \frac{1}{s} \times \frac{s+0.5}{s+3} \times \frac{1}{s^2} = \infty$$

- Unit-ramp response:

$$\lim_{s\to 0} s \times \frac{1}{s^2} \times \frac{s+0}{s+2} \times \frac{1}{s^2} = \infty$$

$$\lim_{s\to 0} s \times \frac{1}{s^2} \times \frac{s+0.5}{s+3} \times \frac{1}{s^2} = \infty$$

- Unit-acceleration response:

$$\lim_{s\to 0} s \times \frac{1}{s^3} \times \frac{s+0}{s+2} \times \frac{1}{s^2} = \infty$$

$$\lim_{s\to 0} s \times \frac{1}{s^3} \times \frac{s+0.5}{s+3} \times \frac{1}{s^2} = \infty$$

Problem 3