

6.13 Closed-Loop Poles

Consider the transfer function

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

Assume standard feedback configuration with K as the controller. Using the Bode plots of $KG(s)$ explain how you can confirm the presence of $j\omega$ -axis closed-loop poles if $K = 5$ or $K = 8$. You can use the following bode plot to answer the question.

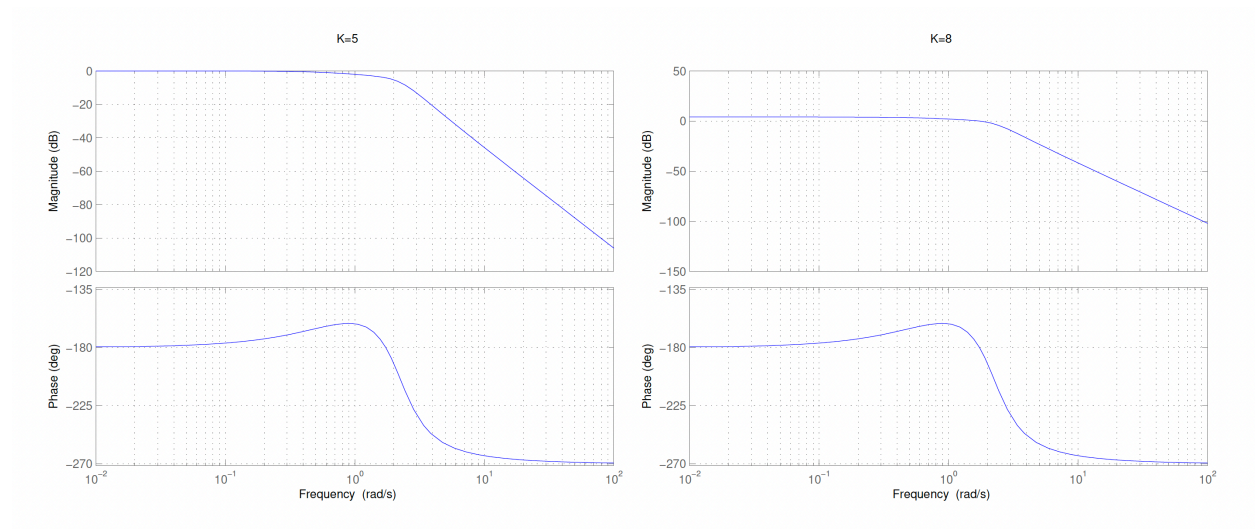


Figure 9: Bode plots for the system

Solution :

According to the bode plots given below for $K = 5$ and $K = 8$, we can see that both GM and PM are zero which confirm the presence of $j\omega$ -axis closed-loop poles.

GPT Answer :

The Bode plots for a system with the transfer function

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

and a gain K indicate the frequency response of $KG(s)$. To confirm the presence of $j\omega$ -axis closed-loop poles, one should check for a gain crossover frequency (where the magnitude plot crosses 0 dB) with a corresponding phase angle of -180 degrees.

For $K = 5$ and $K = 8$, the provided Bode plots do not show a magnitude crossing 0 dB, suggesting the absence of $j\omega$ -axis poles for these gain values. The exact determination would require inspecting the phase plot at the frequency where the magnitude is closest to 0 dB. A phase at or below -180 degrees at this frequency would indicate a $j\omega$ -axis pole.

Confidence Level: 90%

Misreading The Plot

Claude Answer :

To confirm the presence of $j\omega$ -axis closed-loop poles for $K = 5$ or $K = 8$, we can examine the Bode plots of $KG(s)$ and apply the Closed-Loop Stability Criterion.

For $K = 5$: At the phase crossover frequency (where phase = -180 degree), the magnitude is approximately -12 dB, which is less than 0 dB. This indicates a gain margin greater than 1, suggesting no $j\omega$ -axis poles for $K = 5$.

For $K = 8$: At the phase crossover frequency, the magnitude is approximately 0 dB. This indicates a gain margin of 1, suggesting the presence of $j\omega$ -axis poles for $K = 8$.

Therefore, based on the Bode plots, we can confirm the presence of $j\omega$ -axis closed-loop poles for $K = 8$, but not for $K = 5$.

Confidence level: 90%

Misreading The Plot