

Computer Exercise 1

EL2520 Control Theory and Practice

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Suppression of disturbances

The weight is

$$\begin{aligned} W_S(s) &= \frac{1}{(s + \epsilon + i\sqrt{\omega^2 - \epsilon^2})(s + \epsilon - i\sqrt{\omega^2 - \epsilon^2})} \\ &= \frac{1}{(s + 0.5 + i\sqrt{(100\pi)^2 - 0.5^2})(s + 0.5 - i\sqrt{(100\pi)^2 - 0.5^2})} \end{aligned}$$

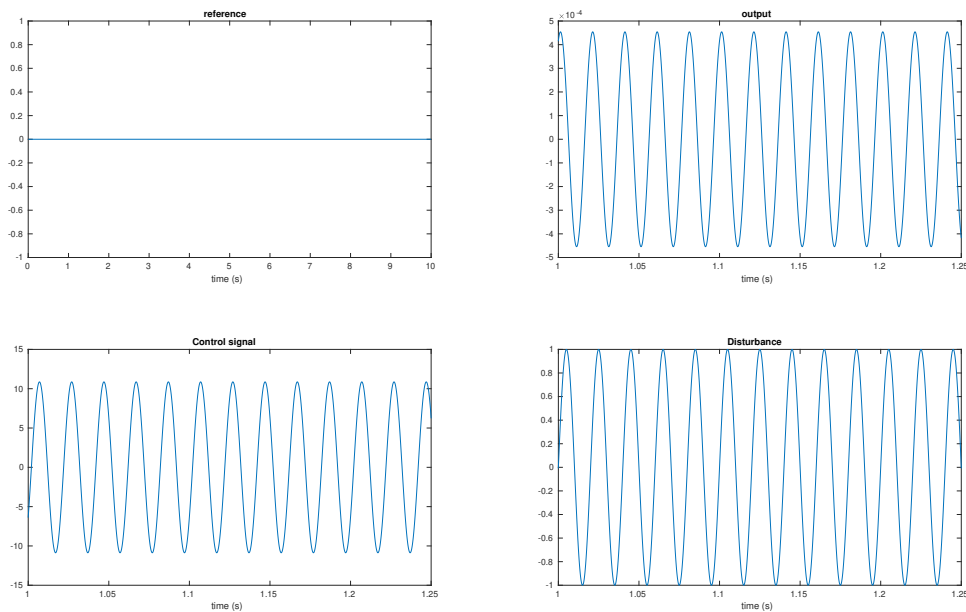


Figure 1: Simulation results with system G , using W_S .

- How much is the disturbance damped on the output?
The ratio between the disturbance amplitude and the output oscillations is 4.543×10^{-4} .
- What amplification is required for a P-controller to get the same performance, and what are the disadvantages of such a controller?

Since $|FG| \gg 1$, we have:

$$\begin{aligned} |S| &\approx |FG|^{-1} \\ &= |FG(i100\pi)|^{-1} \\ &= (0.0920|F|)^{-1} \\ &= 4.543 \times 10^{-4} \end{aligned}$$

So, $|F| = \frac{1}{0.0920 \times 4.543 \times 10^{-4}} = 2.3926 \times 10^4$, which means the approximate amplification for a P-controller to get the same rate is 2.3926×10^4 .

The disadvantage of such a P-controller is that it's not feasible to get controllers with such big amplification.

Robustness

What is the condition on T to guarantee stability according to the small gain theorem, and how can it be used to choose the weight W_T ?

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The weights are

$$W_S(s) = \dots$$

$$W_T(s) = \dots$$

Is the small gain theorem fulfilled?

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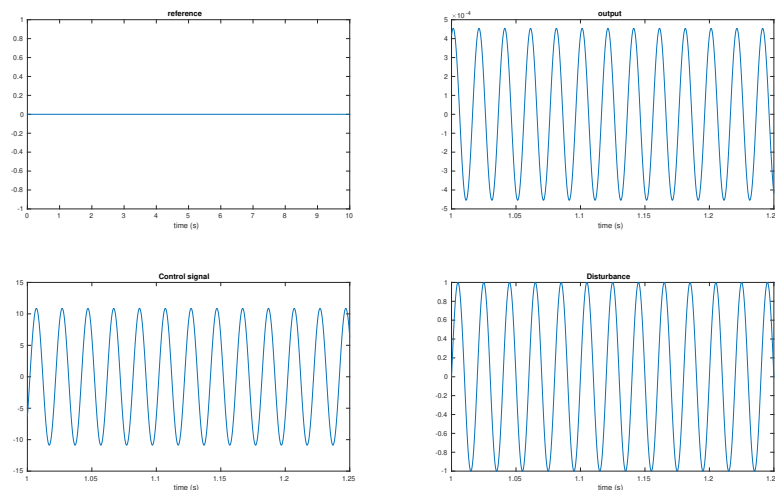


Figure 2: Bode diagram showing that the small gain theorem is satisfied.

Compare the results to the previous simulation

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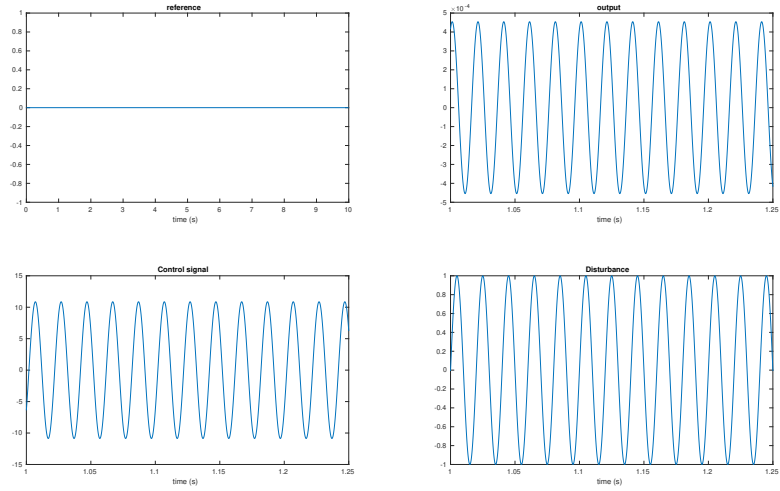


Figure 3: Simulation results with system G_0 , using W_S and W_T .

Control signal

The weights are

$$W_S(s) = \dots$$

$$W_T(s) = \dots$$

$$W_U(s) = \dots$$

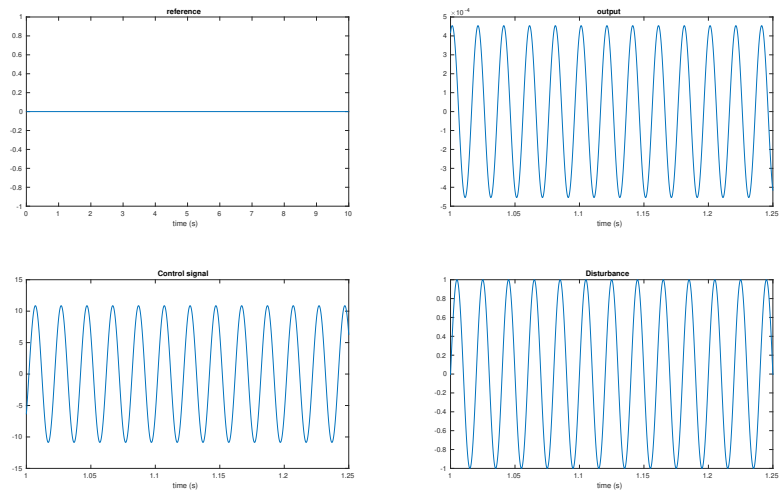


Figure 4: Simulation results with system G_0 , using W_S , W_T and W_U .

Compare the results to the previous simulations

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