Computer Exercise 2
EL2520 Control Theory and Practice

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Minimum phase case

The controller is given by

$$F(s) = \begin{bmatrix} \frac{9.904s+1.678}{5.904s} & 0 \\ 0 & \frac{12.87s+2.014}{6.391s} \end{bmatrix}$$

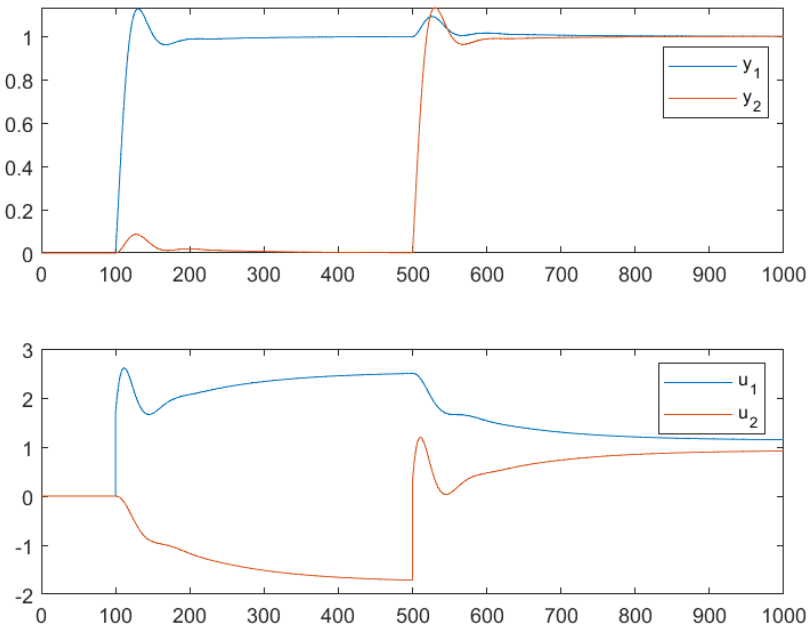

Figure 1: Simulink plots from exercise 3.2.3

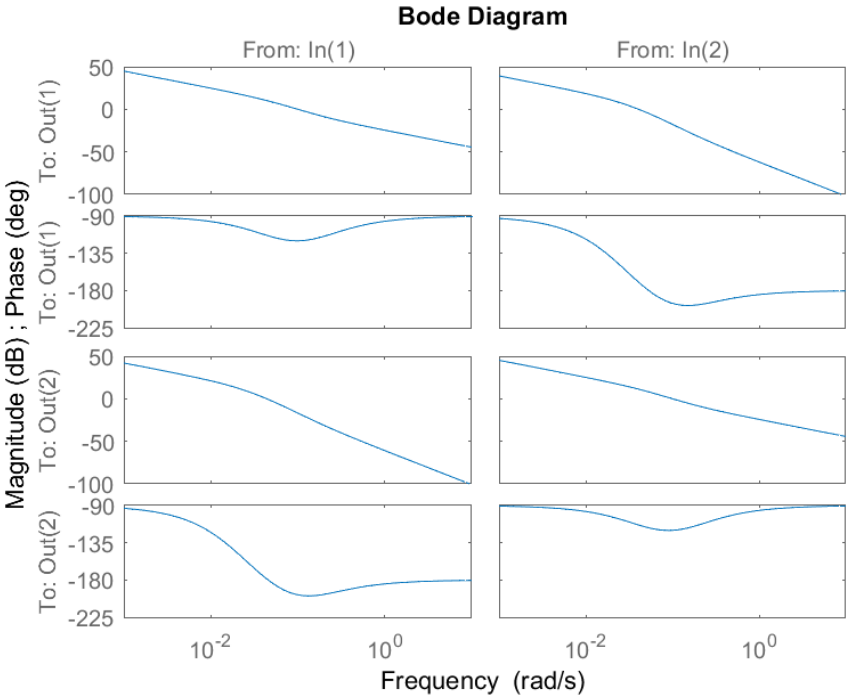

Figure 2: Bode diagram of the loop gain $L(s)$ from exercise 3.2.1

Is the controller good?
The controller manages to make the system reach a steady state for a step response with some overshoot. It also behaves according to the specification of the system of having a crossover frequency of 0.1 rad/s and a phase margin of $\frac{\pi}{3}$ rad. Since the maximum singular values of $S \approx 1.2$ and $T \approx 1.3$ both are below 2 the system can also be said to be stable. Therefore the controller is said to be good.

Are the output signals coupled?
The output signals have an interaction which can be seen in figure 1. But the interactions are weak and thethey don't affect each other significantly.

Non-minimum phase case

The controller is given by

$$F(s) = \begin{bmatrix} 0 & \frac{0.5792s+0.1469}{3.943s} \\ \frac{0.6915s+0.1437}{4.811s} & 0 \end{bmatrix}$$

Is the controller good? No, the controller manages to make the corresponding input reach a steady state for a step response but takes too long to

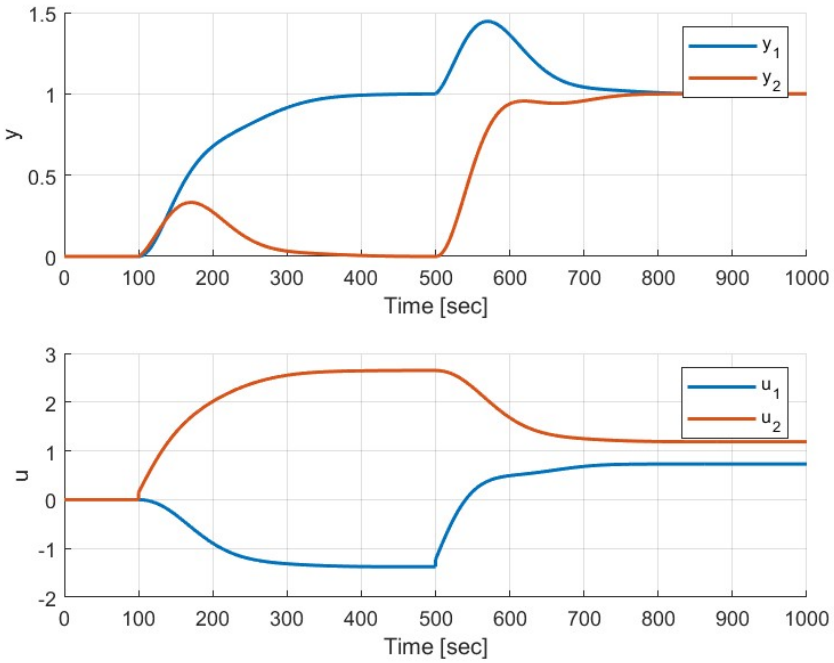

Figure 3: Simulink plots from exercise 3.2.3

settle. Compared to the minimum-phase case the performance of the controlled non-minimum phase plant degrades due to the increased interaction, which is seen in Figure 3. Are the output signals coupled? Yes, the outputs are coupled. A strong interaction is seen in the step responses. For example, a step in input one heavily affects the second output and vice versa.

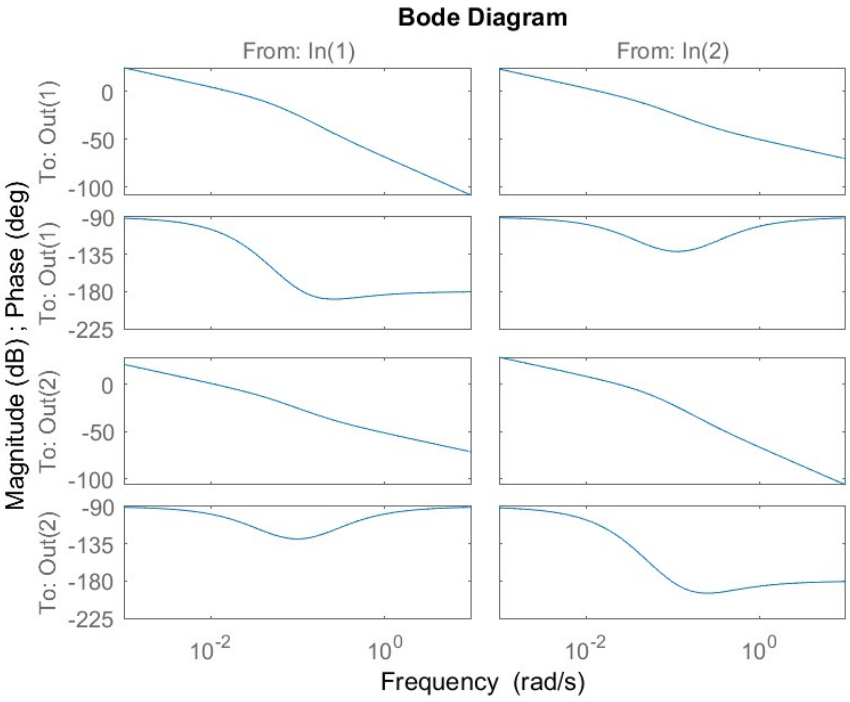

Figure 4: Bode diagram of the loop gain $L(s)$ from exercise 3.2.1