Computer Exercise 4
EL2520 Control Theory and Practice

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Minimum phase case

Dynamic decoupling

The dynamic decoupling in exercise 3.2.1 is

$$W(s) = \begin{bmatrix} 1 & \frac{-4.446\text{e-}4s-2.306\text{e-}5}{0.03013s^2+0.002204s+3.328\text{e-}5} \\ \frac{-4.649\text{e-}4s-2.624\text{e-}5}{0.0348s^2+0.002859s+5.052\text{e-}5} & 1 \end{bmatrix}$$

Is the controller good? Yes, the controller is very good and fulfills the given requirements. Are the output signals coupled? No, there is almost no coupling between the inputs and outputs.

Glover-MacFarlane robust loop-shaping

What are the similarities and differences compared to the nominal design? Both controllers perform very similar. The Glover-MacFarlane controller has a slightly lower overshoot, indicating a higher robustness.

Non-minimum phase case

Dynamic decoupling

The dynamic decoupling in exercise 3.2.1 is

$$W(s) = \begin{bmatrix} \frac{-1.143s^2-0.1575s-0.004674}{s^2+0.2469s+0.009384} & \frac{0.2}{s+0.2} \\ \frac{0.2}{s+0.2} & \frac{-1.615s^2-0.2211s-0.007077}{s^2+0.2511s+0.01021} \end{bmatrix}$$

Is the controller good? Yes, it does its work and performs better than for the case of static decoupling, but not as good as the minimum phase case. Are the output signals coupled? No, there is very little coupling between the outputs.
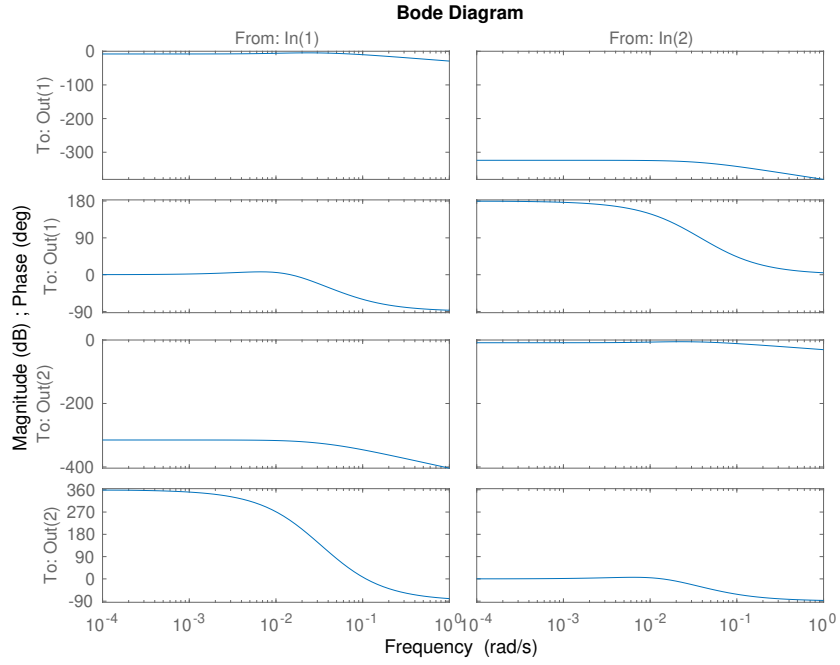
Figure 1: Bode diagram of $\tilde{G}(s)$ derived in exercise 3.2.1

Glover-MacFarlane robust loop-shaping

What are the similarities and differences compared to the nominal design?
The control performance of the Glover-MacFarlane controller is slower than
the nominal design. This shows that the higher robustness comes at the cost
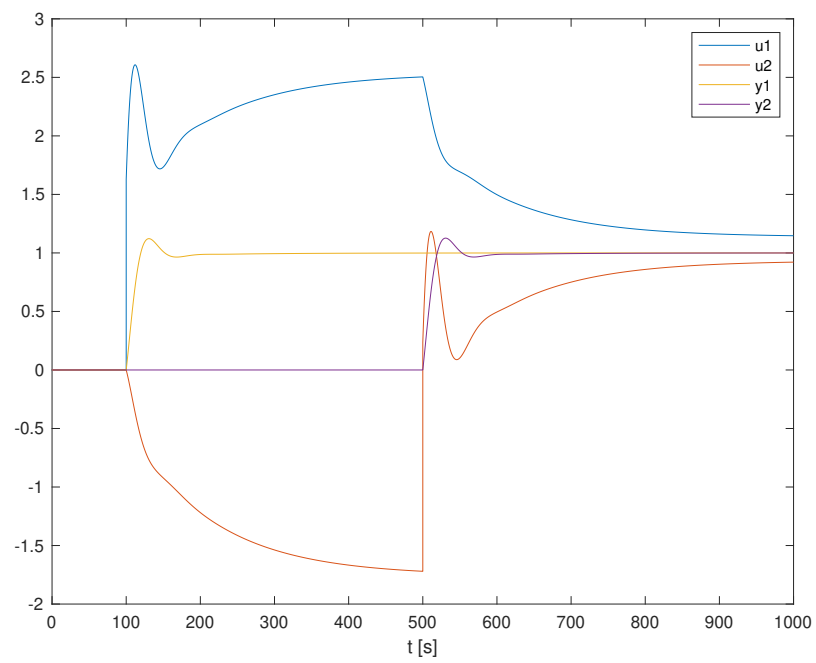of control speed.

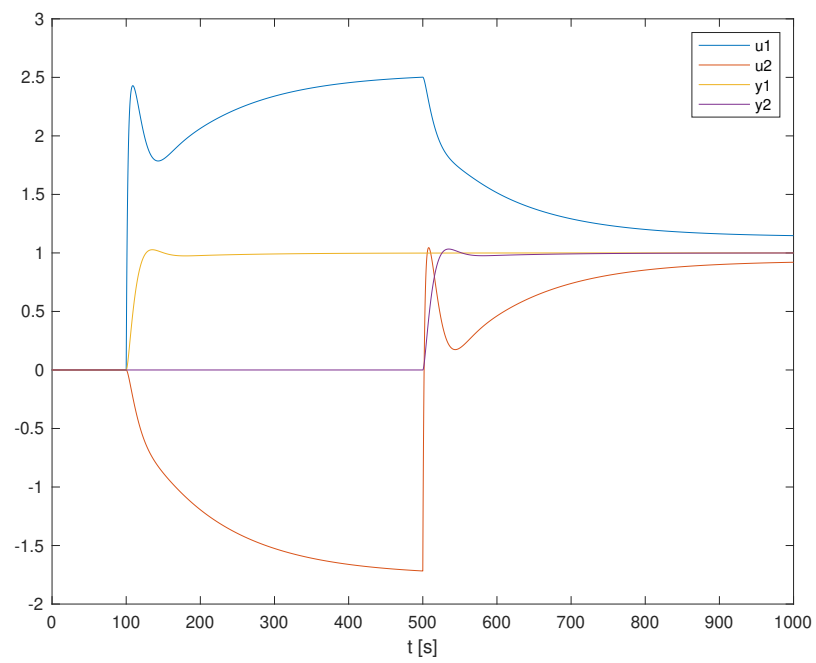Figure 2: Simulink plots from exercise 3.2.4

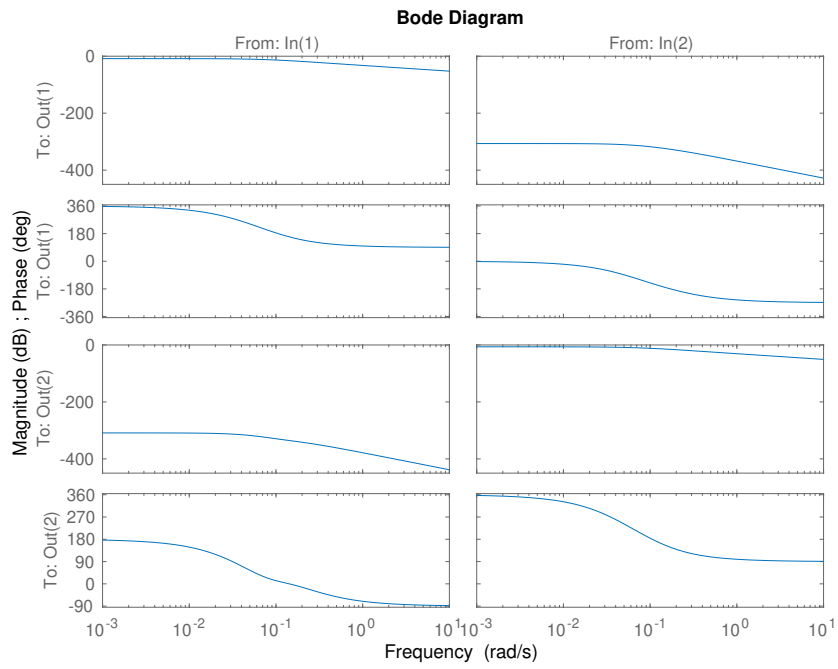Figure 3: Simulink plots from exercise 3.3.4

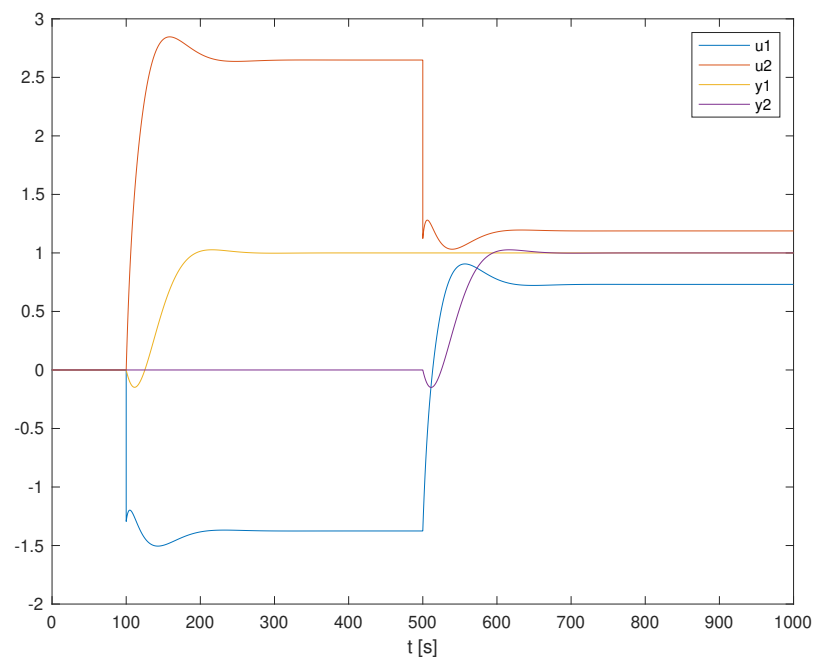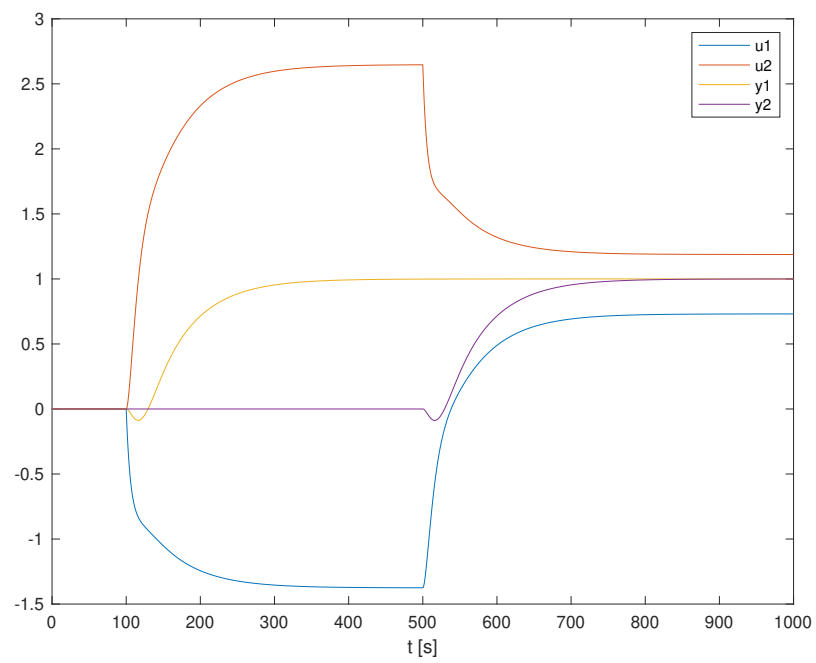Figure 4: Bode diagram of $\tilde{G}(s)$ derived in exercise 3.2.1

Figure 5: Simulink plots from exercise 3.2.4

Figure 6: Simulink plots from exercise 3.3.4