Computer Exercise 2
EL2520 Control Theory and Practice

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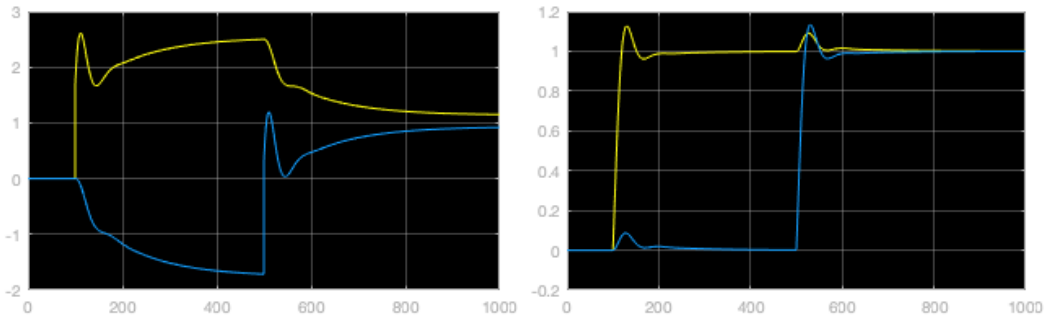
Minimum phase case

The controller is given by

$$F(s) = \begin{bmatrix} \frac{1.678 \cdot s + 0.2842}{s} & 0 \\ 0 & \frac{2.014 \cdot s + 0{,}3151}{s} \end{bmatrix} \tag{1}$$



u, minimum phase y, minimum phase

Figure 1: Simulink plots from exercise 3.2.3

Is the controller good?
The analysis of the sensitivity, S and the complementary sensitivity, T resulted in a crossing of S and T at the cross over frequency $\omega_c = 0.1$, which is desired. Hence, both noise and disturbance is damped. The controller is relatively good due to the low raise time and relative low overshoot. Here the overshoot is less than 20% for both y1 and y2 for input signal u1 and u2.

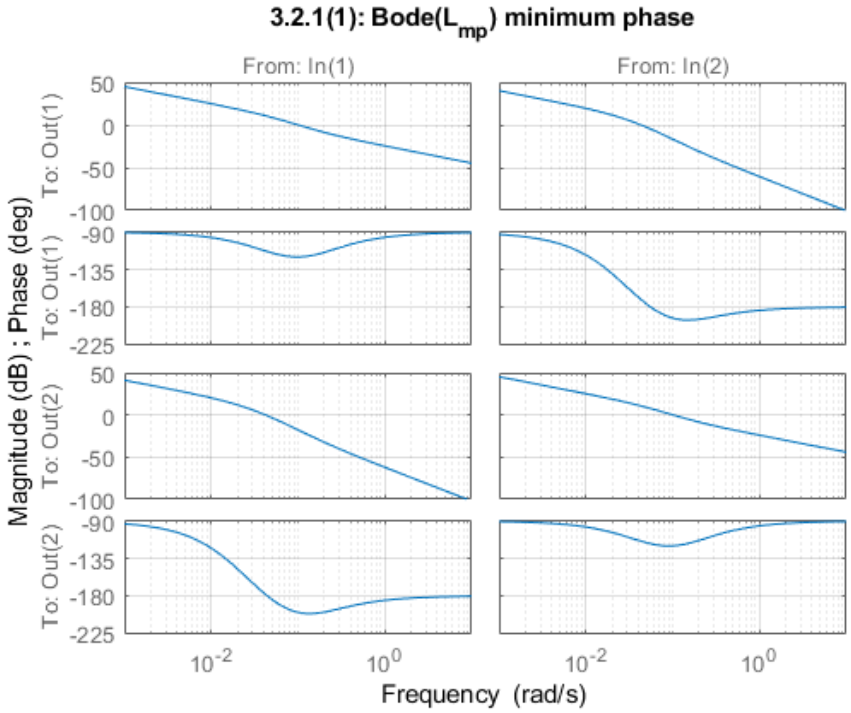


Figure 2: Bode diagram of the loop gain $L(s)$ from exercise 3.2.1

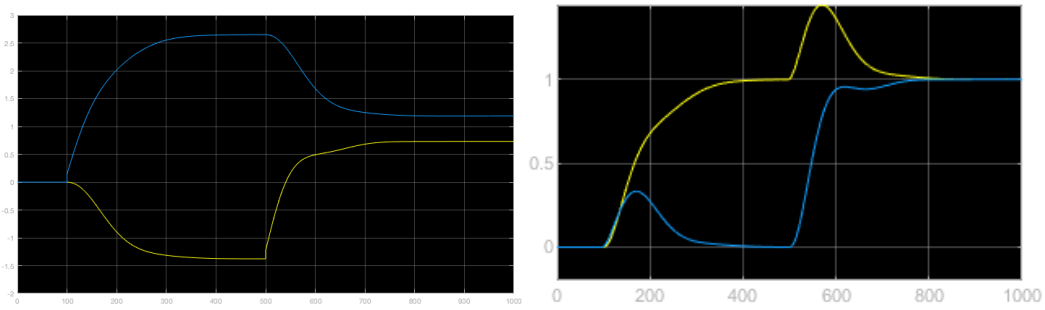
Are the output signals coupled?
As one could observe in Figure 1, the signals are coupled as the outputs y1 and y2 are effected when giving either the input signal from u1 or u2. But the effect is less than for the non-minimum case as can be seen in Figure 3.

Non-minimum phase case

The controller is given by

$$F(s) = \begin{bmatrix} 0 & \frac{0.1437 \cdot s + 0.02988}{s} \\ \frac{0.1469 \cdot s + 0.03726}{\cdot s} & 0 \end{bmatrix} \tag{2}$$

Is the controller good?
When analysing S and T for the non-minimum phase the result is similar to the minimum phase. S and T are crossing at the desired cross over frequency $\omega_c = 0.02$ and since S is damping disturbance and T is damping noise, both noise and disturbance are damped. The controller is relatively bad in comparison to the controller in the minimum phase case, with an raise time that is around 4 times higher. Also the controller has a higher effect on



u, non-minimum phase

y, non-minimum phase

Figure 3: Simulink plots from exercise 3.2.3

the output signal that is not supposed to be controlled i.e. y2 are effected a lot when u1 are used and same thing for y1 when u2 are used.

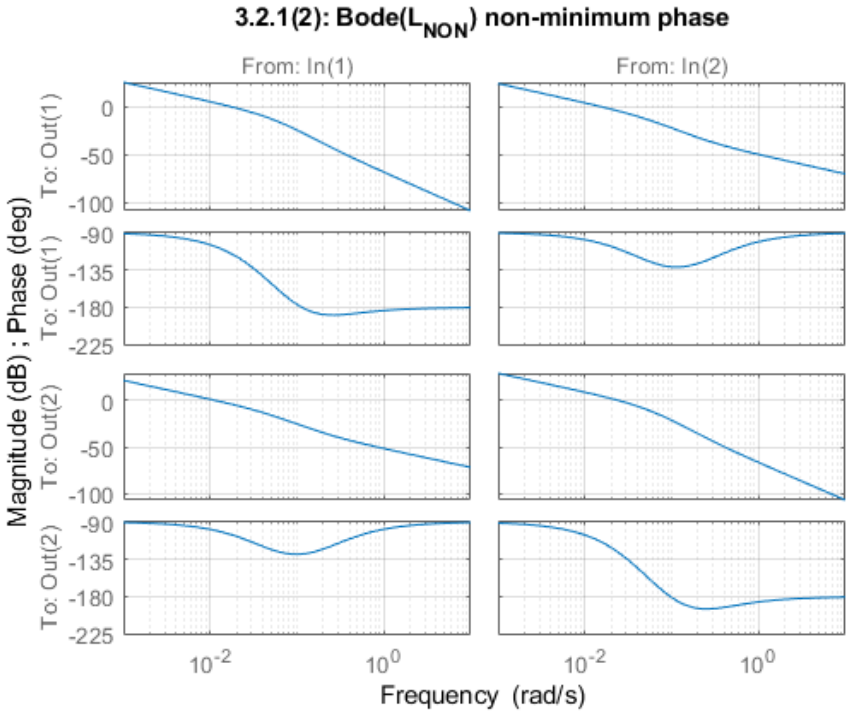


Figure 4: Bode diagram of the loop gain $L(s)$ from exercise 3.2.1

Are the output signals coupled?
Yes, as one could notice in Figure 3 both the signals are coupled as y1 and y2 are effected by u1 and u2.