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Control Design (F, IT) Computer Controlled Systems (STS, W)

Computer exercise 4

Decentralized control: Hints

Excercise 3.1

`G=zpk(Gm)`

Input Nb	Output Nb	Poles	
1	1	-0.0159	
1	2	-0.0159	-0.02651
2	1	-0.0159	-0.159
2	2	-0.0159	

No, there are no limitations since there are only poles in the left half plane, and there are no zeros.

Excercise 3.2

`zero(Gm)` = -0.0214, -0.1640
`pole(Gm)` = -0.0159, -0.0159, -0.1590, -0.0265
Only stable poles and zeros. No limitations. Select ω_c as large as possible, i.e. $\omega_c = 0.1$ rad/s. If we would have a non-minimum phase zero in z, then select $\omega_c \leq z/2$.

Excercise 4.1

$RGA(G(0)) = \begin{bmatrix} 1.2 & -0.2 \\ -0.2 & 1.2 \end{bmatrix}$

$RGA(G(0.1)) = \begin{bmatrix} 0.99 - 0.03i & 0.01 + 0.03i \\ 0.01 + 0.03i & 0.99 - 0.03i \end{bmatrix} \approx \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

Pair along the diagonal, i.e. input 1–output 1, input 2–output 2. According to the RGA decentralized control should work fine, but with some interaction in the steady state ($\omega = 0$).

Excercise 4.2

```
step(Gm)
```

In the step response we can se that input i mostly affects output i but also the other output, so clearly, there are interactions between the loops.

Excercise 4.3

```
F1m = decpid(Gm,0.1,pi/3,1)
clpoler(Gm,F1m)
```

Yes, the closed loop system is stable.

Excercise 4.4

```
simtank('min',F1m)
```

Slightly coupled.

Excercise 5.1

```
P=eye(2)
W1=inv(dcgain(Gm))
```

Yes it is decoupled.

$RGA(\tilde{G}(0)) = I$

$RGA(\tilde{G}(\omega_c) \approx \begin{bmatrix} 1.03 + 0.096i, & -0.03 - 0.096i \\ -0.03 - 0.096i & 1.03 + 0.096i \end{bmatrix}$

Pair input i with output i.

Excercise 5.2

Yes, the closed loop system is stable.

Excercise 5.3

F2m is possibly somewhat faster than F1m but with more coupling.

Excercise 5.4

Fully decentralized. RGA=I. Pair input i with output i.

Excercise 5.5

Yes, the closed loop system is stable.

Excercise 5.6

Yes, it works better than F1m (decentralized control) and F2m (statically decoupled).

Excercise 6.1

Select $\alpha = 1.1$. This gives γ_1=1.87, $\gamma_2 = 2.03$, $\gamma_3 = 1.82$. Yes, stable.

Excercise 6.2

Small coupling. Smoother levels.