

PHILIPS



Stelsel en Regelsysteem

FMT / Mechatronica

Deel 3: Vervolg regelsysteem

Oefening: Werken met blokschema's

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Cursus Stelsel en Regelsysteem

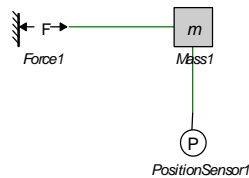
Overzicht

- Deel 1 Blok 1. Inleiding
- Wo. 14-04 Blok 2. Basisprincipes modelvorming massa-veersystemen
- Blok 3. De regelaar als veer-demper combinatie
- Deel 2 Blok 4. Frequentie-domein beschrijving
- Wo. 21-04 Blok 5. Basisconcepten in de regelsysteemtheorie
- Deel 3 Blok 6. Verdere inleiding in de regelsysteemtheorie
- Wo. 28-04 Blok 7. De PD regelaar als veer-demper combinatie
- Deel 4 **Stabiliteit van regelsystemen**
- Wo. 12-05
- Deel 5 **Toepassing: PID regelaarontwerp**
- Wo. 19-05
- Deel 6 **Extra regelsysteemtheorie**
- Wo. 26-05

20-sim oefening

Exercise block scheme of simple mass

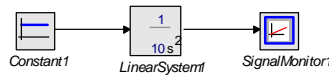
Build a block scheme representation of the following model:



$$M = 10 \text{ kg}$$

Use 'LinearSystem.em' to build $1/Ms^2$...

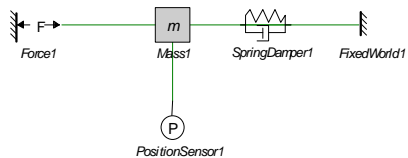
Result:



- Check that Bode plots are identical!!!

Exercise block scheme of mass-spring system

Build a block scheme representation of the following model:



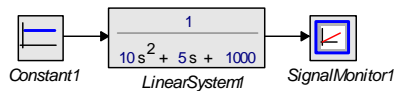
$$M = 10 \text{ kg}$$

$$d = 5 \text{ Ns/m}$$

$$k = 1000 \text{ N/m}$$

Use 'LinearSystem.em' to build $1/(Ms^2+ds+k)$...

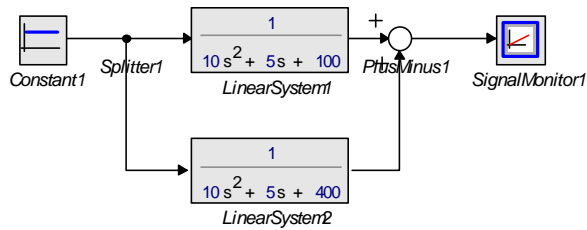
Result:



- Check that time responses are identical!!!
- And Bode plots?

Exercise parallel connection of systems

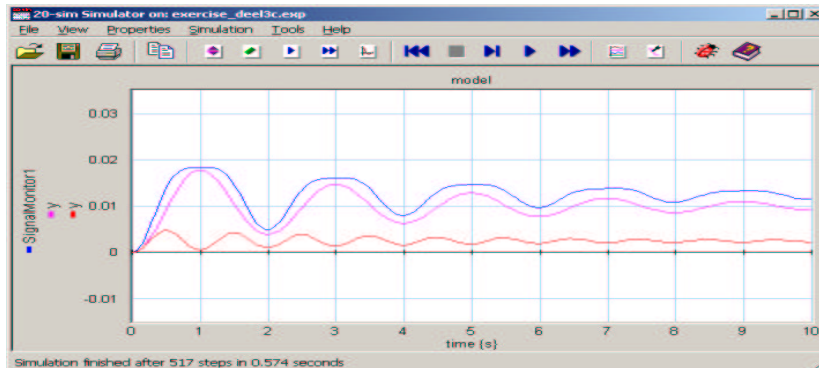
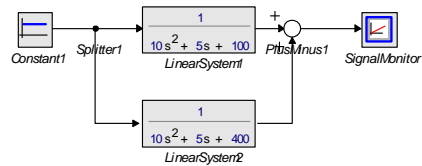
Build the following block scheme:



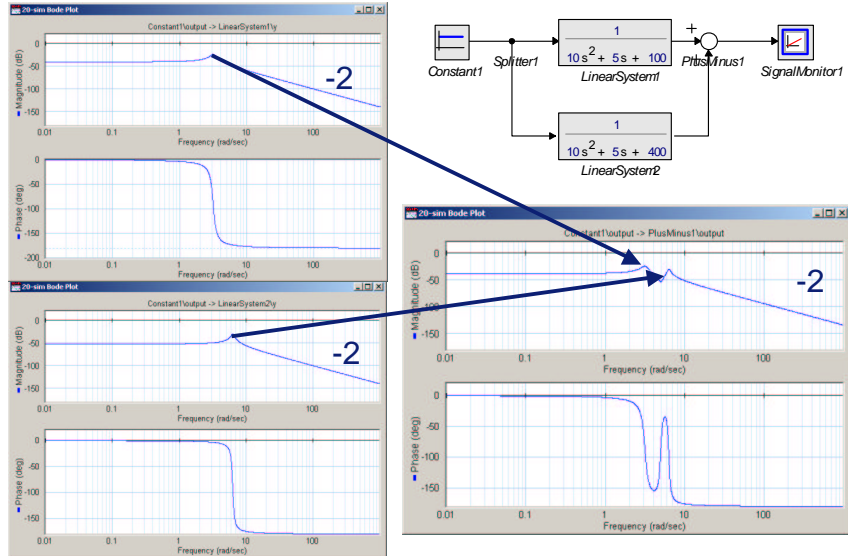
- Check the time responses of the individual system outputs
- Check the time response of the SignalMonitor
- Check the Bode plots as well

Exercise parallel connection of systems

Results:

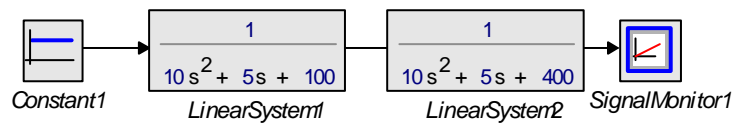


Exercise parallel connection of systems



Exercise series connection of systems

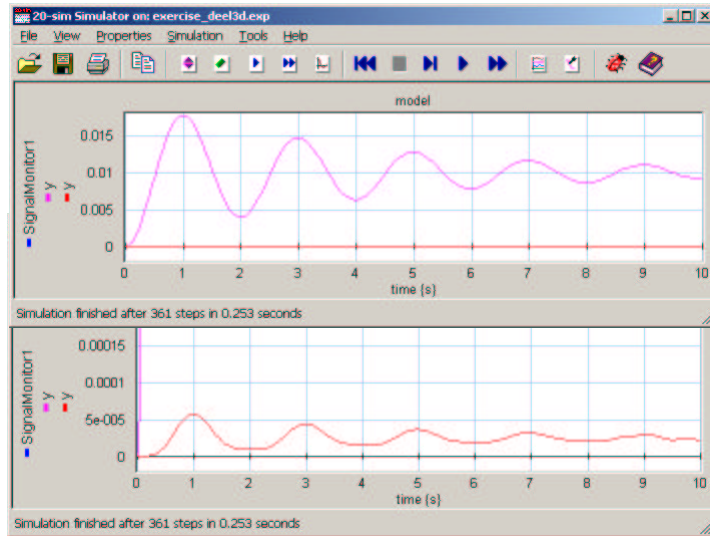
Build the following block scheme:



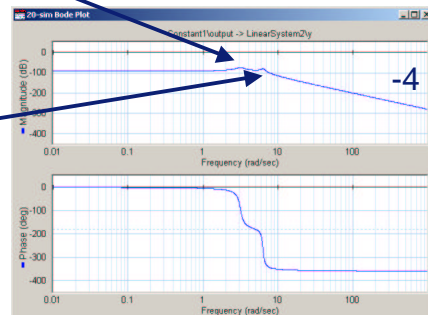
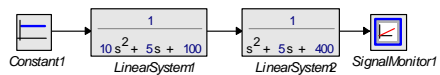
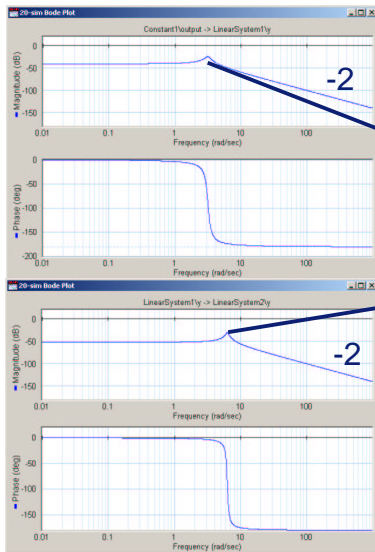
- Check the time responses of the individual system outputs
- Check the time response of the SignalMonitor
- Check the Bode plots as well

Exercise series connection of systems

Results:



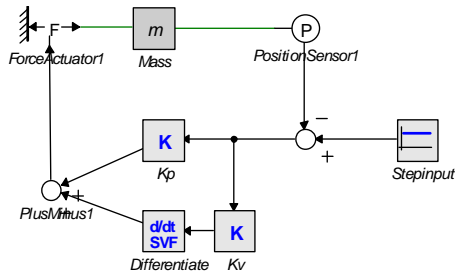
Exercise series connection of systems



Multiplication of Bode plots...

Exercise PD controller

Build the following control system:



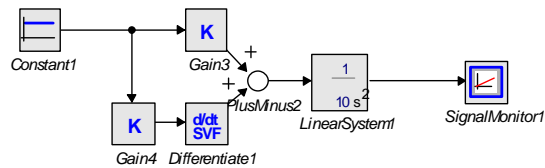
- $M = 10 \text{ kg}$
- $d = 5 \text{ Ns/m}$
- $k = 100 \text{ N/m}$
- $N = 100$ (differentiator)

- Check the time response of the position sensor
- Investigate the effect of varying K_p and K_v
- How does the PD-controller act?

Exercise PD controller

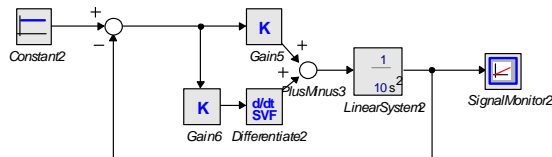
Now build a block scheme representation of the system:

Open loop:

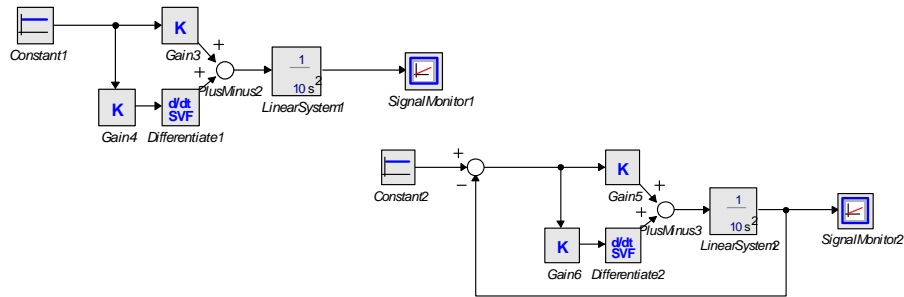


- $K_v = 5$
- $K_p = 100$

Closed loop:



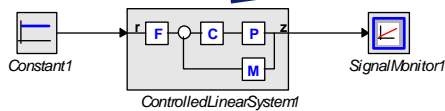
Exercise PD controller



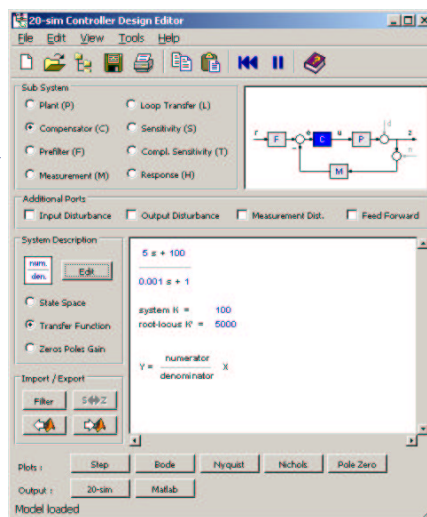
- Check the time responses of the two systems
- Check the Bode plots of the two systems
- Investigate the effect of varying Kp and Kv

Exercise PD controller

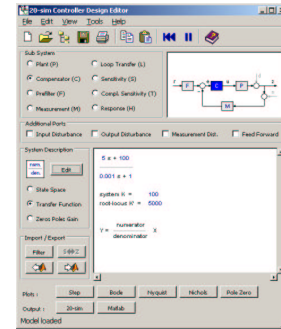
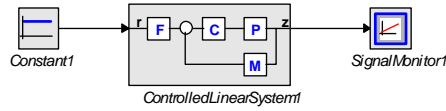
Repeat modelling the same system using linear system descriptions (block schemes):



- Check Bode plots:
 - Loop Transfer
 - Sensitivity
 - Compl.Sensitivity
- Same for step responses...



Exercise PD controller



Additional assignments:

- What is the bandwidth of the system?
- Increase bandwidth by increasing the controller gain (100x)
- Check the influence on Bode plots and step responses
 - Why is the system damped better?

