REPORT ON REGELTECHNIEK WPO SESSION

Date
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# First AND SECOND sessionS - Exercises

## Consider the following system $H\left(s\right)=\frac{2}{s^{2}+3s+2}$

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|  | 1. Realize the system in transfer function form
2. Calculate the zeros and poles. Is the system stable/unstable (explain!)
3. Define the Zero-Pole-Gain form
4. with numerical analysis (calculate yourself)
5. with automatic Matlab conversion
6. Verify in Matlab that the Zero-Pole-Gain representation is equal to the transfer function representation
7. Plot the poles and zeros on the S plane and make sure that 1) and 2) give exactly the same results
8. Using your own Matlab commands (e.g. plot)
9. Using pzplot command
10. Simulate and display impulse and step responses with the following parameters: fs=1 kHz, t=[0...15] sec. Make sure that 1) and 2) give exactly the same results
11. Using your lsim command
12. Using impulse and step commands
13. How do you obtain the step response if only the impulse response is available?
14. Show the codes of the computation in Matlab
15. Compare the step response estimates from point g) and f)
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|  | **Delete this part after reading**Notes: please insert your Matlab codes, figures and comments in the text after right after the exercise description. Please make sure to use text formatting (your document should be well-readable). For example:1. **Realize the following system in transfer function form and plot its impulse response function**

clear all; close all; clcnumerator=1;denomerator=[1 2 3];H=tf(numerator, denomerator);impulse(H)My conclusions, explanations come here… I can also insert formulas $E=mc^{2}$… |

## Consider the following systems $H\_{1}\left(s\right)=\frac{1}{s^{2}+3s+2}$ and $H\_{2}\left(s\right)=\frac{s+1}{s+2}$

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|  | 1. Realize the systems in transfer function form
2. Calculate the resulting plant model from the serial connection of the systems considered
3. using \* operator
4. using series command
5. check if 1) and 2) provide the same results
6. store the results in Hs variable, use zpk (Zero-Pole-Gain) form
7. Calculate the resulting plant model from the parallel connection of the systems considered
8. using + operator
9. using parallel command
10. check if 1) and 2) provide the same results
11. store the results in Hp variable, use zpk form
12. Simplify Hs and Hp
13. in analytic way (show your equations)
14. using minreal command
15. check if 1) and 2) provide the same results
16. store the results in Hs and Hp variables, respectively
17. Place Hs in the forward loop and apply a negative feedback (-1 gain)
18. using \* and - operators
19. using feedback command
20. check if 1) and 2) provide the same results
21. simplify the results using minreal command
22. is the system stable? (explain)
23. *store the result in Hfs variable*
24. Place Hs in the forward loop and Hp in a negative feedback loop
25. using \* and + operators
26. using feedback command
27. check if 1) and 2) provide the same results
28. simplify the results using minreal command
29. is the system stable? (explain)
30. Plot the step responses of Hfs and Hfp

Use lsim to simulate the responses with fs=1 kHz, choose an appropriate time interval for the simulation1. compare the different responses
2. estimate with the help of step response figures the static gain, rise time, settling time, peak-time, dominant time constant. Show clearly on your plot how you estimate the different quantities
3. Compare your results from 2) with the results of stepinfo and other related commands used to obtain the above-mentioned quantities. Explain the differences. Use a table to compare the quantities
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## Consider the following systems $H\_{1}\left(s\right)=\frac{10s+1}{s+1}$ and $H\_{2}\left(s\right)=\frac{s}{(10s+1)(5s+1)}$

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|  | 1. Realize the systems
2. Calculate the resulting plant model from the serial connection of the systems considered and store the result in Hs variable, simplify if it is possible
3. Calculate the resulting plant model from the parallel connection of the systems considered and store the result in Hp variable, simplify if it is possible
4. Place Hs in the forward loop and apply a negative feedback (-1 gain) and store the results in Hfs variable
5. Place Hs in the forward loop and Hp in the negative feedback loop and store the results in Hfp variable
6. Plot the step responses of Hp; and Hfs and Hfp for open and closed loop cases. Use lsim command with fs=1 kHz. Choose carefully the simulation time and the limits on y-axis
7. compare the different responses in one figure
8. estimate with the help of step response figures the static gain, rise time, settling time, peak-time, overshoot. Show clearly on your plot how you estimate the different quantities
9. Compare your results from 2) with the results of stepinfo command. Explain the differences. Use a table to compare the quantities
10. Define the characteristic function (polynomial) and loop (gain) function of Hfs and Hfp
11. Create Bode plot of Hfs and Hfp by bode command between $\left[10^{-4};10^{4}\right]\frac{rad}{sec} $with $10^{-3}\frac{rad}{sec}$ resolution.

Be very careful: transfer function you use should be not the closed loop but the open loop one (i.e. the loop (gain) function)1. compare the different Bode plots in one figure
2. *estimate with the help plots the static gain, time constants (which one is the dominant one), gain margin, phase margin, cross-over frequency. Show clearly on your plot how you estimate the different quantities. Provide the results both dB and magnitude, rad/sec and Hz values.*
3. Compare your results from 2) with the results of margin command. Explain the differences. Use a table to compare the quantities
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