Modelling and control summaries

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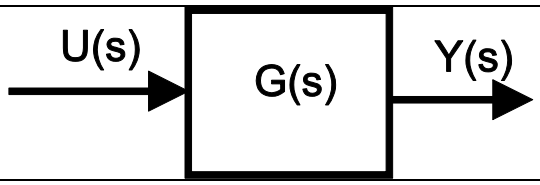
Behaviours 6 – Tutorial sheet 2

Assume that inferences about output behaviour Y(s) can be made be asolely on an analysis of transfer function G(s). Typically U(s) is assumed to be a step signal.	

Q1. Find the steady-states for signals with the following transforms.

$$V(s)=\frac{20}{s(2s+5)};$$

$$W(s)=\frac{-3}{s(s-2)};$$

$$X(s)=\frac{5}{(4s+0.1)(s+3)};$$

$$Z(s)=\frac{6}{s^2+0.1s+2};$$

$$H(s)=18\frac{s+4}{(s+2)(s+3)}$$

$$H(s)=0.5\frac{s+1}{(3s+2)s}$$

$$H(s)=2\frac{s+4}{s(s-3)}$$

Q2. The following first order models are excited by a unit step input. Find the corresponding steady-states for the outputs.

$$G_1(s)=\frac{20}{(s+5)};\quad G_2(s)=\frac{-3}{s+2};\quad G_3(s)=\frac{5}{(4s-0.1)};$$

Q3. A compensator H(s) and system G(s) are arranged in series. What is the steady-state output for a unit step input.

$$G=\frac{3}{s+4};\quad H=2\frac{s+5}{(s+1)(s+4)}$$

Q4. What is the difference between a Laplace transform and a transfer function. How does this impact on the possible uses of the final value theorem?

Q5. Which system settles fastest, and why?

$$G1=\frac{-3}{s+1};\quad G2=\frac{5}{6s+1};$$
$$G3=\frac{0.25}{s+0.01};\quad G4=\frac{2}{4s+6}$$

$$G1=\frac{56}{s+200};\quad G2=\frac{0.05}{0.05s+1};$$
$$G3=\frac{25}{s+1.5};\quad G4=\frac{2}{0.1s+60}$$

Q6. What is the link between pole positions and response times. Demonstrate this using a map of the pole positions in a complex plane.

Q7. What do LHP and RHP mean? Why are poles in the RHP undesirable in general? Why are poles on the imaginary axis undesirable in general?

Q8. Which of the following transfer functions must be stable.

$$\frac{8}{s+2};\quad \frac{8}{s^2+2s+1};\quad \frac{4(s-1)}{s^2+5s+6};\quad \frac{2(s+3)}{s^2-s-6};\quad \frac{2(s+3)}{s^3+2s^2-s-2}$$

Q9. Give some quick rules for spotting unstable poles.

Q10. Use MATLAB to plot and overlay the step responses for Q2,3,5 and Q8. Do these plots reinforce the answers you have given?

OUTLINE ANSWERS

Q1. 4, NA, 0, 0, 0, 0.25, NA

Q2. 4, -1.5, NA

Q3. 30/16

Q 4,6,7, 9. **Bookwork**

Q5, Follow the procedure from the previous tutorial. Find the pole positions, confirm stable or not. If stable estimate dominant time constant. Check your answers using MATLAB (impulse.m or step.m)

Q8: If you are unsure then use MATLAB functions roots.m or pzmap.m to find the pole positions. Any poles in the RHP means the system is unstable.

Q10. If you are not sure about this it is better to ask in a tutorial so we can unpick the cause of your confusion.