MTRE4002 Feedback Control Laboratory

Lab #1 System Response using MATLAB Control Toolbox

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Objective

In this lab, students are required to analyze the response of a control system using the MATLAB control toolbox and Simulink. Some basic MATLAB functions will be introduced to create a linear control system and find its response. Meanwhile, the instructor will show how to create a linear control system in Simulink step by step.

Background knowledge

1. Create a transfer function in MATLAB

   Example: $G(s) = \dfrac{3s+8}{s^2+2s+3}$

   MATLAB code:

```
num=[3  8];
den=[1   2  3];
G=tf(num,den);
```

2. Determine the poles and zeros of a transfer function

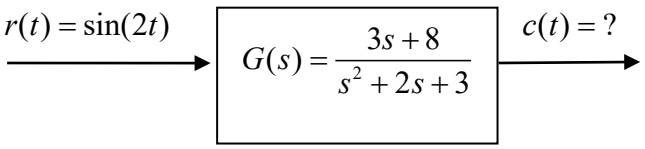
   MATLAB code:

```
pole(G)  //display the poles of the transfer function G
zero(G)  //display the zeros of the transfer function G
pzmap(G)  //plot the pole/zero map on the screen.
```

3. Find the step response of a control system
   MATLAB code:

```
step(G)  // get the step response of a control system represented by the
         transfer function of G
```

4. Simulate the system response to arbitrary inputs
   Example: please determine the system response for the following sinusoid input.



MATLAB code:

```
t=1:0.1:10;
r=sin(2*t);
num=[3  8];
den=[1  2  3];
G=tf(num,den);
c=lsim(G,r,t);
plot(t,r,t,c);
```

5. Generate a test input signal

MATLAB function: [r t]=gensig(type, T_p, T_f, T_s)

Where type='sin', 'square' or 'pulse'

T_p, the period of the signal

T_f, the time duration of the signal

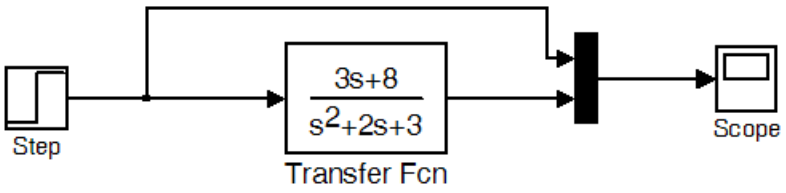
T_s, the spacing of the time samplings in t

Example:

```
% the following program shows how to create a square signal as the system
% input, and generate the corresponding response.
[r, t]=gensig('square', 20, 200, 1);
G=tf([3  8], [1  2  3]);
lsim(G, r, t);
```

6. Simulink model

Please follow the instructor step by step to create the Simulink model for the following system, and run the model to get the response curve.



Lab report requirements

For the following four systems,

$$G_1(s)=\frac{3s+8}{s^2+6s+5},\quad G_2(s)=\frac{3s+8}{s^2+9},\quad G_3(s)=\frac{3s+8}{s^2+2s+8},\quad G_4(s)=\frac{3s+8}{s^2-6s+8}$$

(1) Please use MATLAB to determine the poles, the zeros, the pole/zero map, and the step response curve of each system.
(2) For the system of $G_3(s)$, please use MATLAB to find its response curve corresponding to the input signal r(t)=sin(2t+0.8).
(3) For the system of $G_1(s)$, please use MATLAB to find its response curve corresponding to a **square** input signal with a period of 10 seconds and the time duration of 100 seconds.
(4) For the system of $G_3(s)$, please create a Simulink model to display its step response curve.

Please note:

- Each student needs to submit his/her independent lab report.
- You need to submit the MATLAB source codes, its running result and the output figures.
- You need to submit the Simulink model circuit and the response curves.