ECSE 307 Linear Systems and Control

Lab 4 Assignment

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1 Problem 1

For this question, we are exploring something about the equation below.

$$G(s) = \frac{1}{(s+1)(s+2)(s+3)} \tag{1}$$

1.1 Draw the step response of the function

Since we know $(s+1)(s+2)(s+3) = x^3 + 6x^2 + 11x + 6$. To find the step response, the following MATLAB code is implemented.

```
G = tf([1], [1, 6, 11, 6]);
step(G);
```

The graph is shown as follow:

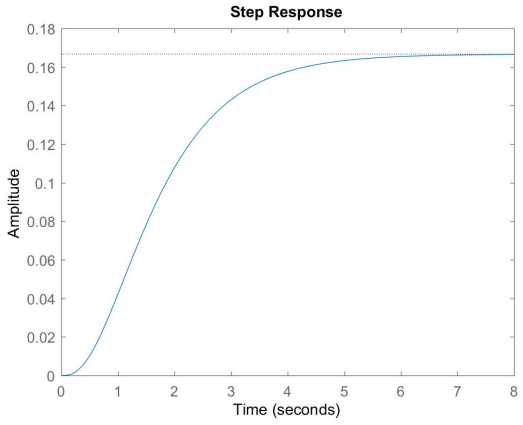

Figure 1: The step response of the function

1.2 The step function information of this system

1.3 Values for the steady state error, rise time, settling time and overshoot

1.4 Root locus of the open loop system

1.5 The gain and the frequency of at the marginal stability

1.6 The proportional controller

Using the following code, we can add the proportional controller.

```
C_P = pid(40);
open_loop = series(C_P, G);
H1 = feedback(open_loop, 1);
hold on;
figure;
step(H1);
stepinfo(H1);
```

1.7 The drawbacks and benefits of using proportional controller

1.8 The derivative controller

Using the following code, we can add the derivative controller.

```
C_PD = pid(40, 0, 30);
open_loop_PD = series(C_PD, G);
H2 = feedback(open_loop_PD, 1);
hold on;
figure;
step(H2);
stepinfo(H2);
```

1.9 The characteristics can be improved and the benefits of adding derivative controller

1.10 Keep the proportional controller and add the integral controller

Using the following code, we can keep the proportional controller and add the integral controller.

```
C_PD = pid(40, 10, 0);
open_loop_PD = series(C_PI, G);
H3 = feedback(open_loop_PI, 1);
hold on;
figure;
step(H3);
stepinfo(H3);
```

1.11 The characteristics can be improved and the benefits of adding integral controller

1.12 Analysis about Kp

1.13 PID controller

Using the following code, we can use P, I and D controller together.

```
C_PD = pid(19, 12, 8);
open_loop_PD = series(C_PID, G);
H5 = feedback(open_loop_PID, 1);
hold on;
figure;
step(H5);
stepinfo(H5);
```

2 Problem 2