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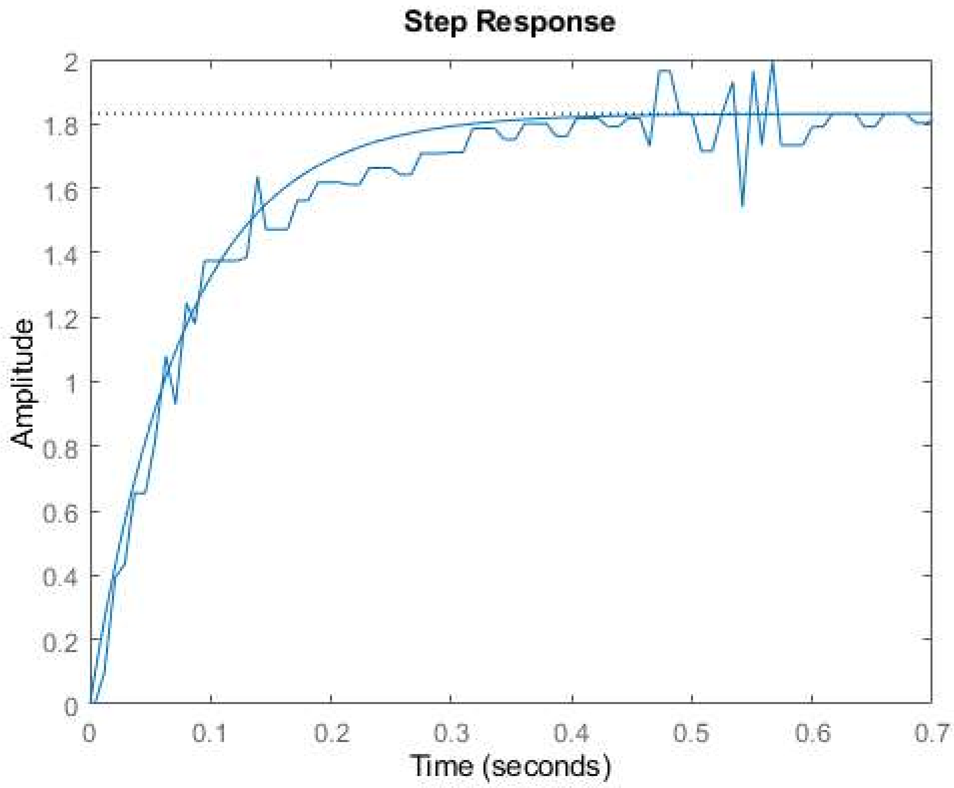
```
%%Mini Project Script
```

OPEN LOOP STEP RESPONSE EXPERIMENT

Read the values from the step response experiment and put them into an excel file.

```
X =xlsread('controllerdata');

%I only wanted the 3rd and 4th collumns because that was were I was
%printing time and angular velocity
Xnew = X(:,3:4);
figure(1)
plot(Xnew(:,1)/1000, Xnew(:,2)/7.5)
K = 13.74/7.5; %divided by 7.5 because that is the magnitude of the step
sigma = 1/.078;%0.78 was found by looking at the graph to determine when
                %the graph hit .64K
sys = tf([K*sigma], [1 sigma])%this is the equivalent first order system

hold on
step(sys)
```

```
sys =

    23.49
  ---------
  s + 12.82

Continuous-time transfer function.
```

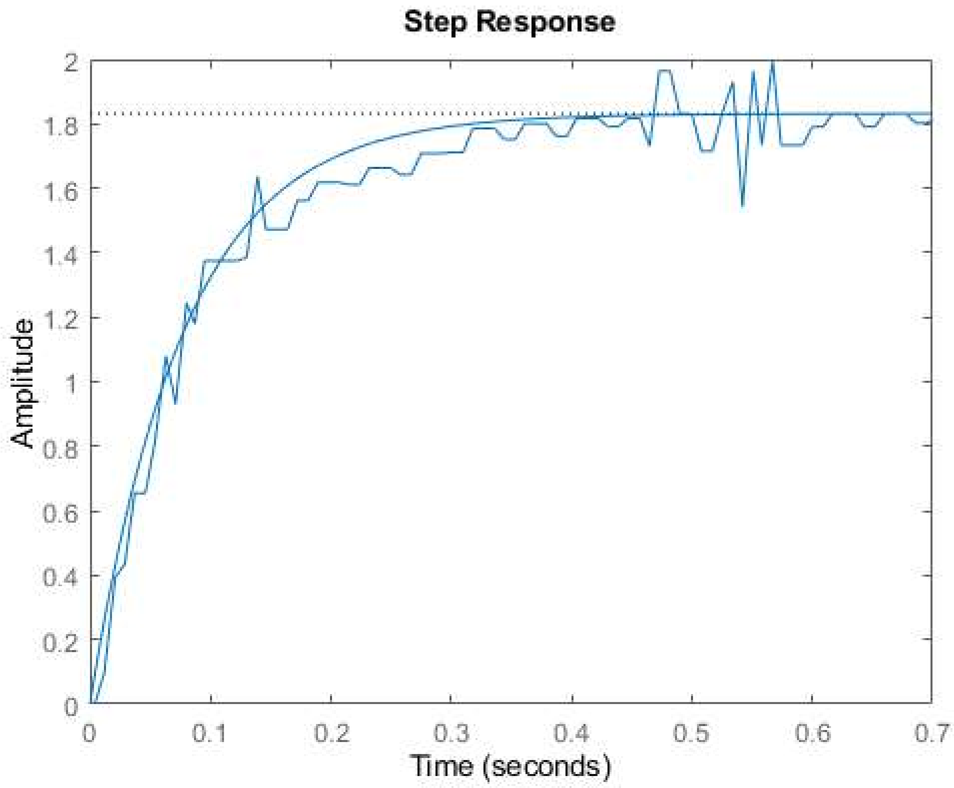


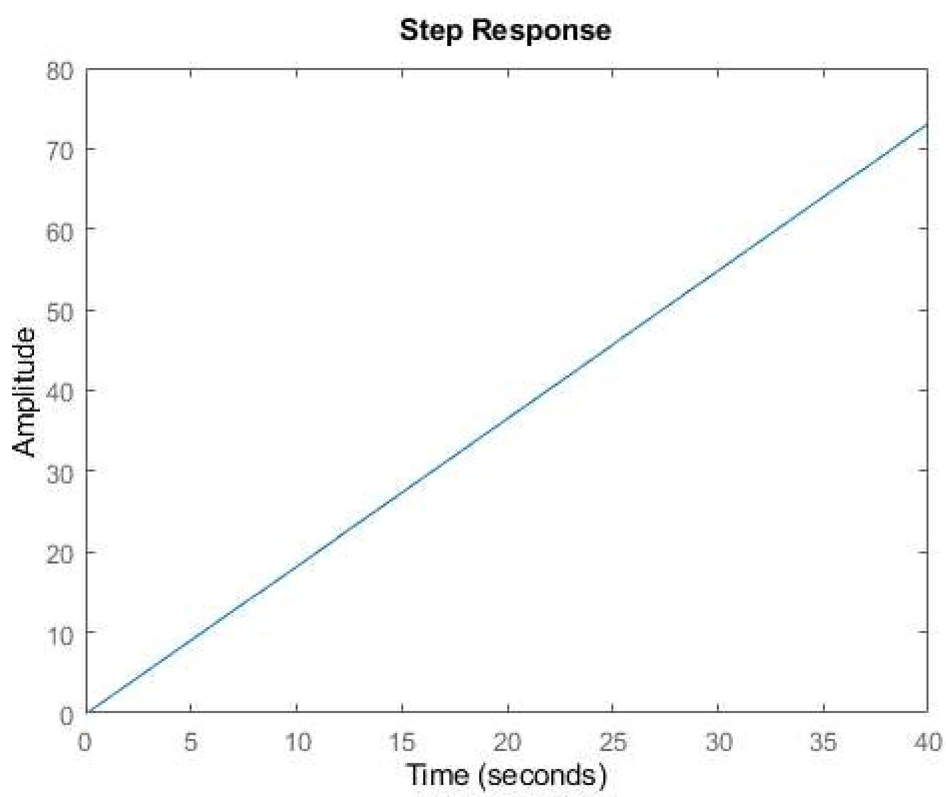
CLOSED LOOP STEP RESPONSE

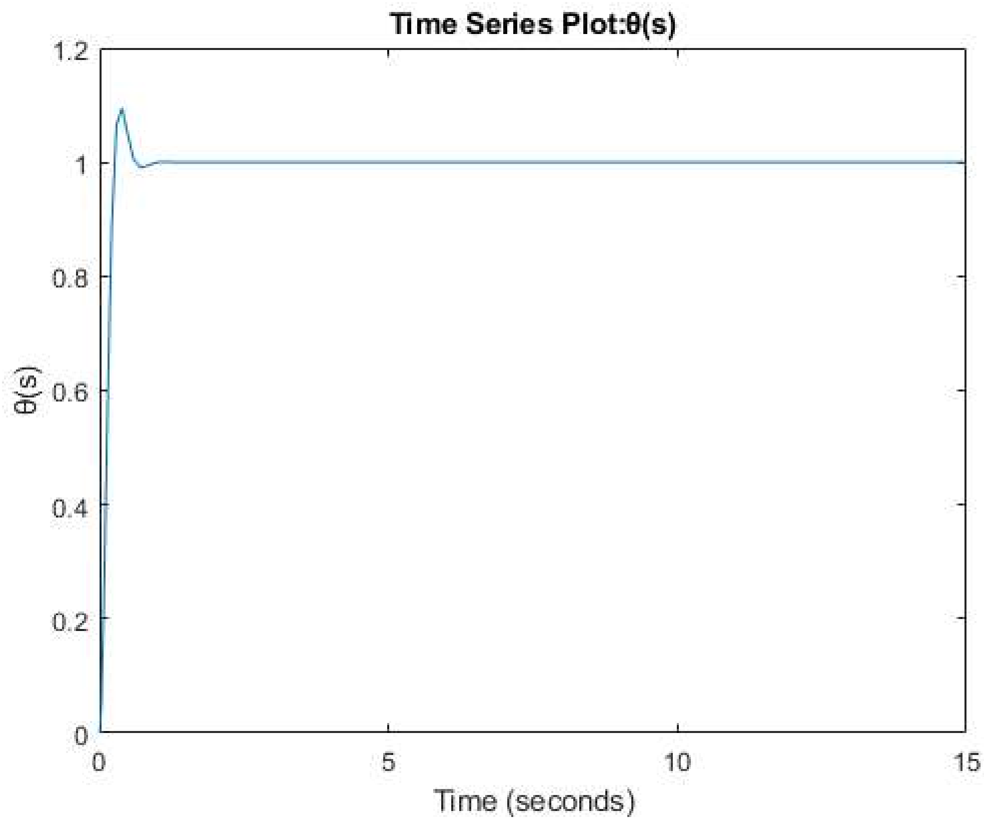
```
%Once again I am storing my data into the same excel file for the closed
%loop step response.
%I only wanted the 5th and 6th collumns because that was were I was
%printing time and angular position.
Y = X(:,5:6);

%Since this is a step response experiment I will set the desired position
%to be one radian.

%the closed loop transfer function follows the following model which is the
%open loop transfer function multiplied by 1/s since we are now interested
%in angular position rather that angular velocity

sys2 =tf([K*sigma], [1 sigma 0])

%from here I built a simulink model with a PI controller to control the
%plant of our motor. With specifications of 1 second rise time less than
%12% overshoot and steady state error of zero, I used the controll tuner
%until I meet all of the requirements in order to do this I have found that
%Kp =5 and Ki = 0;


open_system('miniProjectModel');

%run the simulation
out=sim('miniProjectModel');

%this is the simulated closed loop step response without the controller
figure(2)
title('Angular Position Step Response');
step(sys2)
```

```
%this is the closed loop step resopnse with the controller.
figure(3)
title('Controlled Angular Position Step Response');
plot(out.position)

%in order to compare the results between the simulated and the experimental
%step response I have included the plot of both the simulated and
%experimental data on the same plot

figure(4)

plot(out.position);
hold on
plot(Y(:,1)/1000, Y(:,2));

%the differences in the graphs can be attributed to the fact that the
%simulation assumes that any  voltage can be applied between the controller
%and plant, but in reality we can only apply a maximum of 7.5 volts at a time
%so our step response does not overshoot as simulated. However the end position is the
%same and it still meets all design requirements.
```

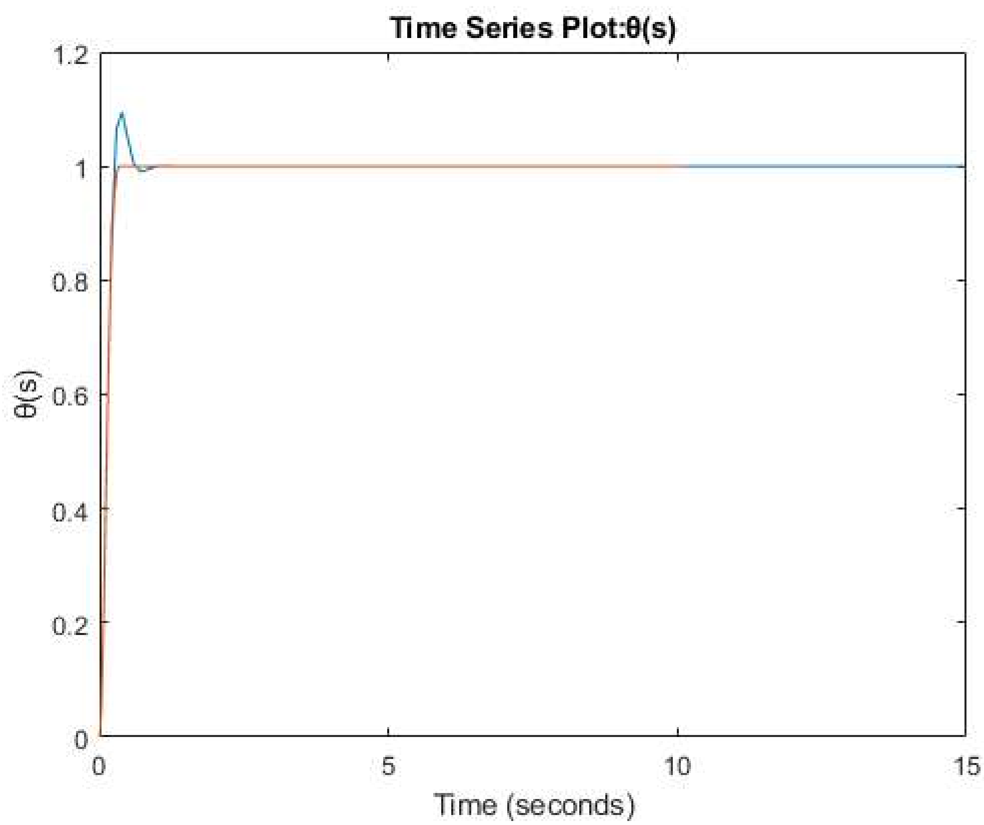
```
sys2 =

      23.49
  -------------
  s^2 + 12.82 s

Continuous-time transfer function.
```


Step Response
Amplitude
Time (seconds)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
0.1
0.2
0.3
0.4
0.5
0.6
0.7


Step Response
Amplitude
Time (seconds)
0
10
20
30
40
50
60
70
80
5
10
15
20
25
30
35
40



Time Series Plot:θ(s)
θ(s)
Time (seconds)



Time Series Plot:θ(s)
θ(s)
Time (seconds)