Motor Control Mini Project Documentation

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Group 10

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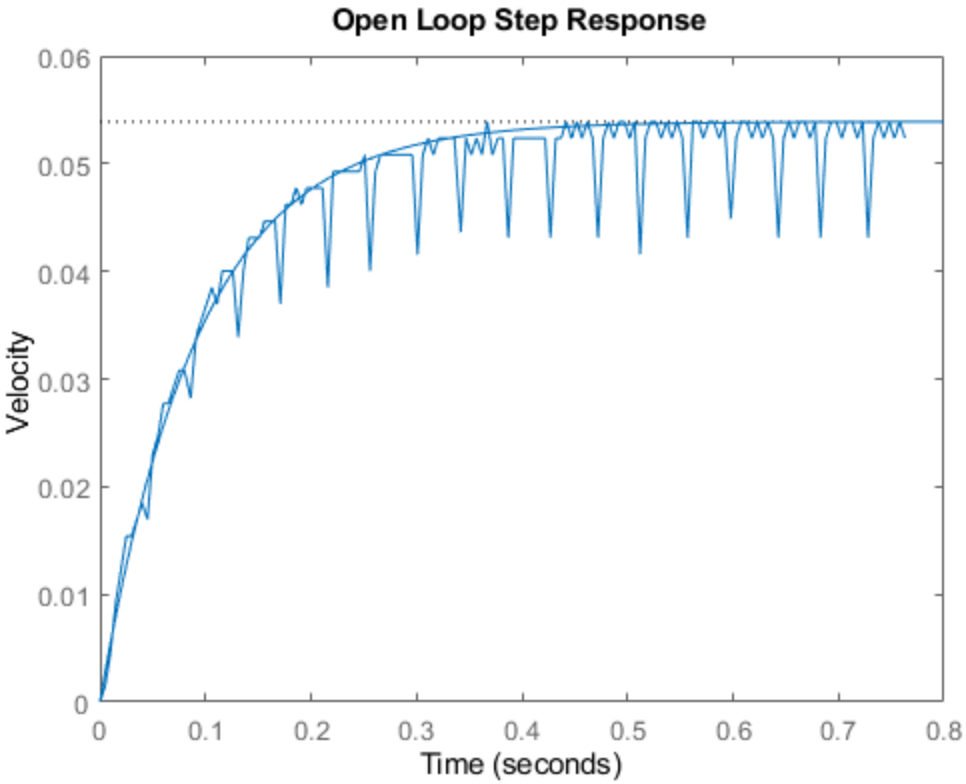
Open Loop Step Response

Graphs the experimental step response and the estimated transfer function step response.

```
%experimental
[V,T,VT] = xlsread('StepResponse.xlsx');
t = V(:,5);
y = V(:,4);

plot(t,y)

%transfer function
K = 0.0539;
sigma = 10.75;
sys = tf(K*sigma, [1  sigma]);

hold on
step(sys)
xlim([0 0.8])
xlabel('Time')
ylabel('Velocity')
title('Open Loop Step Response')
hold off

open_system('openLoop')

% The step response of the estimated transfer function traces the
% general shape of the experimental data so should be accurate
% when tuning the PI controller.
```

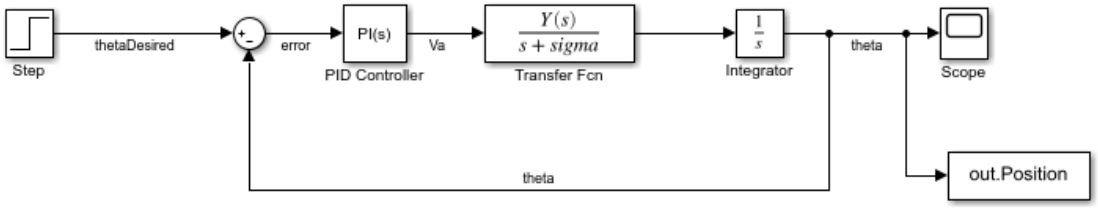


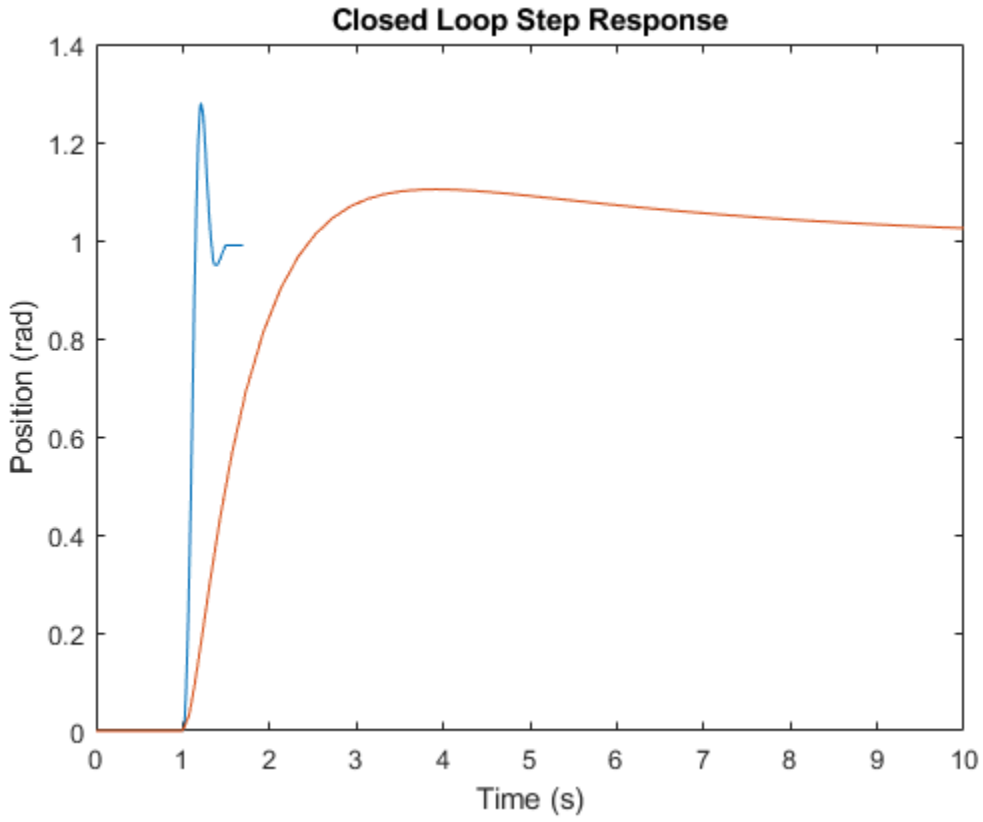
Closed Loop Step Response

Graphs the experimental step response and the estimated transfer function with a PI controller step response.

```
%experimental
[W,R,WR] = xlsread('StepResponse.xlsx');
x = (W(:,21) + 1);
v = W(:,18);

plot(x,v)
xlabel('Time (s)')
ylabel('Position (rad)')
title('Closed Loop Step Response')

%transfer function
out = sim('PIcontrol');
hold on
plot(out.Position)
hold off

open_system('PIcontrol')

% The experimental step response is much quicker than the simulated
% response, which causes additional overshoot and a quicker rise time.
% This is most likely due to the voltage of the battery being lower
```

```
% when we collected data on the open loop step response. The steady
% state error is not affected and is approximately 0.
```





Controller Design

Once the transfer function was estimated using the open loop step response, the closed loop system was created in Simulink. The proportional and intergral gain were tuned using the built-in tuning function. The design in Simulink has an overshoot of 10.4% and a rise time of 0.981 seconds, meeting the design specifications.

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