ME 419 Solar Tracking Panel Control Term Project

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Class: ME419

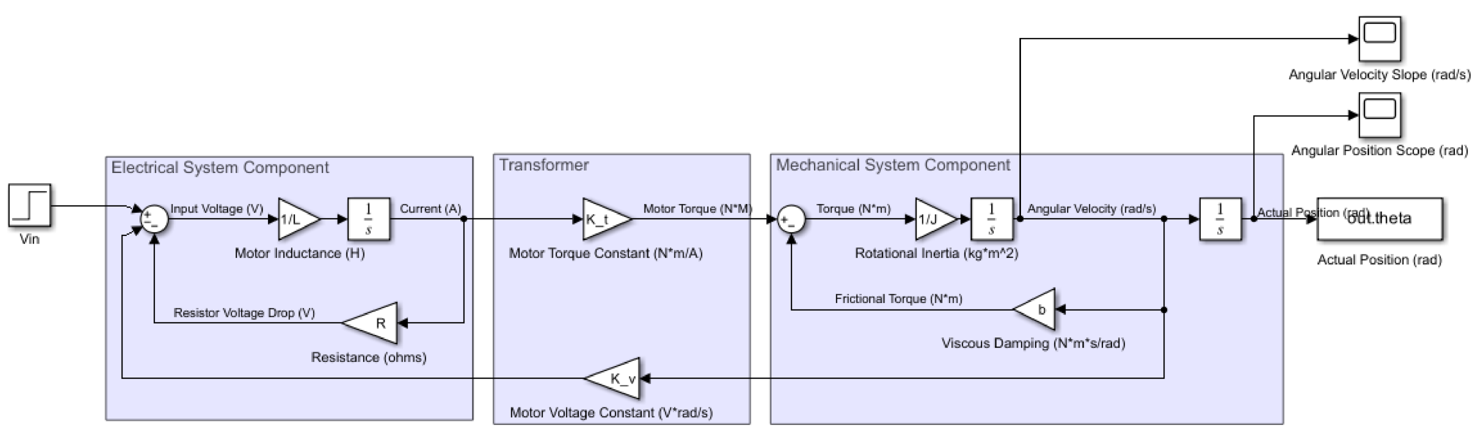
Description: The purpose of this file is to simulate the control of a solar tracking solar panel to compare to experimental behaviors found with testing.

System Properties

```
% Visous damping coefficient
b               = 10;            % [N*m*s/rad]
% Winding resistance
R               = 1;             % [Ω]
% Winding inductance
L               = 0.078e-3;      % [H]
% Rotor inertia
Jmotor          = 9.82e-7;       % [kg*m^2]
%Panel inertia
Jpanel          = 5;             % [kg*m^2]
%Total inertia
J               = Jmotor+Jpanel;  % [kg*m^2]
% Motor torque constant
K_t             = 5;             % [N*m/A]
% Motor voltage constant
K_v             = 5;             % [V*sec/rad]
% Radian to voltage conversion factor
K_c             = 1/(0.5*pi());   % [V/rad]
```

Block Diagram

```
snapshotModel('ME419TermProj') %output simulink image
```



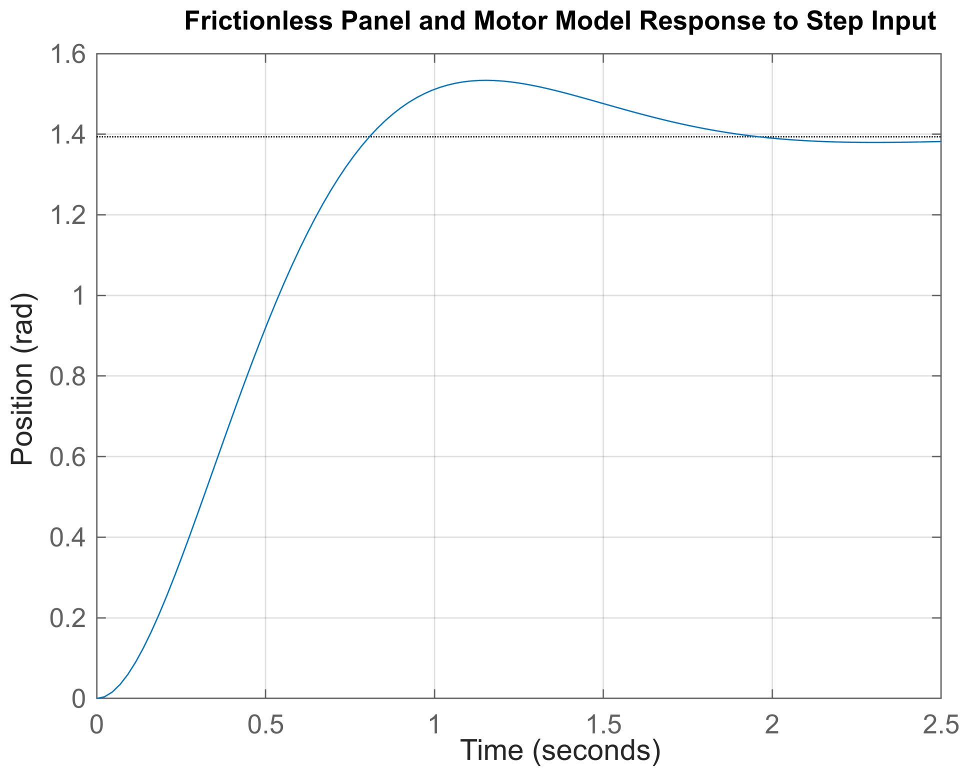
Frictionless Simulation

```
%Input A,B,C, and K matricies
```

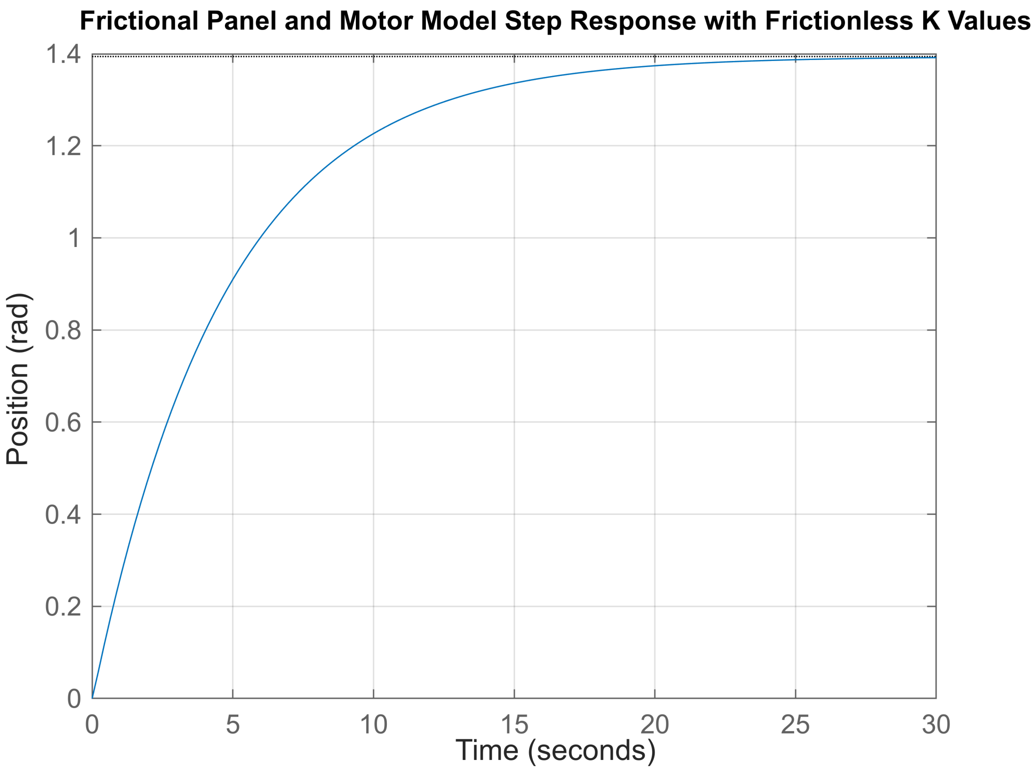
```
b = 0;

K1 = [11.42 -121.01];

A_new_1 = [0                1
    -(K1(1,1))      -(((R*b + K_v^2)/R*J)+K1(1,2))];

B = [0
     1];

C = [((K_v*K_c)/R*J) 0];

D = [0];

sys1_tf = tf(((K_v*K_c)/R*J),[1 ((R*b + K_v^2)/R*J) 0])
```

```
sys1_tf =

     15.92
  -----------
  s^2 + 125 s

Continuous-time transfer function.
Model Properties
```

```
sys1 = ss(A_new_1,B,C,D);

figure;
step(sys1)
xlabel("Time");
ylabel("Position (rad)");
title('Frictionless Panel and Motor Model Response to Step
Input','FontSize',10,'FontWeight','bold');
grid on
```




```
%now try to simulate the system with friction using the K values calculated
%for the frictionless system
b = 10;
K2 = [11.42 -121.01];

A_new_2 = [0              1
    -(K2(1,1))      -(((R*b + K_v^2)/R*J)+K2(1,2))];

sys2 = ss(A_new_2,B,C,D);
step(sys2)
xlabel("Time");
ylabel("Position (rad)");
title('Frictional Panel and Motor Model Step Response with Frictionless K
Values','FontSize',10,'FontWeight','bold');
grid on
```



Friction Simulation

```
%now reintroduce friction
%Input Anew,B,C, and K matricies
K3 = [11.42 -171.01];

A_new_3 = [0              1
    -(K3(1,1))      -(((R*b + K_v^2)/R*J)+K3(1,2))];

B1 = [0
     1];

C1 = [((K_v*K_c)/R*J) 0];

D1 = [0];

sys3_tf = tf(((K_v*K_c)/R*J),[1 ((R*b + K_v^2)/R*J) 0])
```

```
sys3_tf =

      15.92
  -----------
  s^2 + 175 s

Continuous-time transfer function.
Model Properties
```

```
sys3 = ss(A_new_3,B1,C1,D1);
```

```
figure;
step(sys3)
xlabel("Time");
ylabel("Position (rad)");
title('Panel and Motor Model with Friction Response to Step
Input','FontSize',10,'FontWeight','bold');
grid on
```