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```
function Schur_HW6_3
close all;

theta=2.5;
k=[5 2];
m=0.5;
g=9.81;
e3=[0 0 1]';

gamma=[1 1 1];

X0=[1; -1; 0; 2; -1; 1; 0];
N=501;
t=linspace(0,20,N);

[t, X]=ode45(@eom,t,X0);

p = X(:,1:3);
v = X(:,4:6);
theta_hat = X(:,end);

for i=1:N
    u(i,:) = control(t(i), X(i,:));
end

figure;plot(t,p);ylabel('x'); xlabel('t')
title('Position vs. time'); legend('p_1', 'p_2', 'p_3');
figure;plot(t,v);ylabel('v','interpreter','latex'); xlabel('t')
title('Velocity vs. time'); legend('v_1', 'v_2', 'v_3');
figure;plot(t,u);ylabel('u'); xlabel('t')
title('Control Input vs. time'); legend('u_1', 'u_2', 'u_3');
figure;plot(t,theta_hat);ylabel('$\hat{\theta}$','interpreter','latex'); xlabel('t')
title('Estimated theta vs. time');

end

function X_dot=eom(t,X)
theta=2.5;
m=0.5;
g=9.81;
e3=[0 0 1]';
gamma=[1 1 1];

p=X(1:3);
v = X(4:6);
theta_hat = X(end);

u=control(t,X);

p_dot=v;
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v_dot = g*e3 + u/m - theta/m*sat(v);
theta_hat_dot=gamma*p;

X_dot=[p_dot; v_dot; theta_hat_dot];
end

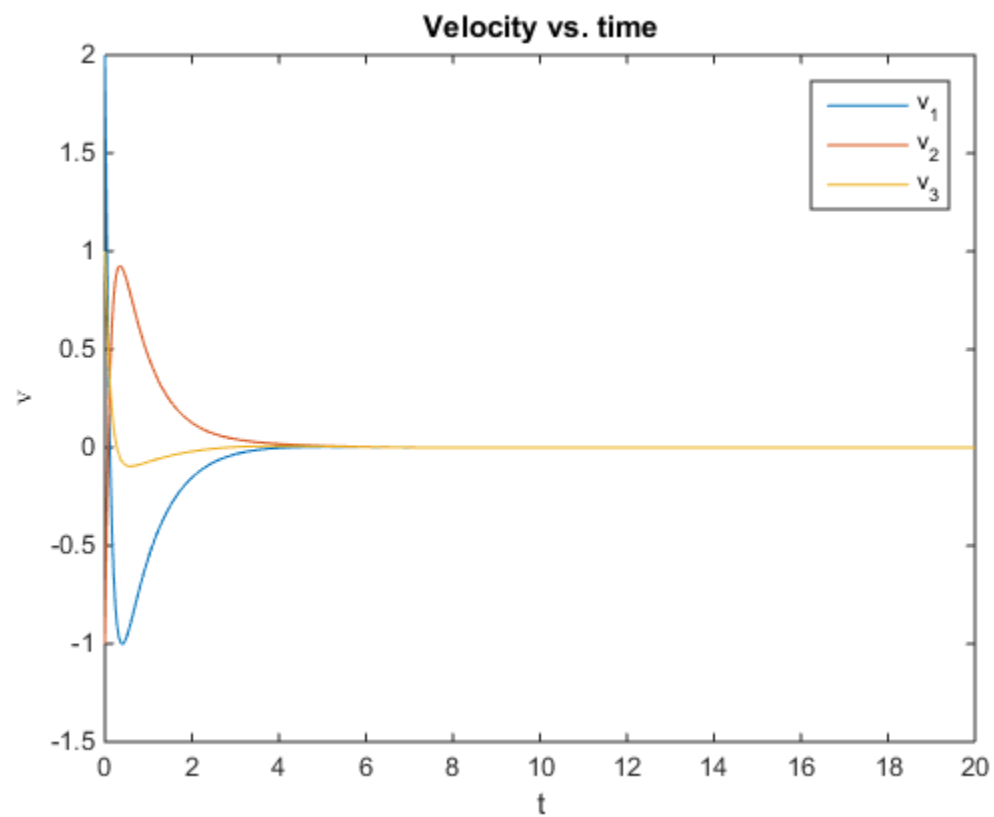
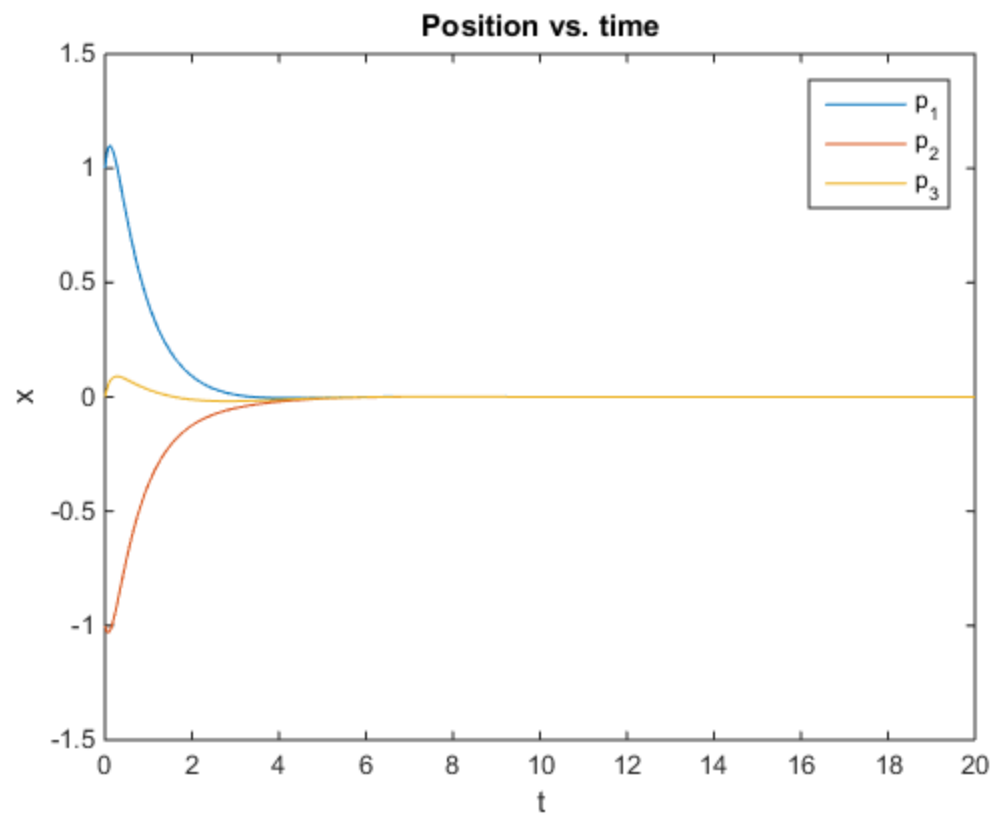
function u=control(t,X)
k=[5 2];
m=0.5;
g=9.81;
e3=[0 0 1]';

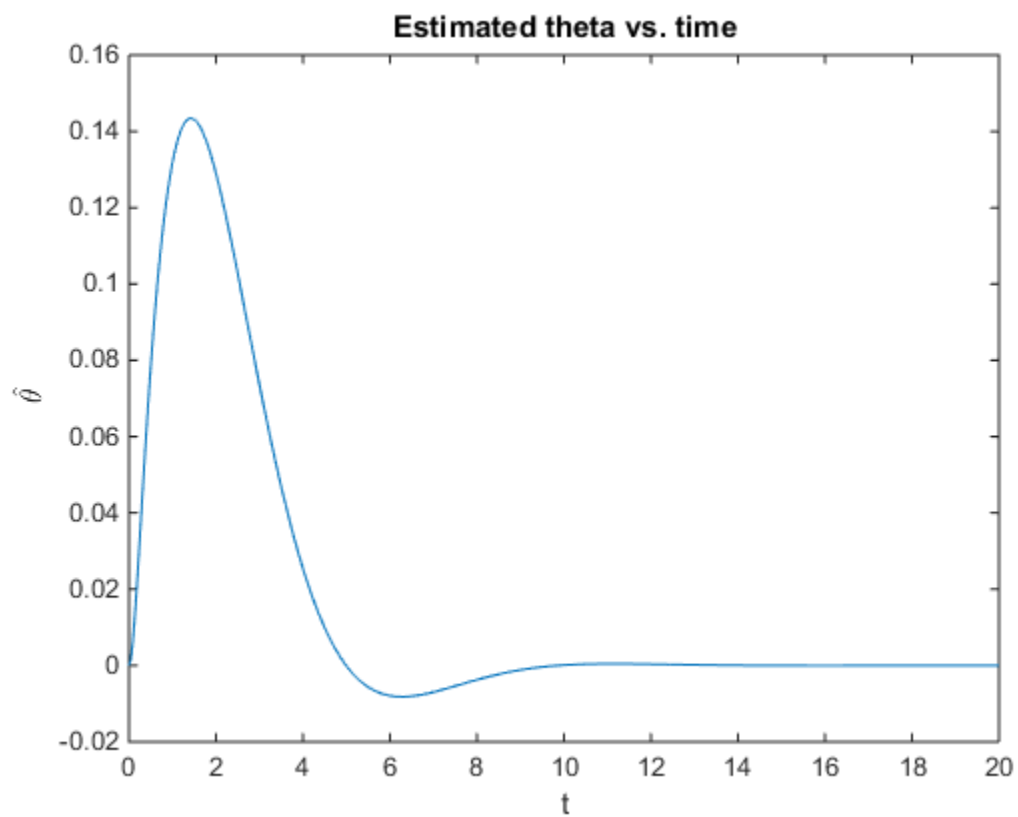
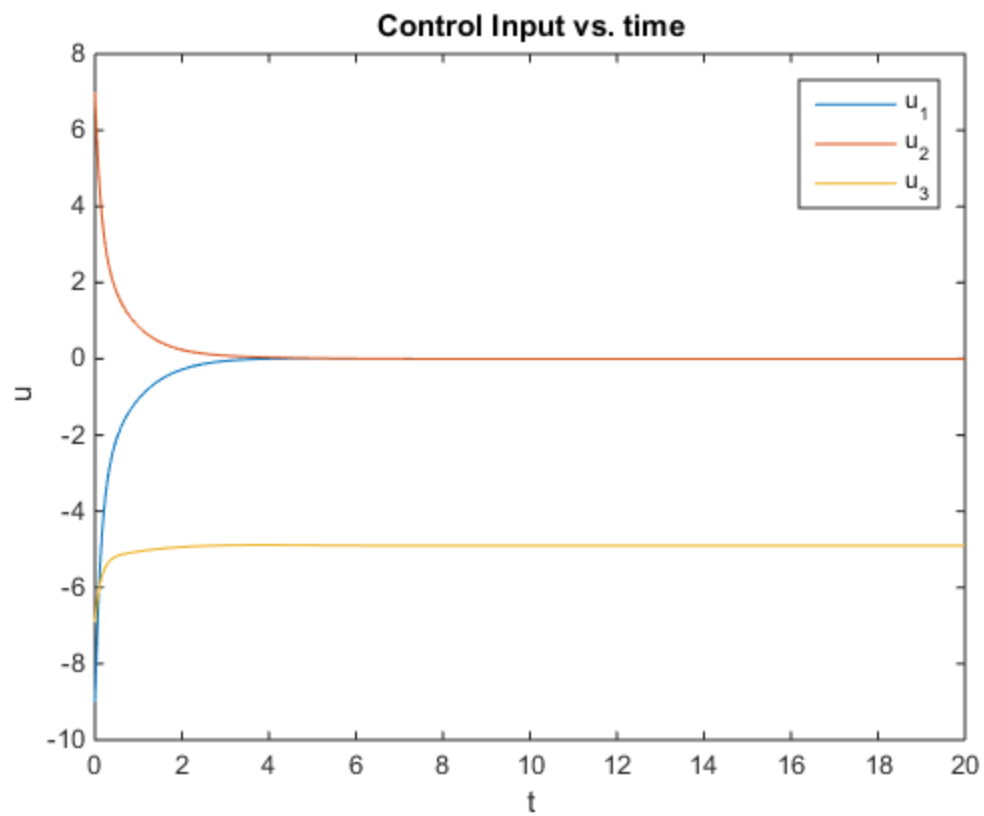
p=X(1:3);
v = X(4:6);
theta_hat=X(end);

u=-k(1)*p - k(2)*v - m*g*e3 - theta_hat;
end

function s = sat(z)
    s = zeros(size(z));
    for ii=1:size(z,1)
        if z(ii) >=1
            s(ii) = 1;
        elseif z(ii) <=-1
            s(ii) = -1;
        else
            s(ii) = z(ii);
        end
    end
end

end
```





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*Published with MATLAB® R2014b*