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## MAE5903 - HW#4 Part 1 Switching Controller

```
function HW4P1_ab()  
  
% Given  
m = 1;  
alpha1_lims = [4 6];  
alpha2_lims = [1 2];  
dlims = [-1 1];  
omega_avoid = 4.2;      % (rad/s)  
eta = [1 10];  
  
% Choose parameters  
alpha1_hat = mean(alpha1_lims);  
alpha2_hat = mean(alpha2_lims);  
d_hat = mean(dlims);  
lambda = 2*pi*omega_avoid/3;  
  
tspan = [0 6];  
X0 = [1; 0];  
for i = 1:length(eta)  
  
    [t,X] = ode45(@switchingEOM,tspan,X0,  
    [],m,alpha1_hat,alpha2_hat,d_hat,eta(i),lambda);  
    x1 = X(:,1);  
    xd = 2*sin(t);  
    x1_tilde = x1 - xd;  
    % Calc s and phi again (I haven't found a better way to do this  
    yet)  
    for j = 1:length(t)  
        [~,s(j),u(j)] =  
switchingEOM(t(j),X(j,:),m,alpha1_hat,alpha2_hat,d_hat,eta(i),lambda);  
    end
```

## Plots

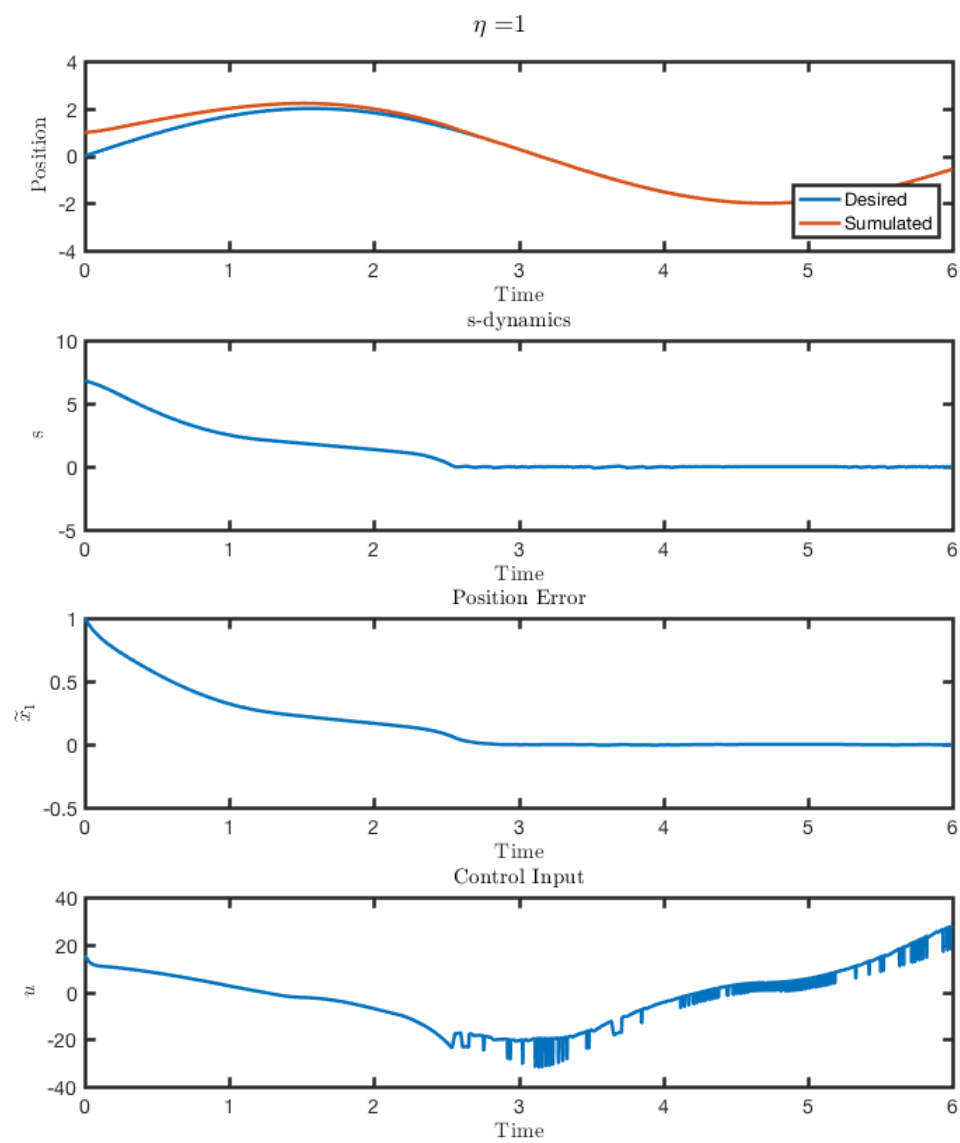
```
fh = figure(i);  
set(fh,'Position',[0 0 799 1089])  
suptitle(['$\eta = $' num2str(eta(i))]);  
% Dynamics  
subplot(411)  
plot(t,xd,t,x1)  
legend('Desired','Sumulated','location','southeast')  
xlabel('Time'); ylabel('Position');
```

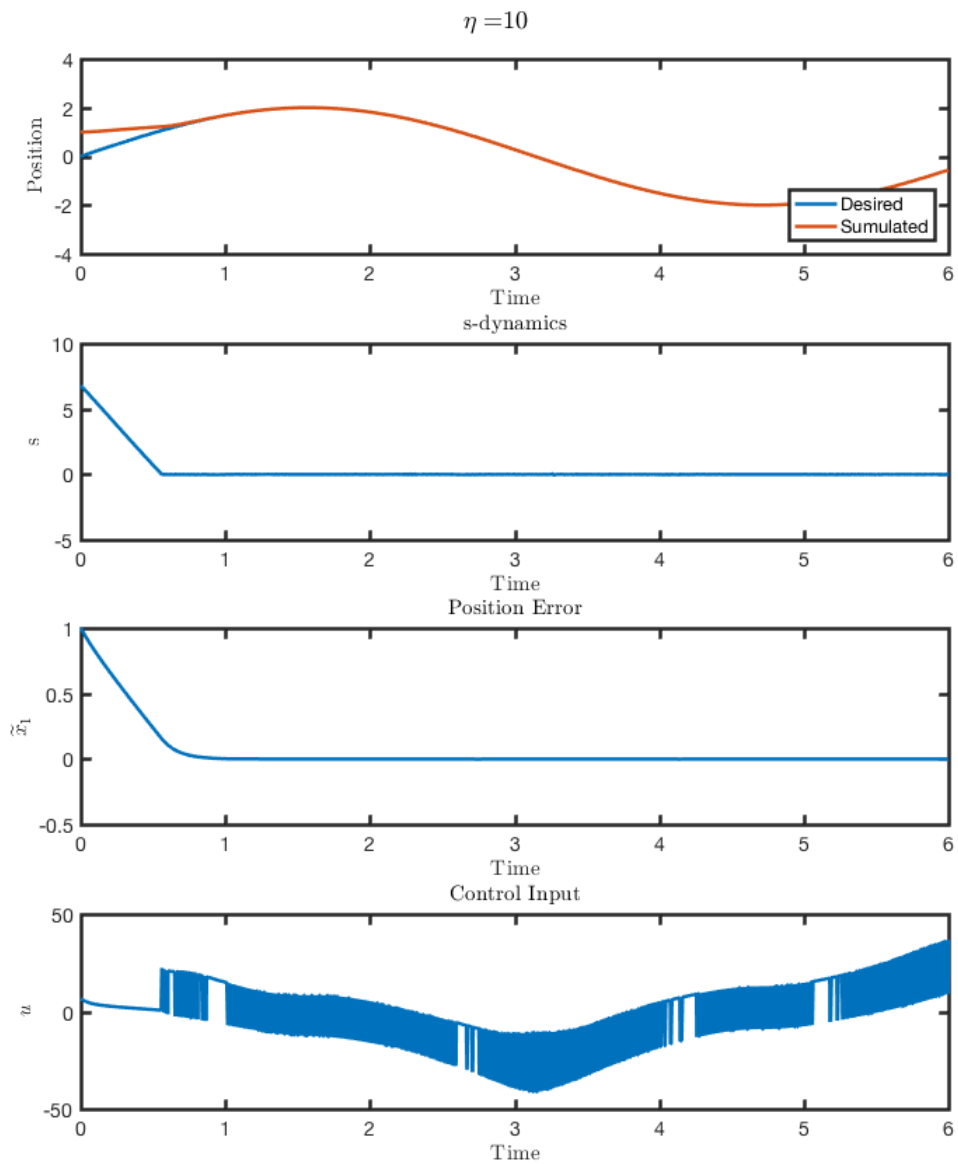
---

```
subplot(412)
plot(t,s)
title('s-dynamics')
xlabel('Time'); ylabel('s');

% Error Plot
subplot(413)
plot(t,x1_tilde);
title('Position Error')
xlabel('Time'); ylabel('$\widetilde{x}_1$');

% Control Input
subplot(414)
plot(t,u);
title('Control Input')
xlabel('Time'); ylabel('$u$');
```





```
end
end
```

## EOM

```
function [dx, s, u] =
    switchingEOM(t,x,m,a1_hat,a2_hat,d_hat,eta,lambda)
dx = zeros(size(x));
x1 = x(1);
x2 = x(2);
xd = 2*sin(t);
```

---

```
xd_dot = 2*cos(t);
xd_dd = -2*sin(t);

a1 = 5 + cos(t);
a2 = 1 + abs(sin(2*t));
d = cos(1.3*t);
f = (-1/m)*((a1 + a2*cos(x1)^2)*abs(x2)*x2 + d);
b = 1/m;
f_hat = (-1/m)*((a1_hat + a2_hat*cos(x1)^2)*abs(x2)*x2 + d_hat);
F = abs(f-f_hat);
k = F + eta;
s = x2 - xd_dot + lambda*(x1-xd);
u = -f_hat + xd_dd - lambda*(x2-xd_dot) - k*sign(s);

dx(1) = x2;
dx(2) = f + b*u;
end
```

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