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MAE5903 - HW#4 Part 1 Switching Controller

```
function HW4P1_ab()
```

Given Values

```
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;
```

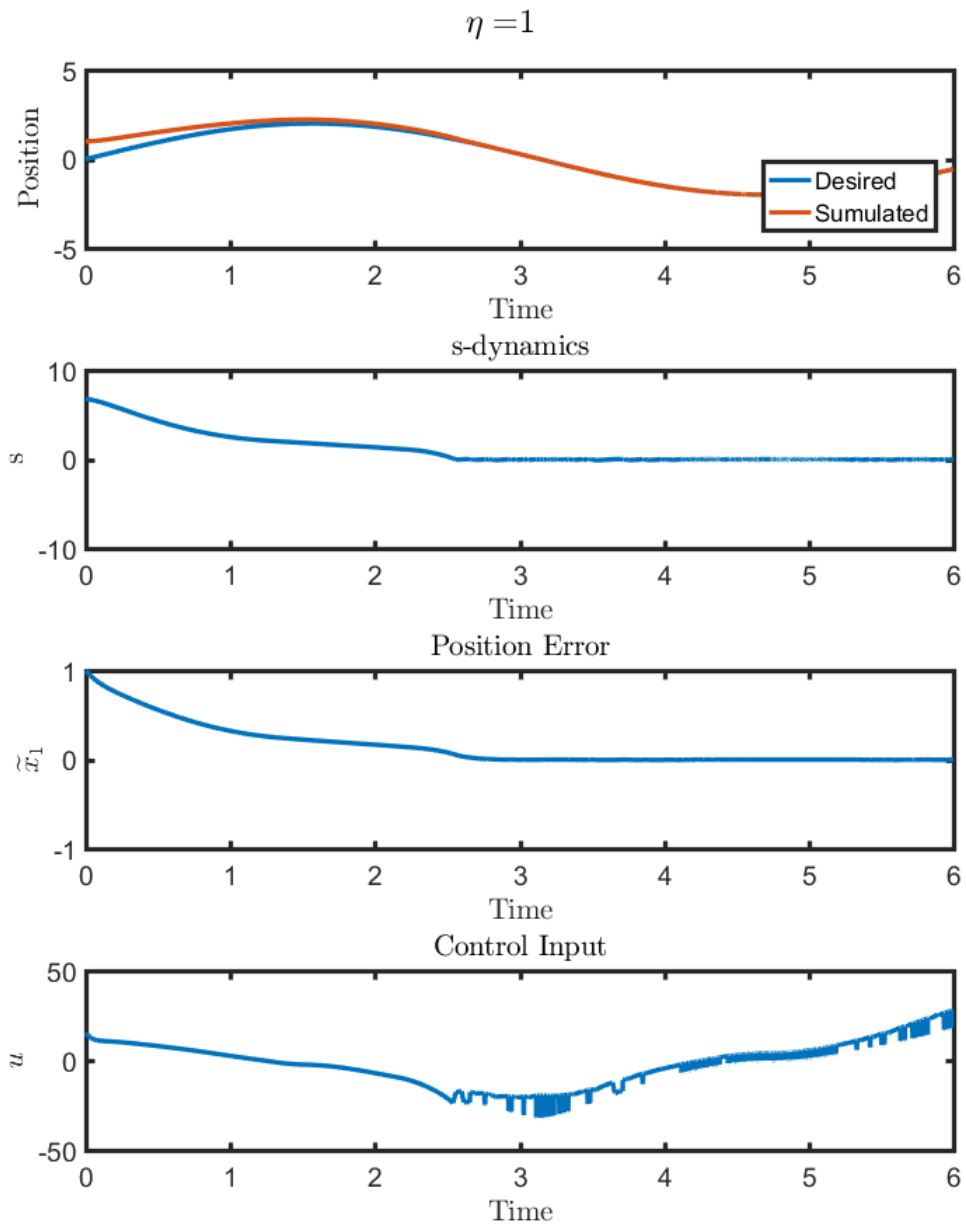
Integrate

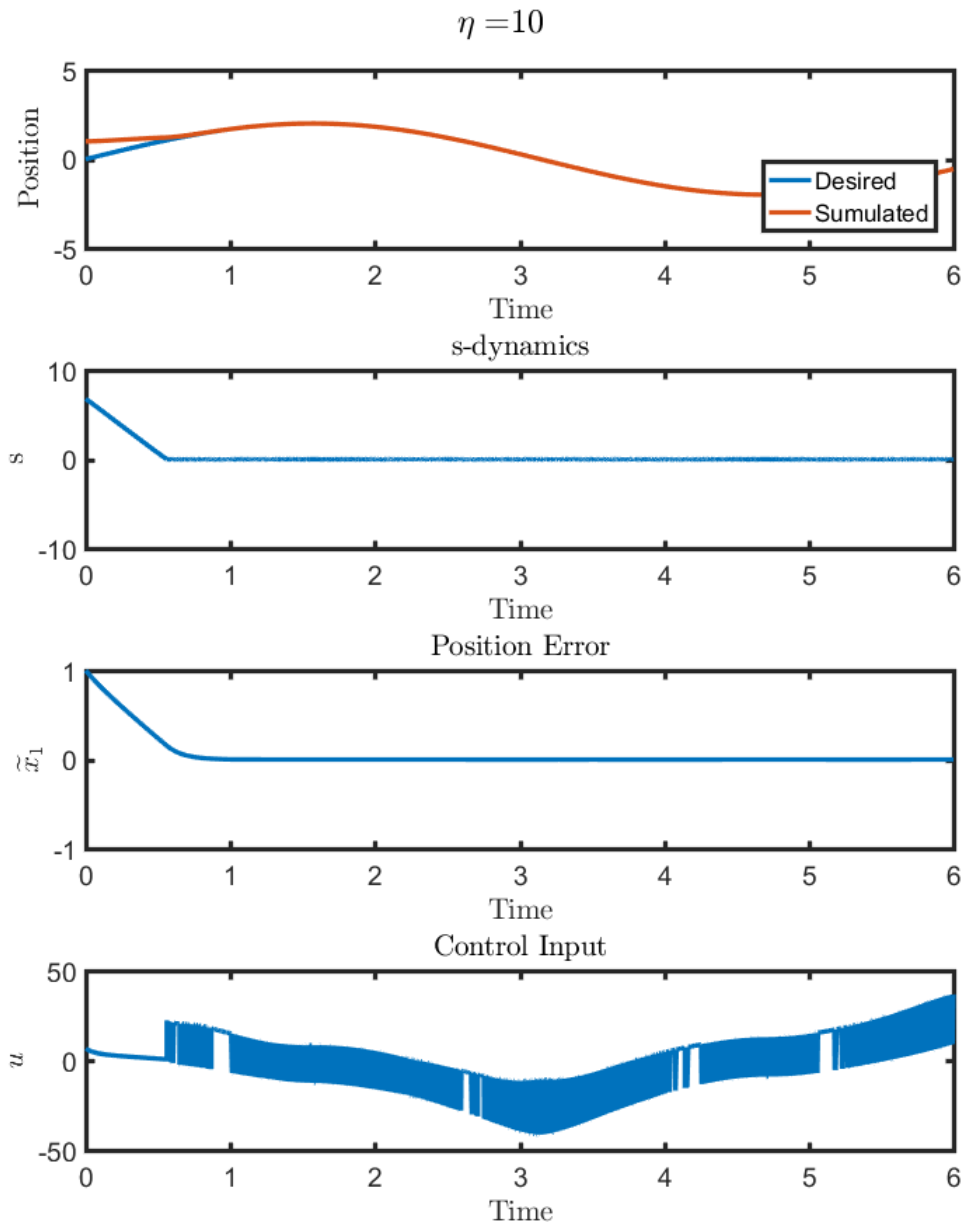
```
tspan = [0 6];
X0 = [1; 0];
for i = 1:length(eta)

    [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 = $' num2str(eta(i))]);
% Dynamics
subplot(411)
plot(t,xd,t,x1)
legend('Desired','Sumulated','location','southeast')
xlabel('Time'); ylabel('Position');
% s-Dynamics
subplot(412)
plot(t,s)
title('s-dynamics')
xlabel('Time'); ylabel('s');
% Error Plot
subplot(413)
plot(t,x1_tilde);
title('Position Error')
xlabel('Time'); ylabel('$\widetilde{x}_1$');
% Control Input
subplot(414)
plot(t,u);
title('Control Input')
xlabel('Time'); ylabel('$u$');
```


$\eta = 1$
Position
Desired
Sumulated
Time
s-dynamics
s
Time
Position Error
$\widetilde{x}_1$
Time
Control Input
u
Time




```
end

end
```

Equation of Motion

```
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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