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Lab 2 Prep

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```
% Workspace Init
close all
clear all
clc
```

Underdamped Fitting

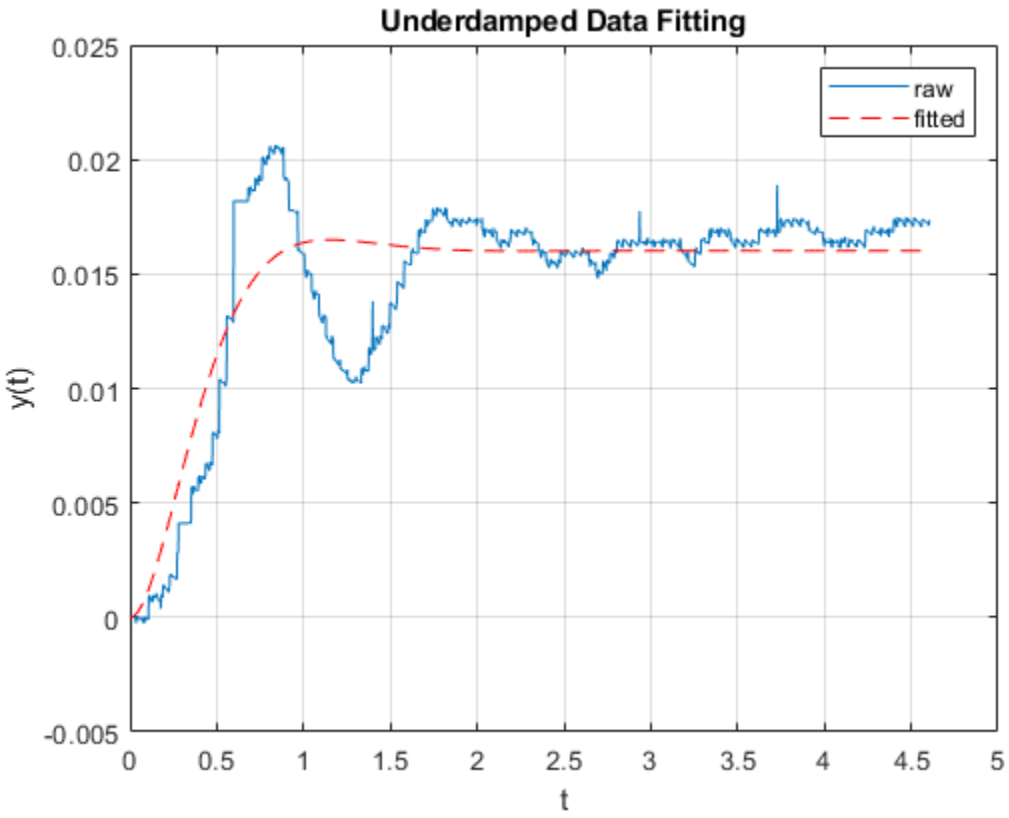
This section loads our step response lab data and fits and underdamped curve to this data, control parameters can then be calculated from this

```
% Data load and manipulation
load("attempt5.mat")
t_under = sensor_v.Time(15574:end)-sensor_v.Time(15574);
y_under = (sensor_v.Data(15574:end)-sensor_v.Data(15574))*.025;


% function handle
UD_function = @(params, t) params(3).*(1- (exp(-
params(1)*params(2)*t) .*( cos((params(2) .*sqrt(1-params(1)^2))*t) +
(params(1)/sqrt(1-params(1)^2)) .*sin((params(2).*sqrt(1-params(1)^2))*t))));

% Init Parameters
UD_init=[0.25,3.5,20];

% perform curve fitting
coeff_UD = lsqcurvefit(UD_function,UD_init,t_under,y_under, [], []);
% fit model
y_UD=UD_function(coeff_UD,t_under);

% plot
plot(t_under,y_under)
hold on;
plot(t_under,y_UD,'r--')
```

```
xlabel('t');
ylabel('y(t)');
title('Underdamped Data Fitting')
legend('raw','fitted')
grid on;
```

Local minimum possible.

lsqcurvefit stopped because the final change in the sum of squares relative to
its initial value is less than the value of the function tolerance.



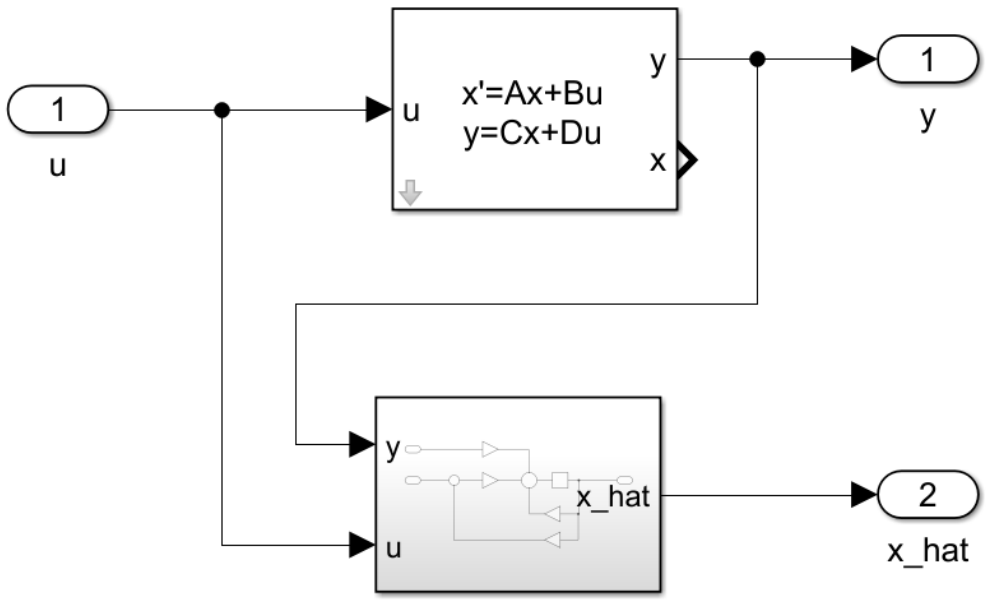
Controller Design

```
% Pull Calculated Parameters
zeta = coeff_UD(1);
w_n = coeff_UD(2);
K = coeff_UD(3);

% State space matrices
A = [0 1; -w_n^2 -2*zeta*w_n];
B = [0; 1];
C = [1, 0];
D = 0;
```

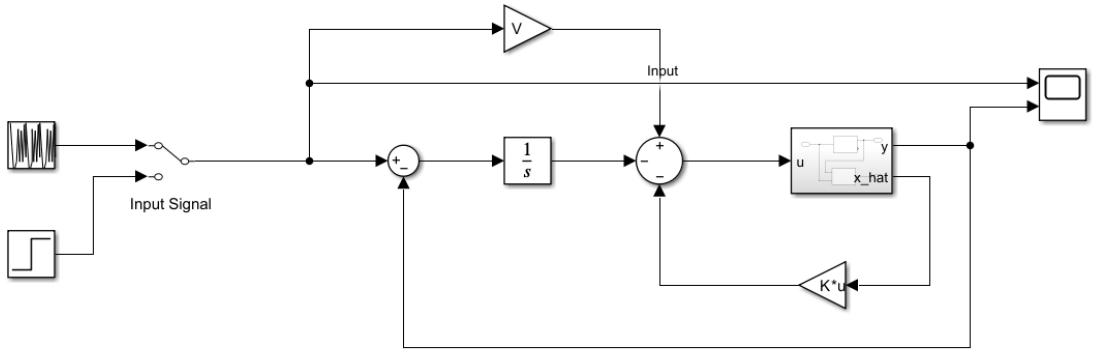
```
% Settling Time
t_s = 4/(zeta*w_n);

% Pole Placement
s1 = complex(-15, 3);
s2 = complex(-15, -3);
poles = [s1, s2];

% Gain calculation
K = acker(A,B,poles);

% Prefilter Calc
V=-1/(C*inv(A-B*K)*B);

% Observor Poles
Pl=0.2*poles;
L=acker(A',C',Pl)';

% Init X
x_init = [0 0];
```

Simulink Models

Linearized System

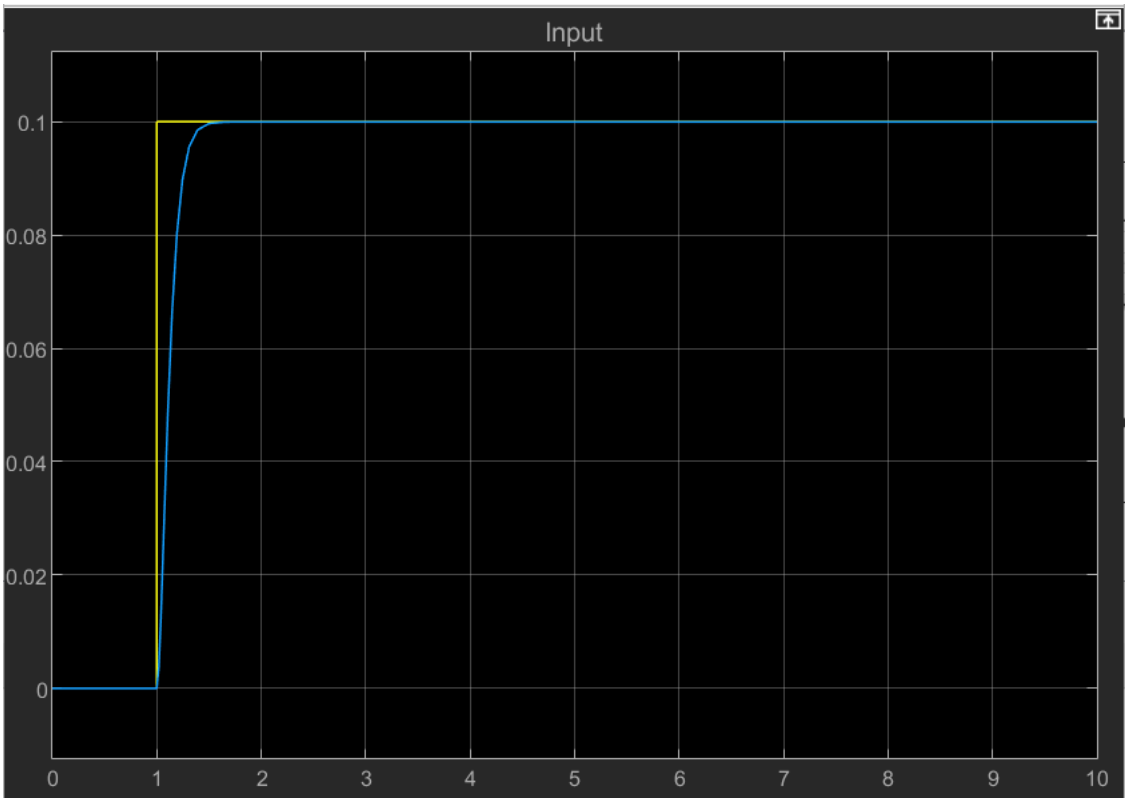


Observer

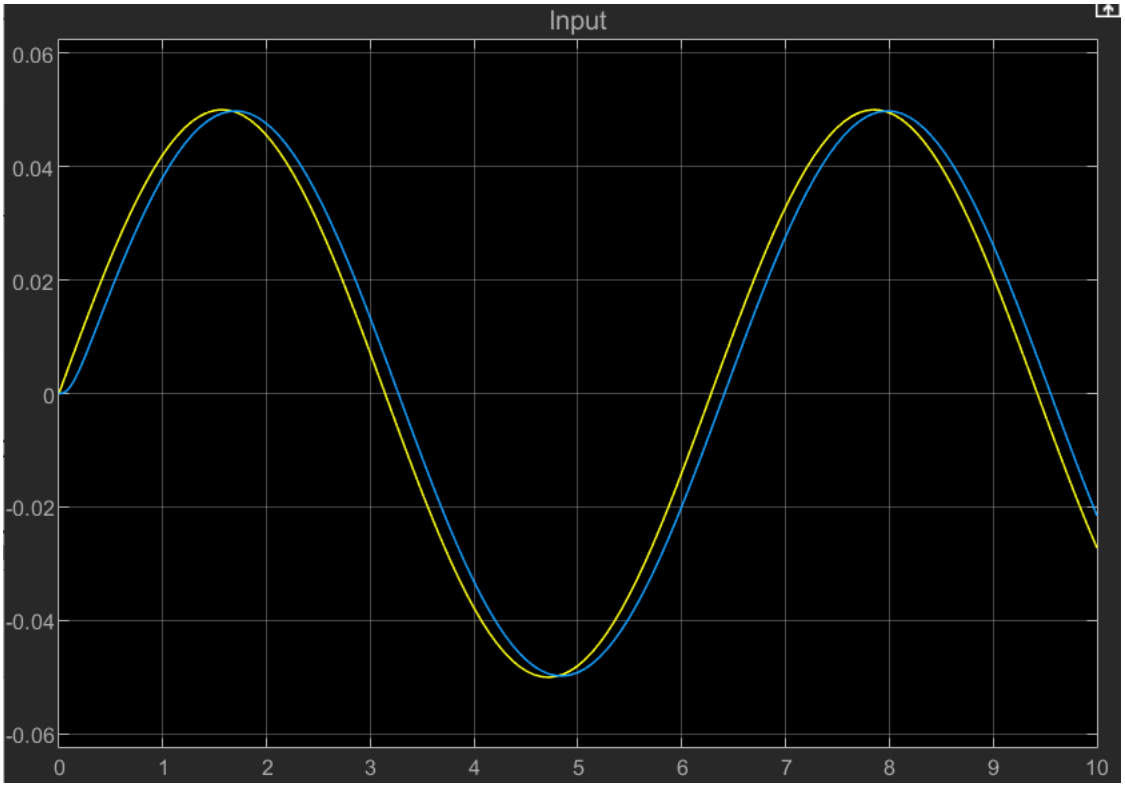


System Response

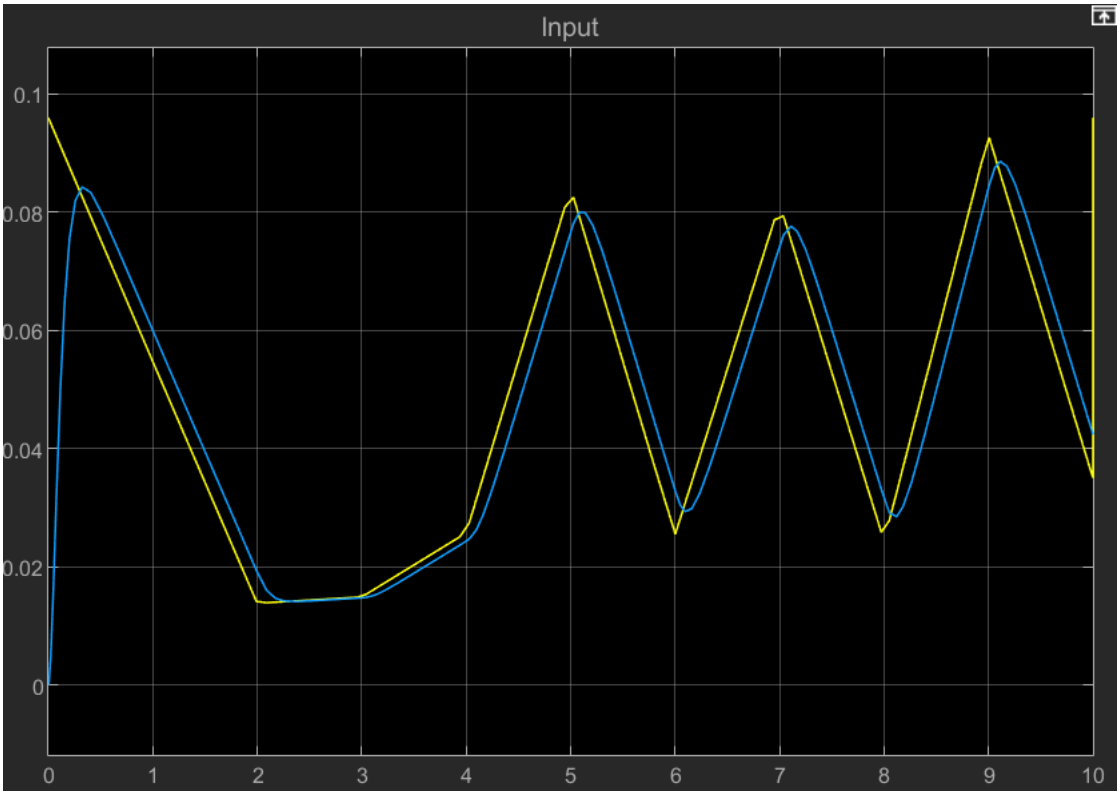
Step Response



Sin Wave Response



Random Signal Response



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