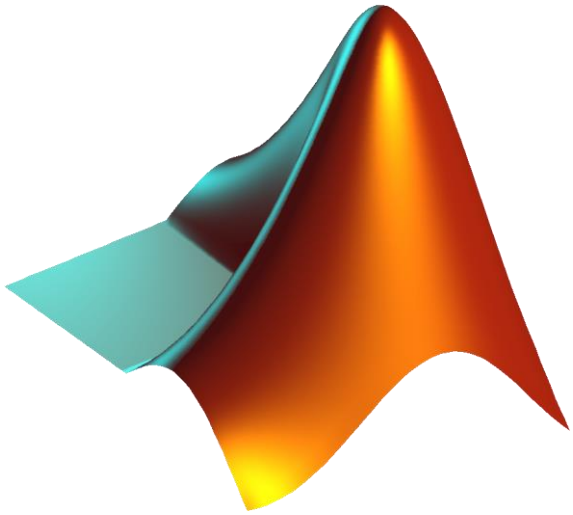
MATLAB PROJECT



Power Method
Least Squares Fitting
PID Controller & GUI

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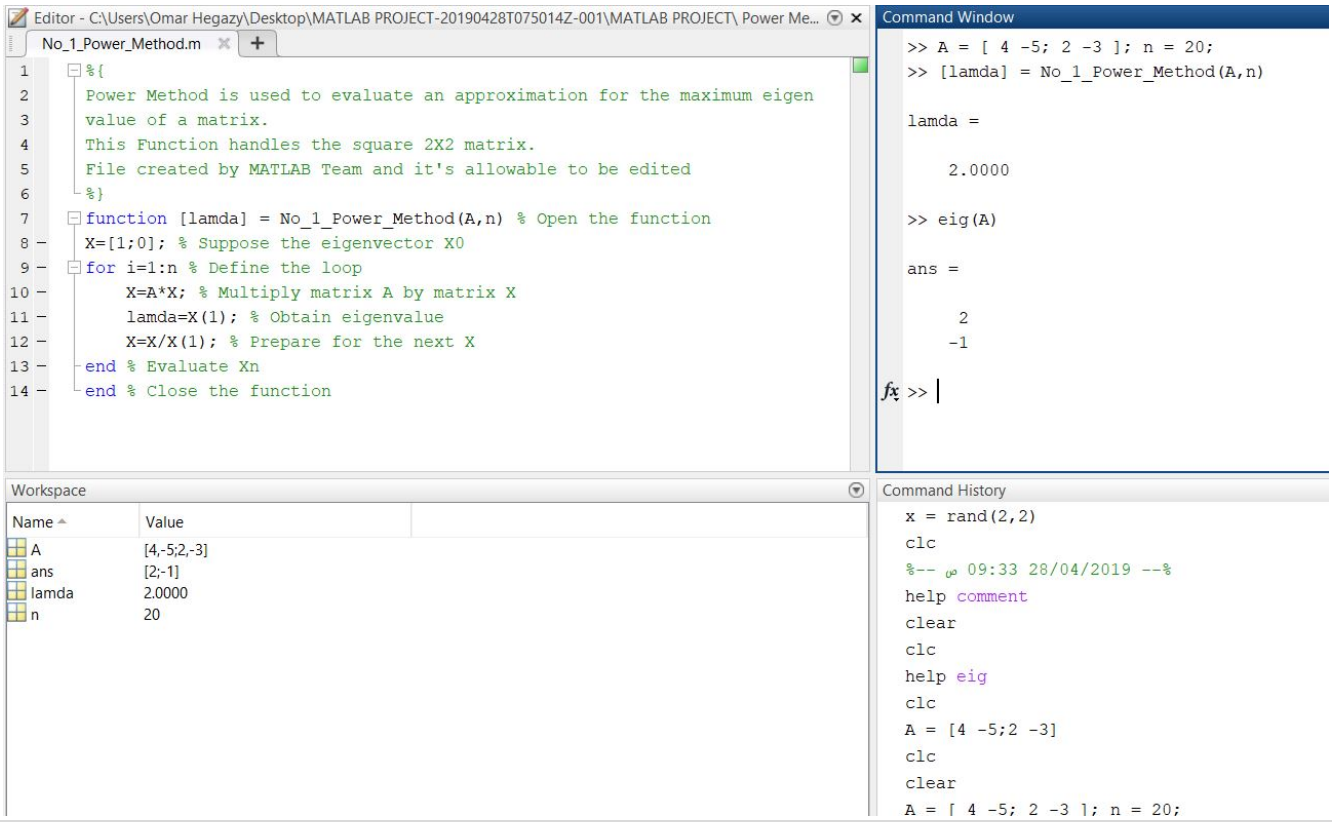
Part 1 | PROGRAMMING

A-Power Method

The Source Code:

```
%{
Power Method is used to evaluate an approximation for the
maximum eigen
value of a matrix.
This Function handles the square 2X2 matrix.
File created by MATLAB Team and it's allowable to be
edited
%}
function [lamda] = No_1_Power_Method(A,n) % Open the
function
X=[1;0]; % Suppose the eigenvector X0
for i=1:n % Define the loop
    X=A*X; % Multiply matrix A by matrix X
    lamda=X(1); % Obtain eigenvalue
    X=X/X(1); % Prepare for the next X
end % Evaluate Xn
end % Close the function
```

Code Test with eig() function:



B-Least Squares Fitting

The Source Code:

```
%{
Least Squares Method 'or Linear Least Squares Regression'
is used to fit
a dependent variable 'y for example' equal to some
functions of the
independent variables'x & u & v for example'.
the functions are : y1=a0+a1*x1+a2*u1+a3*v1
                    y2=a0+a1*x2+a2*u2+a3*v2
                    y3=a0+a1*x3+a2*u2+a3*v3
                    ........................
                    yn=a0+a1*xn+a2*un+a3*vn
in matrix form :
X = [1,x1,u1,v1 ; 1,x2,u2,v2 ; ..... ; 1,xn,un,vn]
a = [a0 ; a1 ; a2 ; a3]
Y = [y1 ; y2 ; ..... ; yn]
This Function fits y equal to a function of x only to
obtain a line
equation that has two constants (a0 & a1) in the 'a'
matrix that can be
evaluated by the equation : a = inv(X'*X)*X'*Y
File created by MATLAB Team and it's allowable to be
edited
%}
function [a0,a1]=No_2_Least_Squares_Method(x,y)
X = [ones(length(x),1) x]; %first column treated as all
ones since x_1=1
Y = y; %column vector for proper dimension during
multiplication
a = inv(X'*X)*X'*Y;  % Least Squares Estimator -
equivalent code X\y
plot ( x , y , '*'); % original data
a0=a(1);%intersection of the line
a1=a(2);%slope of the line
hold on;
plot( x , a0+a1*x , 'r-' ); %Fitted line
legend('Data',['y=' num2str(a0) '+' num2str(a1) 'x'])
xlabel('X values');
ylabel('Y values');
end
```

Code Test with Plot Diagram:

Editor - C:\Users\Omar Hegazy\Desktop\MATLAB PROJECT-20190428T075014Z-001\MATLAB PROJECT\ ...

No_1_Power_Method.m | No_2_Least_Squares_Method.m

```
1   %{...%}
19  function [a0,a1]=No_2_Least_Squares_Method(x,y)
20  X = [ones(length(x),1) x]; %first column treated as all ones since x
21  Y = y; %column vector for proper dimension during multiplication
22  a = inv(X'*X)*X'*Y;  % Least Squares Estimator - equivalent code X\y
23  plot ( x , y , '*'); % original data
24  a0=a(1);%intersection of the line
25  a1=a(2);%slope of the line
26  hold on;
27  plot( x , a0+a1*x , 'r-' ); %Fitted line
28  legend('Data',['y=' num2str(a0) '+' num2str(a1) 'x'])
29  xlabel('X values');
30  ylabel('Y values');
31  end
```

Workspace

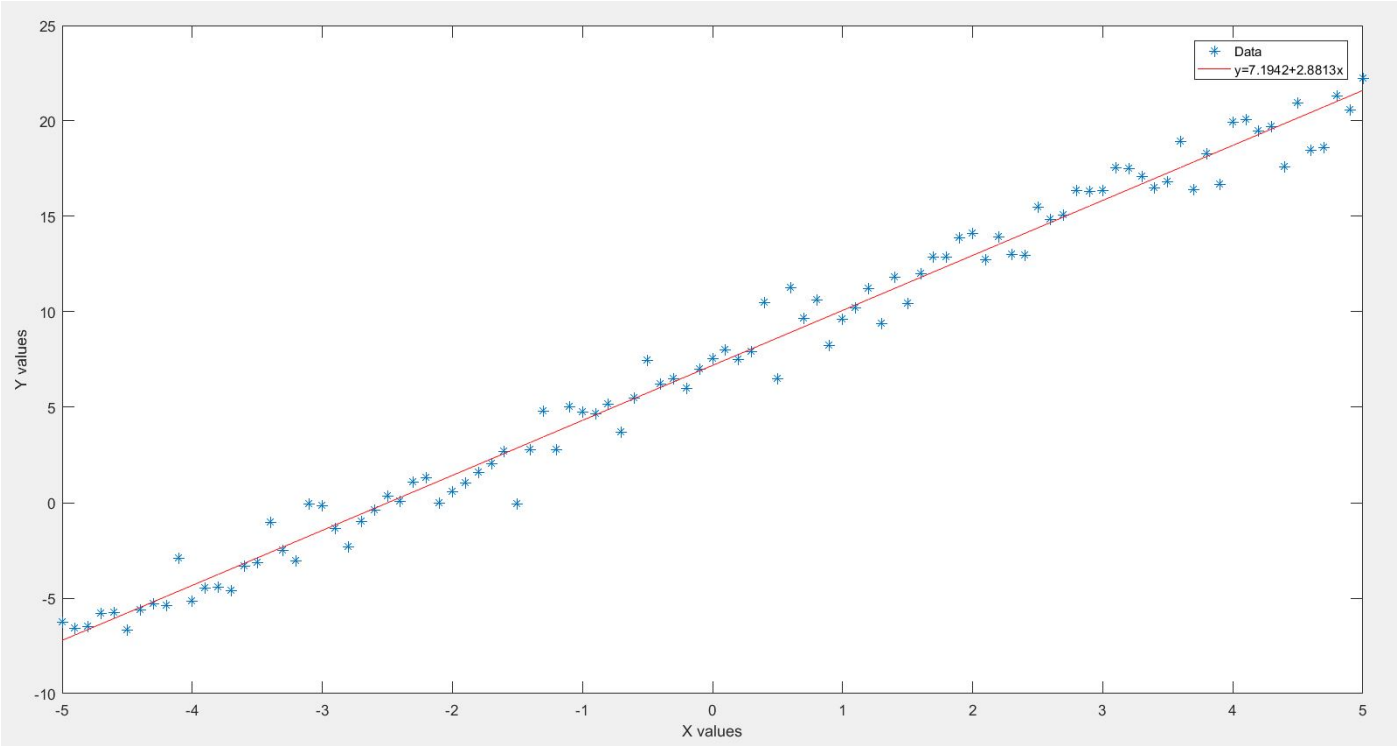
Name	Value
a0	7.1942
a1	2.8813
x	*101x1 double*
y	*101x1 double*

Command Window

```
>> x = (-5 :0.1:5)' ;
>> y = 7.3 + 2.9*x + randn(size(x));
>> [a0,a1]=No_2_Least_Squares_Method(x,y)

a0 =

    7.1942


a1 =

    2.8813

fx >>
```

Command History

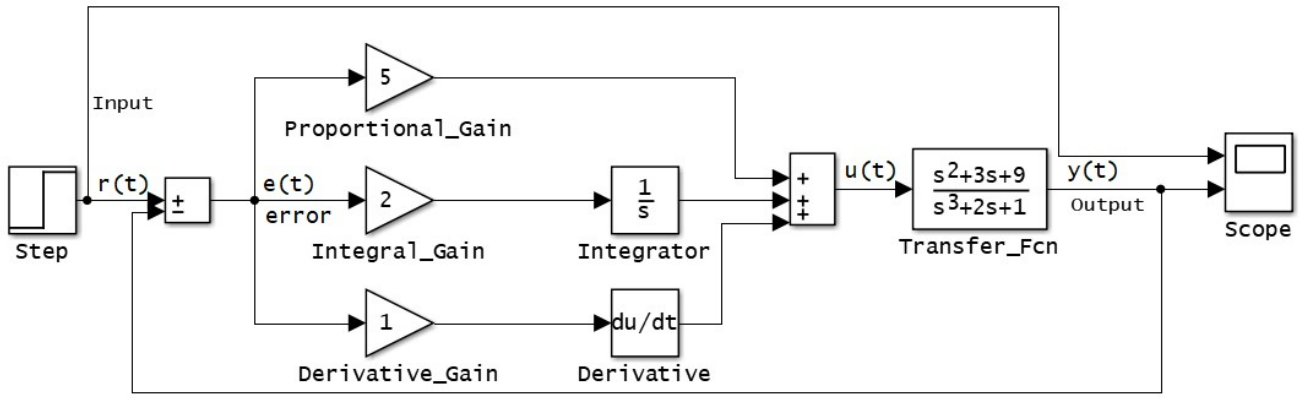
```
clc
x = -5 :0.1:5 ;
y = 7.3 + 2.9*x + randn(size(x));
No_2_Least_Squares_Method
clc
x = -5 :0.1:5 ;
y = 7.3 + 2.9*x + randn(size(x));
[a0,a1]=No_2_Least_Squares_Method(x,y)
clc
x = (-5 :0.1:5)' ;
y = 7.3 + 2.9*x + randn(size(x));
[a0,a1]=No_2_Least_Squares_Method(x,y)
```



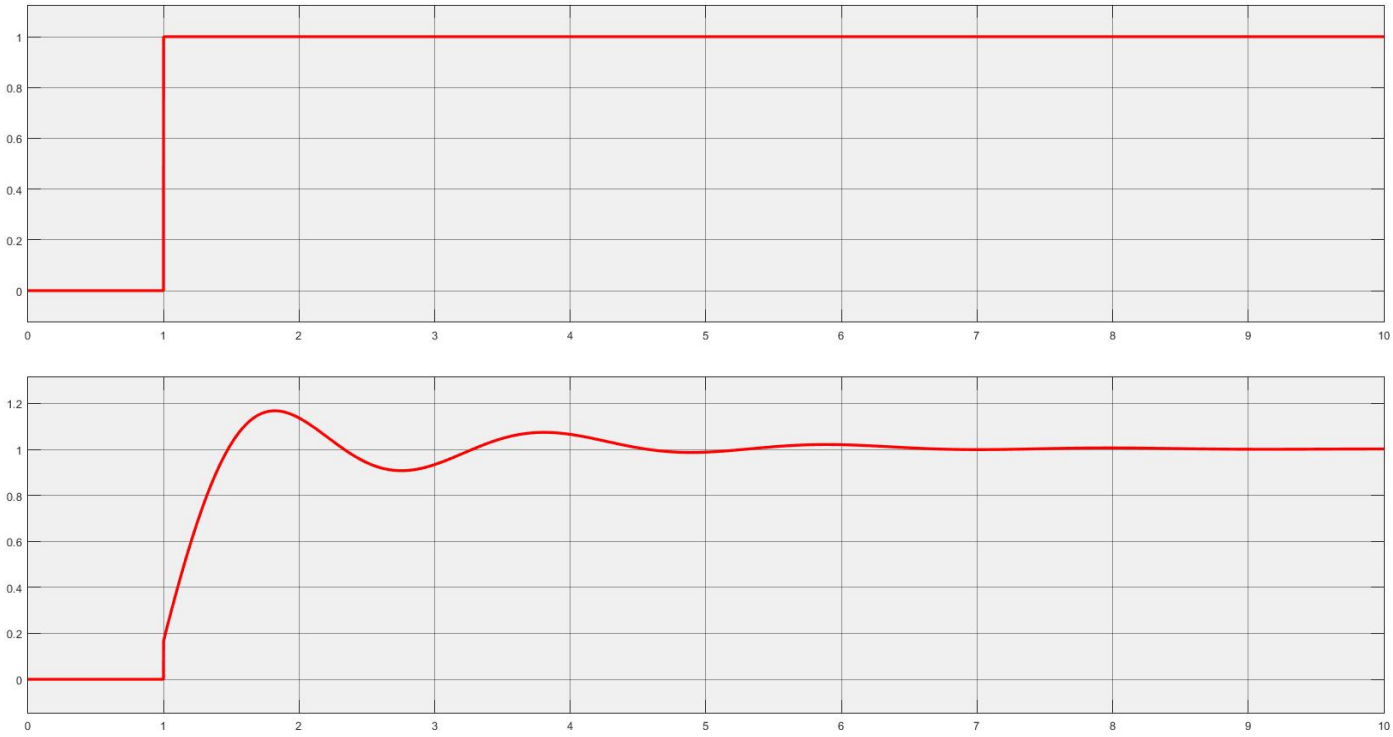
Part 2 | SIMULINK

PID Controller

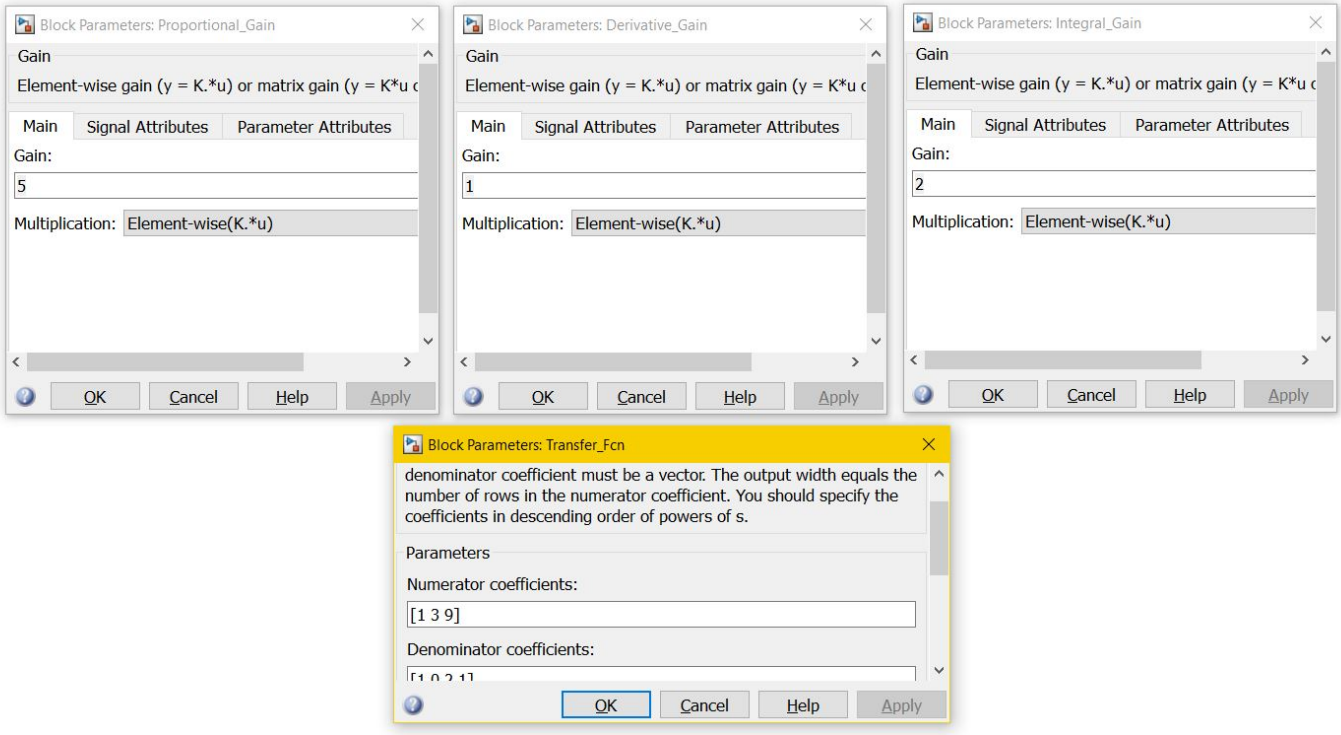
Simulink model:



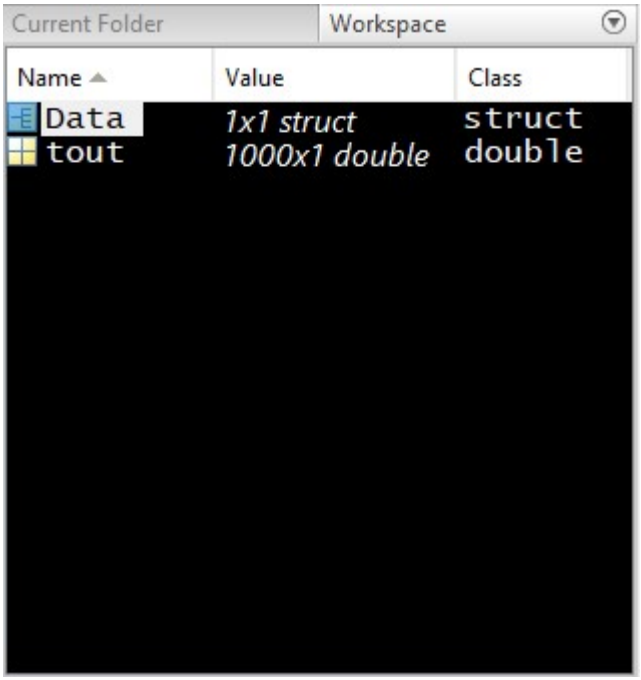
Output & Input Scopes:



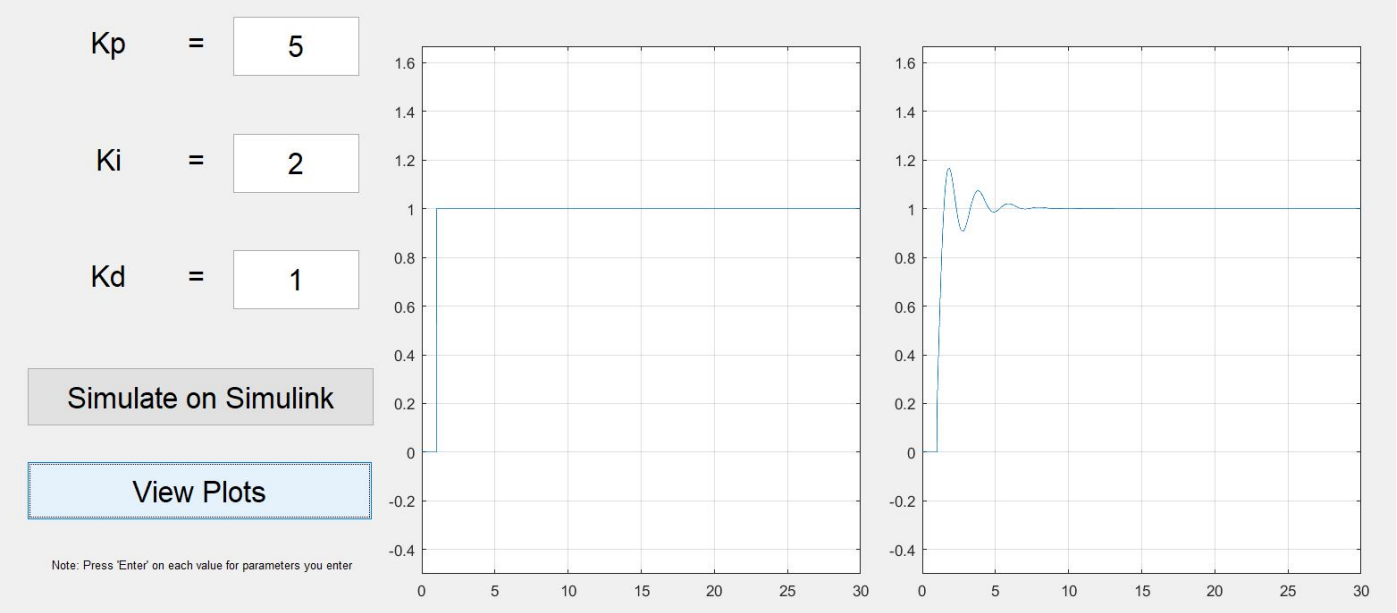
Modified Simulink Parameter:



Workspace:



Bonus:



Edited parts of the associated code:

Function Change No. 1

```
function No_3_PID_Controller_Modified_OpeningFcn(hObject,
eventdata, handles, varargin)
% This function has no output args, see OutputFcn.
% hObject    handle to figure
% eventdata  reserved - to be defined in a future version of
MATLAB
% handles    structure with handles and user data (see
GUIDATA)
% varargin   command line arguments to untitled1 (see
VARARGIN)

%%%                 %%%
%%% Start Changes %%%
%%%                 %%%

model_open(handles)
% Choose default command line output for final
handles.output = hObject;

% Update handles structure
guidata(hObject, handles);

% Now we can use the figure, as required.
%  Set model parameters to match GUI settings

model_open(handles)

%%%                 %%%
%%%  End Changes  %%%
%%%                 %%%
% Choose default command line output for
No_3_PID_Controller_Modified
handles.output = hObject;

% Update handles structure
guidata(hObject, handles);
```

```
% --- Outputs from this function are returned to the command
line.
function varargout =
No_3_PID_Controller_Modified_OutputFcn(hObject, eventdata,
handles)
% varargout  cell array for returning output args (see
VARARGOUT);
% hObject    handle to figure
% eventdata  reserved - to be defined in a future version of
MATLAB
% handles    structure with handles and user data (see
GUIDATA)

% Get default command line output from handles structure
varargout{1} = handles.output;
%end function No_3_PID_Controller_Modified

%%%                %%%
%%% Start Changes %%%
%%%                %%%

% Ensure that the Simulink model is open
function model_open(handles)
% Make sure the diagram is still open
  if
isempty(find_system('Name','No_3_PID_Controller_Simulink')),
      % check whether our Simulink model is opened or not
    open_system('No_3_PID_Controller_Simulink');
  end
  %endfunction model_open

%%%                %%%
%%%  End Changes  %%%
%%%                %%%
```

Function Change No. 2

```
function edit1_Callback(hObject, eventdata, handles)
% hObject    handle to edit1 (see GCBO)
% eventdata  reserved - to be defined in a future version of
MATLAB
% handles    structure with handles and user data (see
GUIDATA)

% Ensure model is open
model_open(handles)

% Get the new value
kp_NewStrVal = get(hObject,'String');
kp_NewVal = str2double(kp_NewStrVal);


% Set the Gain parameter of the Kp Gain Block to the new value
set_param('No_3_PID_Controller_Simulink/Proportional_Gain','Ga
in',kp_NewStrVal);
```

Function Change No. 3

```
function edit2_Callback(hObject, eventdata, handles)
% hObject    handle to edit2 (see GCBO)
% eventdata  reserved - to be defined in a future version of
MATLAB
% handles    structure with handles and user data (see
GUIDATA)

% Ensure model is open
model_open(handles)

% Get the new value
ki_NewStrVal = get(hObject,'String');
ki_NewVal = str2double(ki_NewStrVal);


% Set the Gain parameter of the Ki Gain Block to the new value
set_param('No_3_PID_Controller_Simulink/Integral_Gain','Gain',
ki_NewStrVal);
```

Function Change No. 4

```
function edit3_Callback(hObject, eventdata, handles)
% hObject    handle to edit3 (see GCBO)
% eventdata  reserved - to be defined in a future version of
MATLAB
% handles    structure with handles and user data (see
GUIDATA)

% Ensure model is open
 model_open(handles)

 % Get the new value
 kd_NewStrVal = get(hObject,'String');
 kd_NewVal = str2double(kd_NewStrVal);

 % Set the Gain parameter of the Kd Gain Block to the new
value

set_param('No_3_PID_Controller_Simulink/Derivative_Gain','Gain
',kd_NewStrVal);
```

Function Change No. 5,6

```
function simulatebutton_Callback(hObject, eventdata, handles)
% hObject    handle to simulatebutton (see GCBO)
% eventdata  reserved - to be defined in a future version of
MATLAB
% handles    structure with handles and user data (see
GUIDATA)
myfunc()

function myfunc
    a =
sim('No_3_PID_Controller_Simulink','SimulationMode','normal');
    b = a.get('Data');
    assignin('base','Data',b);
% --- Executes on button press in plotbutton.
function plotbutton_Callback(hObject, eventdata, handles)
sim('No_3_PID_Controller_Simulink');
axes(handles.axes1)
x=Data.time;
y1=Data.signals(1).values;
y2=Data.signals(2).values;
plot(x,y1);
grid on;
axis([min(x) max(x) min(y2)-0.5 max(y2)+0.5]);
axes(handles.axes2)
x=Data.time;
y1=Data.signals(1).values;
y2=Data.signals(2).values;
plot(x,y2);
grid on;
axis([min(x) max(x) min(y2)-0.5 max(y2)+0.5]);
```