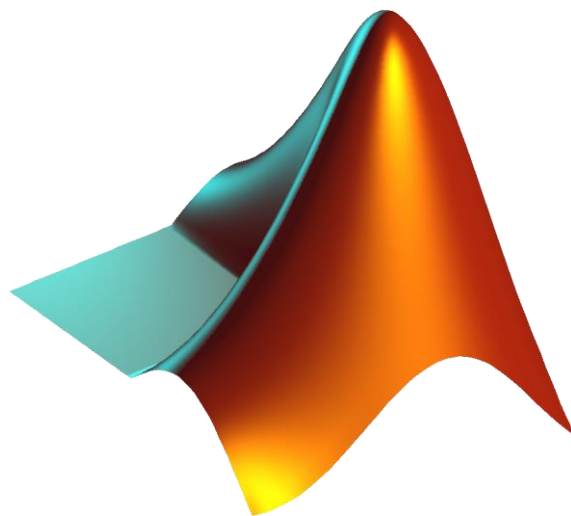


MATLAB PROJECT



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:

The screenshot displays the MATLAB environment with the following components:

- Editor:** Shows the source code for the function `No_1_Power_Method.m`. The code is as follows:


```
1 % {
2 Power Method is used to evaluate an approximation for the maximum eigen
3 value of a matrix.
4 This Function handles the square 2X2 matrix.
5 File created by MATLAB Team and it's allowable to be edited
6 %}
7 function [lamda] = No_1_Power_Method(A,n) % Open the function
8 X=[1;0]; % Suppose the eigenvector X0
9 for i=1:n % Define the loop
10     X=A*X; % Multiply matrix A by matrix X
11     lamda=X(1); % Obtain eigenvalue
12     X=X/X(1); % Prepare for the next X
13 end % Evaluate Xn
14 end % Close the function
```
- Command Window:** Shows the execution of the code:


```
>> A = [ 4 -5; 2 -3 ]; n = 20;
>> [lamda] = No_1_Power_Method(A,n)

lamda =

    2.0000

>> eig(A)

ans =

     2
    -1
```
- Workspace:** A table showing the current variables in the workspace:

Name	Value
A	[4, -5; 2, -3]
ans	[2; -1]
lamda	2.0000
n	20
- Command History:** A list of commands entered in the Command Window:


```
x = rand(2,2)
clc
%-- 09:33 28/04/2019 --%
help comment
clear
clc
help eig
clc
A = [4 -5; 2 -3]
clc
clear
A = [ 4 -5; 2 -3 ]; n = 20;
```

B-Least Squares Fitting

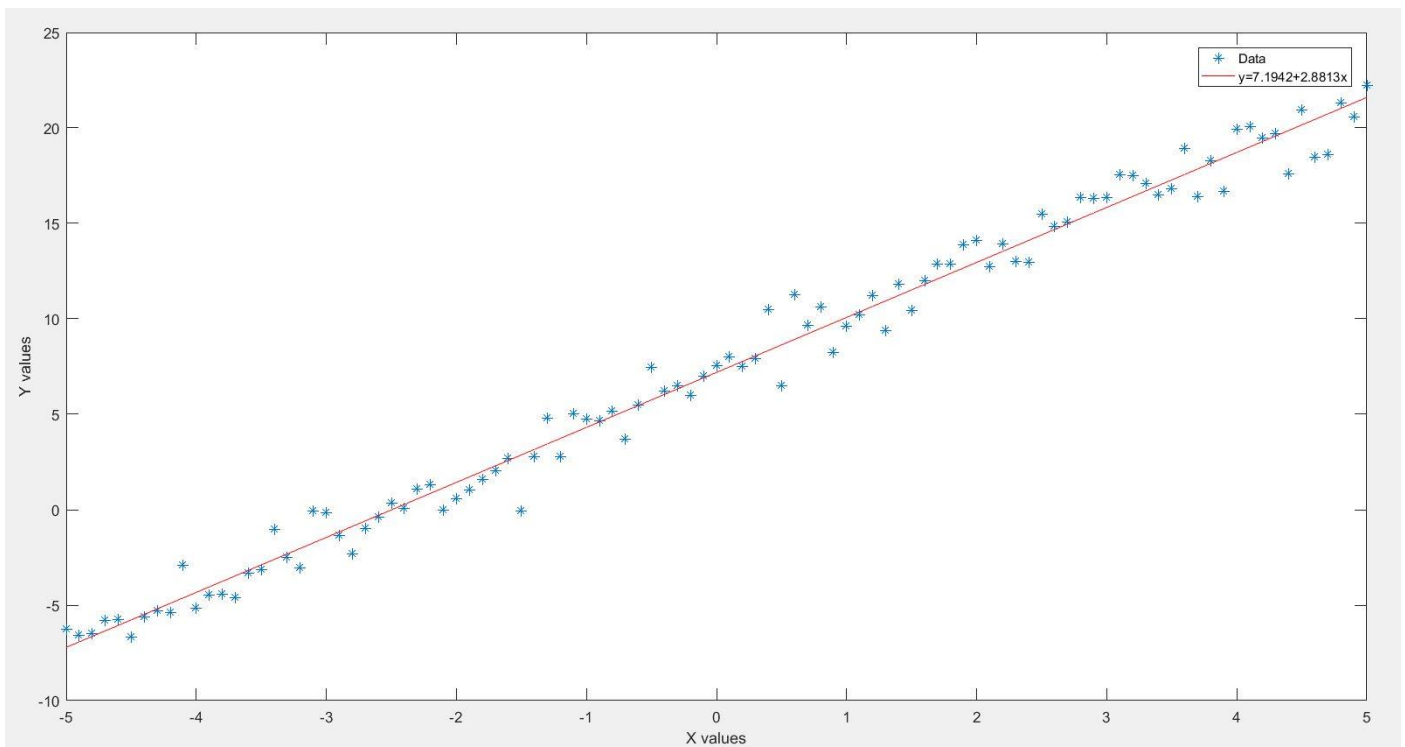
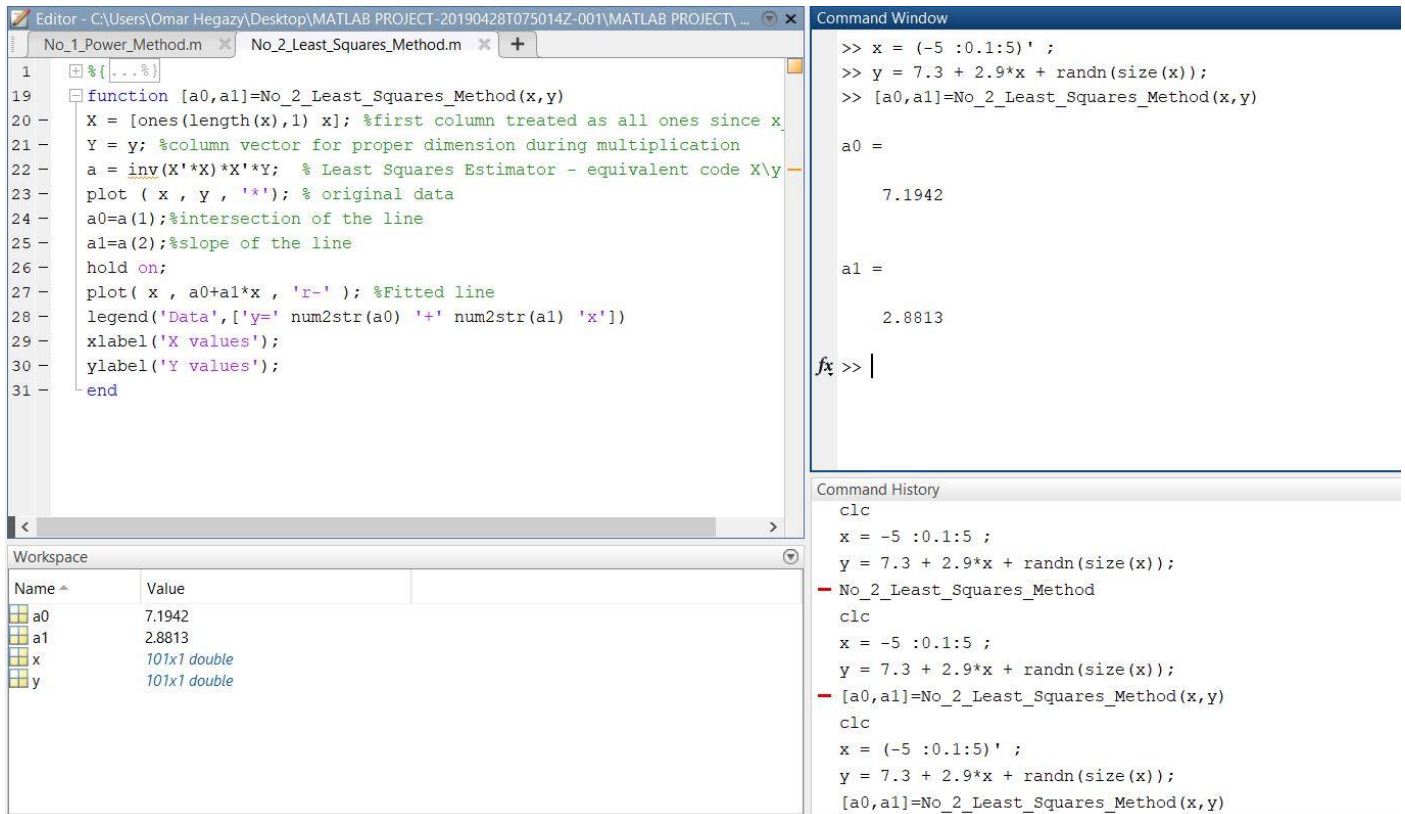
The Source Code:

```
%{
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
```

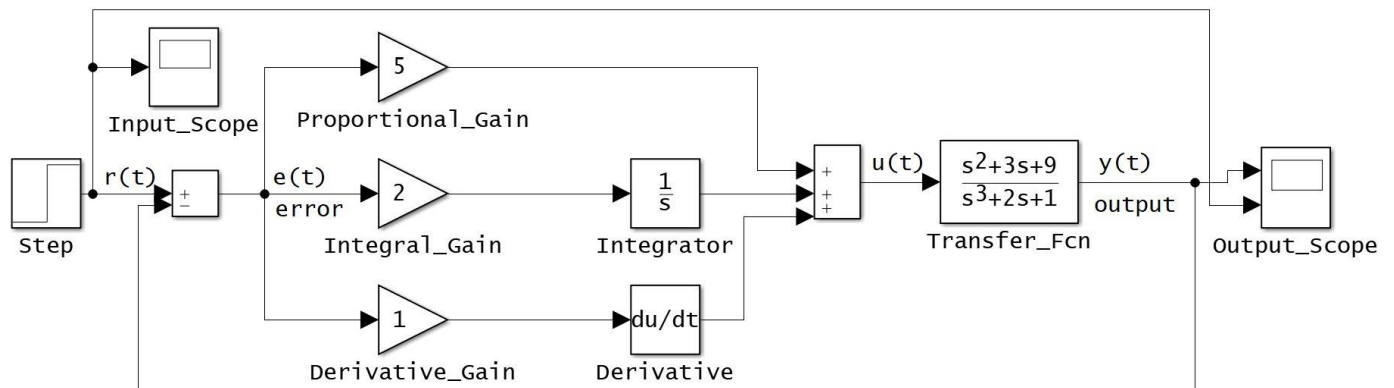
Code Test with Plot Diagram:



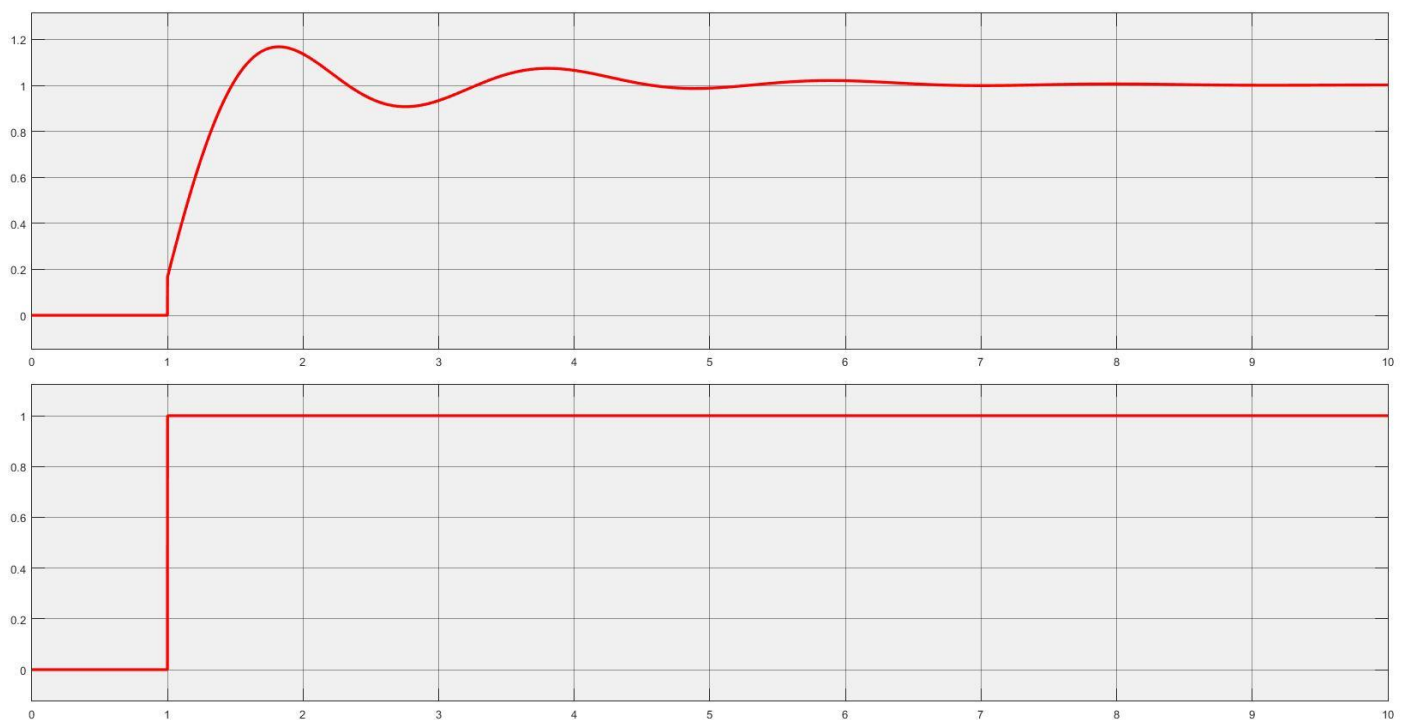
Part 2 | SIMULINK

PID Controller

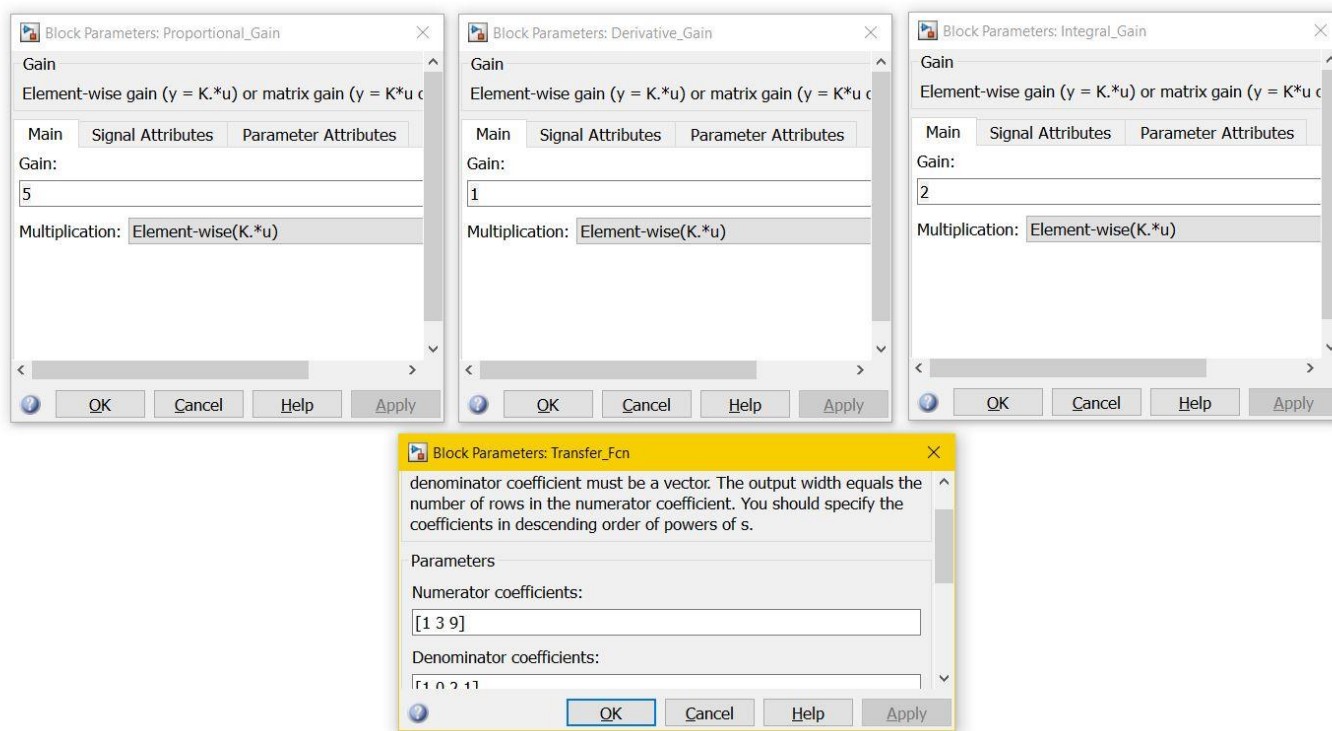
Simulink model:



Output & Input Scopes:



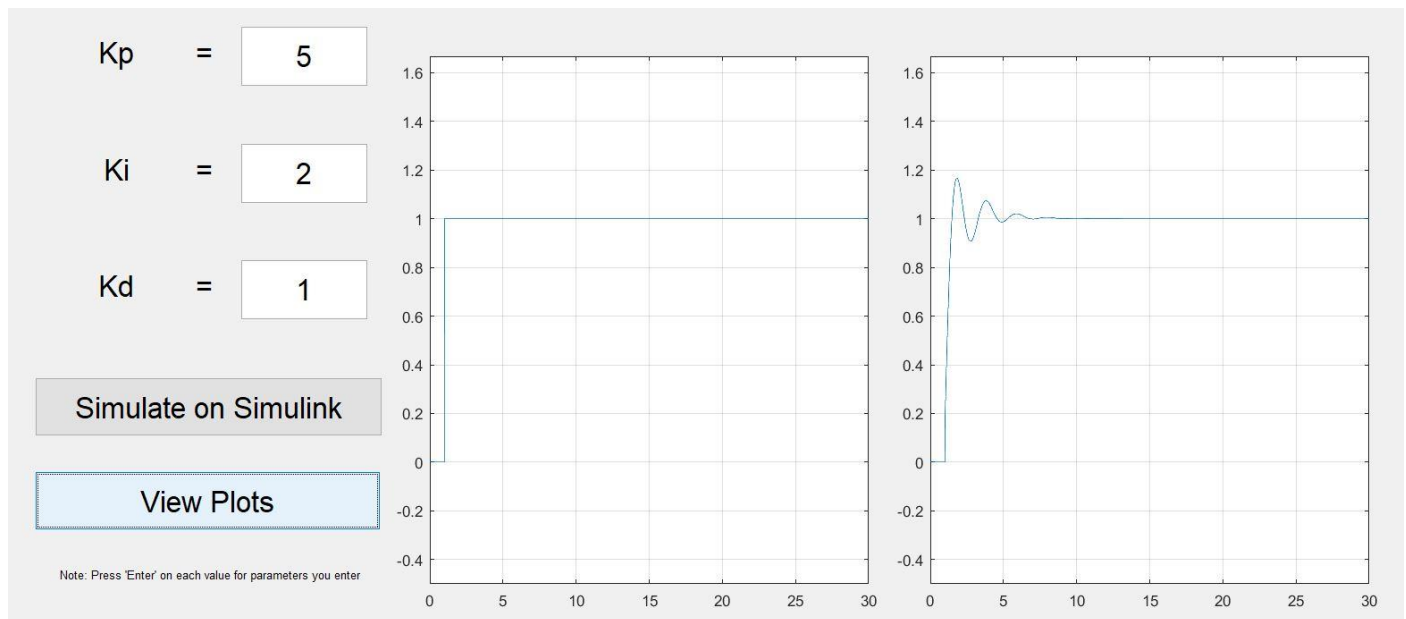
Modified Simulink Parameter:



Workspace:

Current Folder		Workspace	
Name	Value	Class	
Data	1x1 struct	struct	
tout	1000x1 double	double	

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]);
```