EE211 MATLAB Assign1

Hanlin Cai
FZU 832002117
MU 20122161

Statement:

I chose dataset Gr3 and Gr13 to complete the system identification, and all the Code & Pic were created by myself.

Procedure(1)

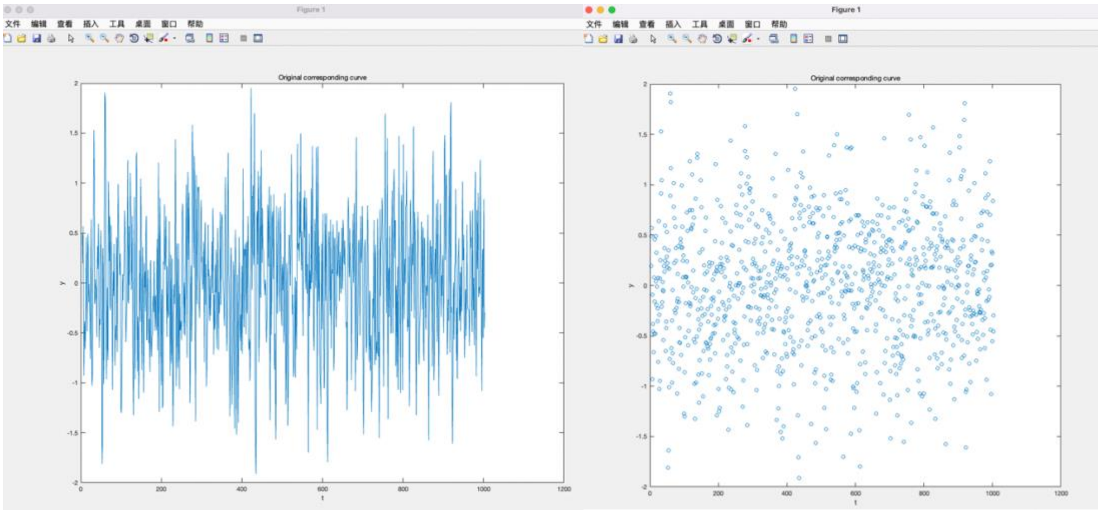


Fig1-2

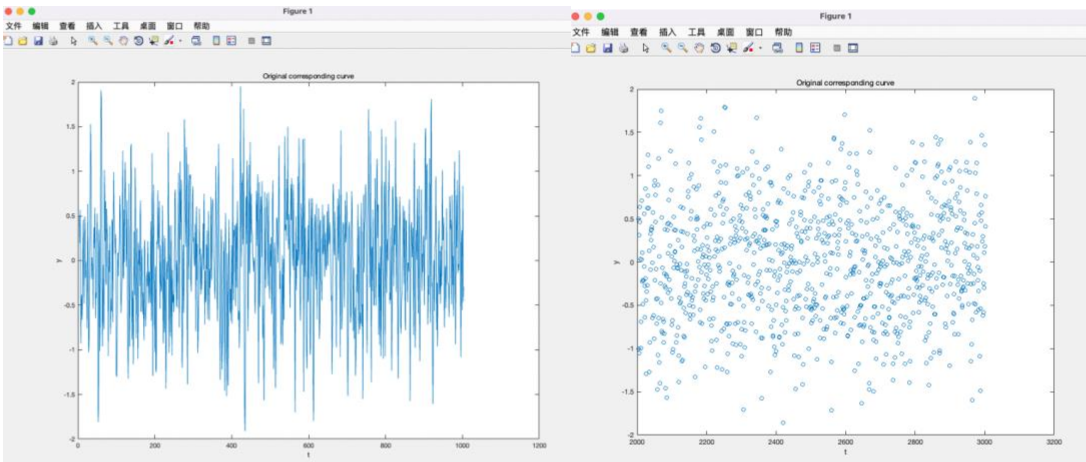


Fig3-4

Procedure(2)

Code1-1 :

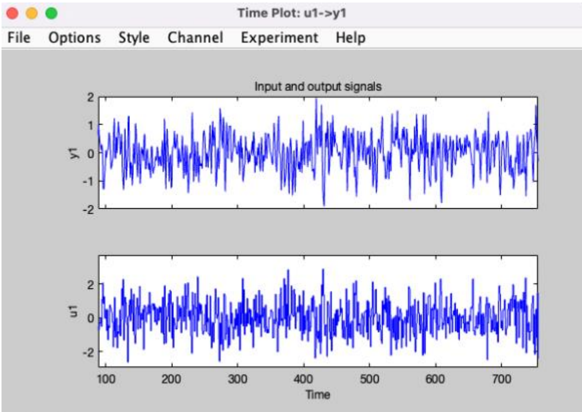
Use struc & arxstruc (ARX) function to fit the model then verify the fitting accuracy.

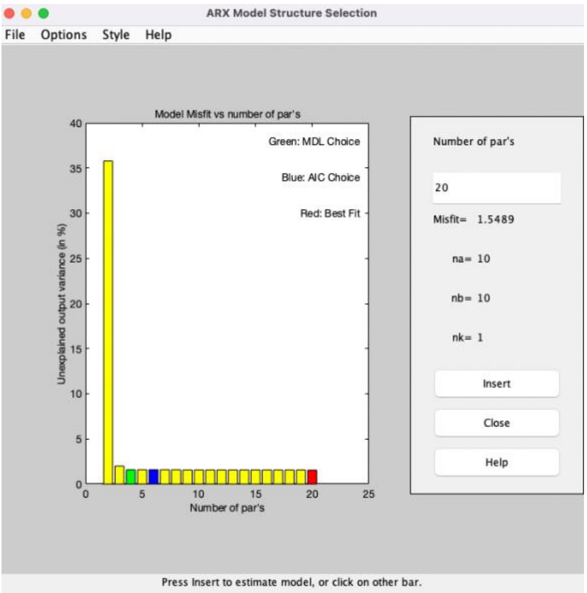
```
%% Assign1-1 2022/05/03 Hanlin Cai
% 使用Matlba内置函数进行拟合，并判断拟合精度
% Use struc & arxstruc (ARX) function to fit the model
% Then verify the fitting accuracy

clear;clc;close all;

%% 1、导入建模训练集
% Import the modeling training set

data1 = importdata('2data/Gr3.txt');
data2 = data1.data;
data3 = data2(1:1000,:);
data4 = data2(2001:3000,:);

t1 = data3(:,1); %time_1
u1 = data3(:,2); %input_1
y1 = data3(:,3); %output_1


t2 = data4(:,1); %time_2
u2 = data4(:,2); %input_2
y2 = data4(:,3); %output_2

% plot(t2,y2,'o')
plot(t1,y1,'-')
xlabel('t')
ylabel('y')
title('Original corresponding curve');

Ts = 1000;
ze = iddata(y1,u1,Ts);
zv = iddata(y2,u2,Ts);
```

```matlab
NN = struc(1:3, 1:3, 0:2);
V = arxstruc(ze,zv,NN);


%% 2、使用卷积神经网络，计算模型表现
% Convolutional neural networks are used to compute model representations.

% [u1, t1] = bodyfat_dataset;
% net = feedforwardnet(10);
% net.performParam.regularization = 0.01;
% net.performFcn
%
% net = train(net, u1, t1);
% y = net(u1);
% perf = perform(net, t2, y2)


%% 3、增加噪音
% Increase the noise

% 1、均匀分布噪声 Uniformly distributed noise
u3 = u1 + 0.1*(2*rand(size(u1))-1).*u1;

% 2、正态分布噪声 Normally distributed noise
u4 = u2 + 0.1*randn(size(u2)).*(u2);


%% 4、验证模型精准度
% Verify model accuracy

order = selstruc(V,0);
M1 = arx(ze,order)

% 增加噪音进入信号部分
Z1 = iddata(y1,u1,0.05);
Z2 = iddata(y1,u3,0.05);
Z3 = iddata(y1,u4,0.05);
% Z4 = iddata(y2,u1,0.05);

% M2 = arx(Z1 , [5,6,0])
% compare(M2, Z1);
% hold on;
```

```
%% 5、绘制 Loss Function
% ident;
% u1 y1
% u2 y2
% u3 y1 noise
```

For dataset Gr3 (1:1000):





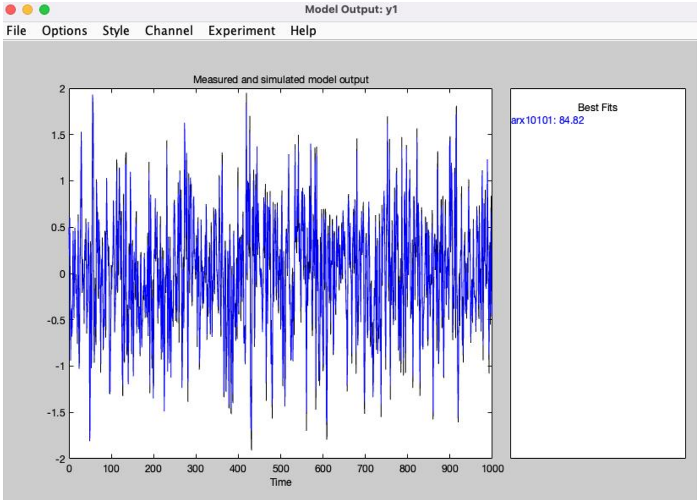
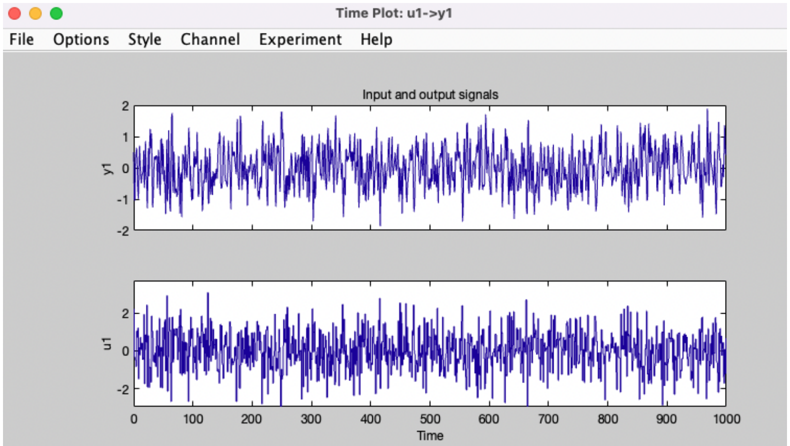
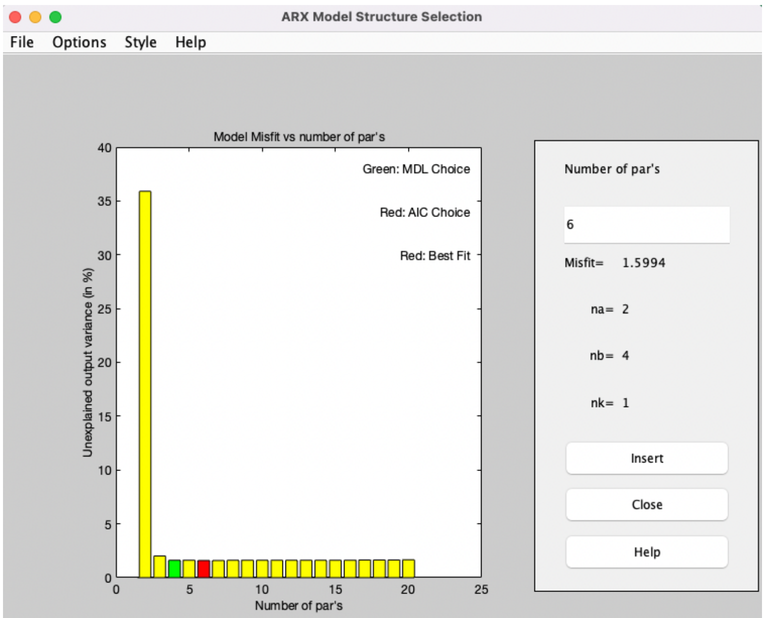


Fig5-7

For dataset Gr3 (1001:3000):





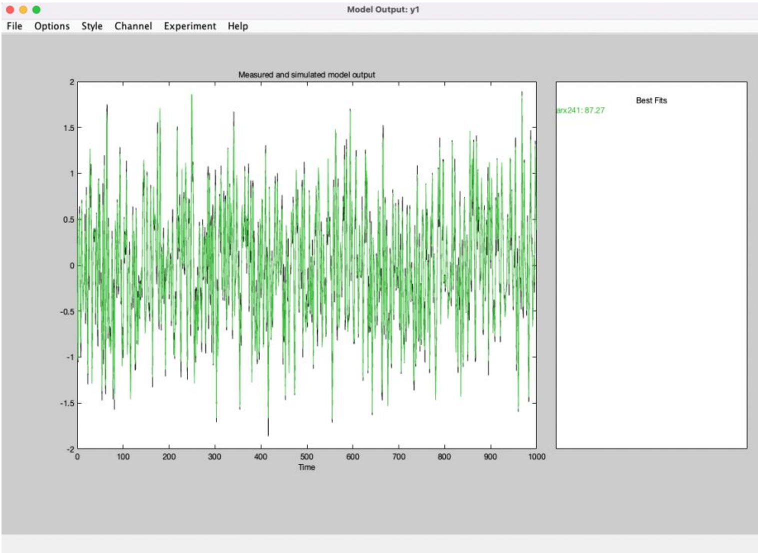


Fig8-10

<u>Procedure(3)</u>

<u>Code1-2 :</u>

The intermediate parameters were calculated using the least square method.

```
%% Assign1-2 2022/05/03 Hanlin Cai
% The least square method was used for fitting

clear;clc;close all;

%% 1、导入建模训练集
% Import the modeling training set

data1 = importdata('2data/Gr3.txt');
data2 = data1.data;
data3 = data2(1:1000,:);
data4 = data2(2001:3000,:);

t1 = data3(:,1); %time_1
u1 = data3(:,2); %input_1
y1 = data3(:,3); %output_1

t2 = data4(:,1); %time_2
u2 = data4(:,2); %input_2
y2 = data4(:,3); %output_2

data4 = importdata('2data/Gr13.txt');
```

```
data5 = data4.data;
data6 = data5(1:1000,:);

t3 = data6(:,1); %time_1
u3 = data6(:,2); %input_1
y3 = data6(:,3); %output_1

% % plot(t1,y1,'o')


%% 使用最小二乘法计算中间参数
% The intermediate parameters were calculated using the least
square method
% y1 = O*(u1)
% 定义 O 为中间变量 Define O as the intermediate variable
u11 = (u1)';
u22 = (u2)';
u33 = (u3)';

% O = ( (u1)'*u1 )^(-1) * (u1)' * y1;
O1 = ( (u11)*u1 )^(-1) * (u11) * y1; % O1 = 0.0789
O2 = ( (u22)*u2 )^(-1) * (u22) * y2; % O2 = 0.0668
O3 = ( (u33)*u3 )^(-1) * (u33) * y3; % O3 = 0.4267
```

Procedure(4)

For dataset Gr3 (1:1000):

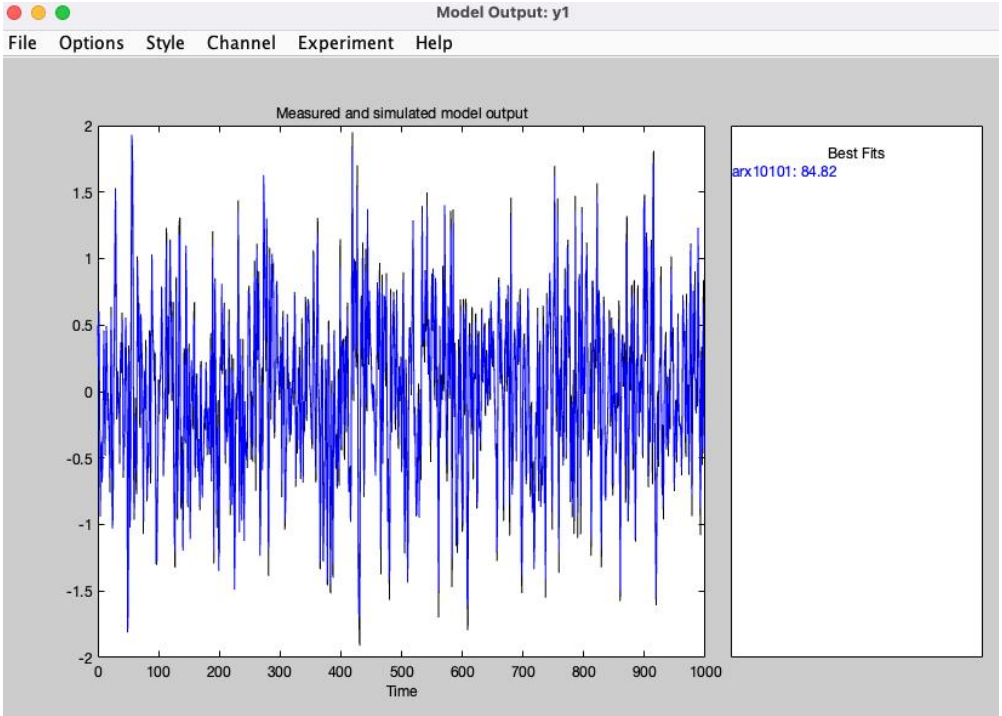


Fig11

For dataset Gr3 (1001:3000):

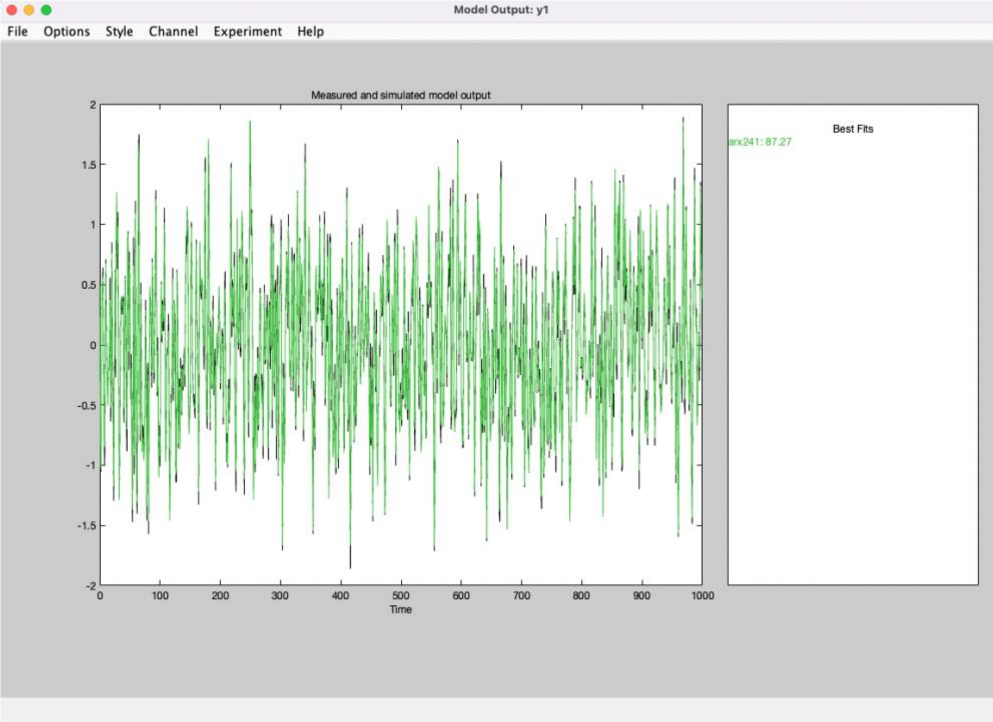


Fig12

Procedure(5)

ARX Function :

For dataset Gr3 (1:1000):

Discrete-time ARX model: A(z)y(t) = B(z)u(t) + e(t)

A(z) = 1 - 0.08718 z^-1 + 0.08923 z^-2 + 0.0005606 z^-3

B(z) = 0.07952 - 0.3896 z^-1 - 0.4509 z^-2

For dataset Gr3 (1001:3000):

Discrete-time ARX model: A(z)y(t) = B(z)u(t) + e(t)

A(z) = 1 - 0.08825 z^-1 + 0.09134 z^-2 + 0.001028 z^-3

B(z) = 0.07846 - 0.39 z^-1 - 0.4492 z^-2

Least Square Method :

For dataset Gr3 (1:1000):

O1 = ((u11)*u1)^(-1) * (u11) * y1; % O1 = 0.0789

For dataset Gr3 (1001:3000):

O2 =   ((u22)*u2)^(-1) * (u22) * y2; % O2 = 0.0668

Procedure(6)

```
%% 3、增加噪音
% Increase the noise

% 1、均匀分布噪声 Uniformly distributed noise
u3 = u1 + 0.1*(2*rand(size(u1))-1).*u1;

% 2、正态分布噪声 Normally distributed noise
u4 = u2 + 0.1*randn(size(u2)).*(u2);
```

For dataset Gr3 (1:1000):

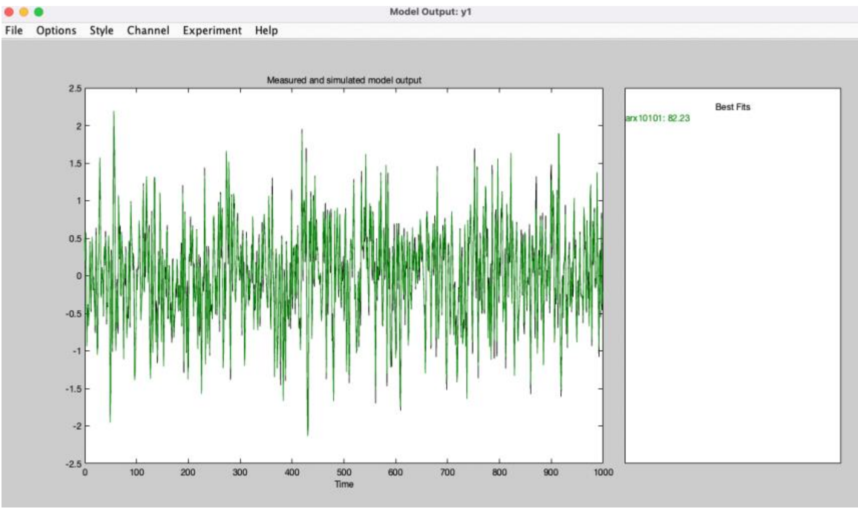


Fig13

For dataset Gr3 (1001:3000):

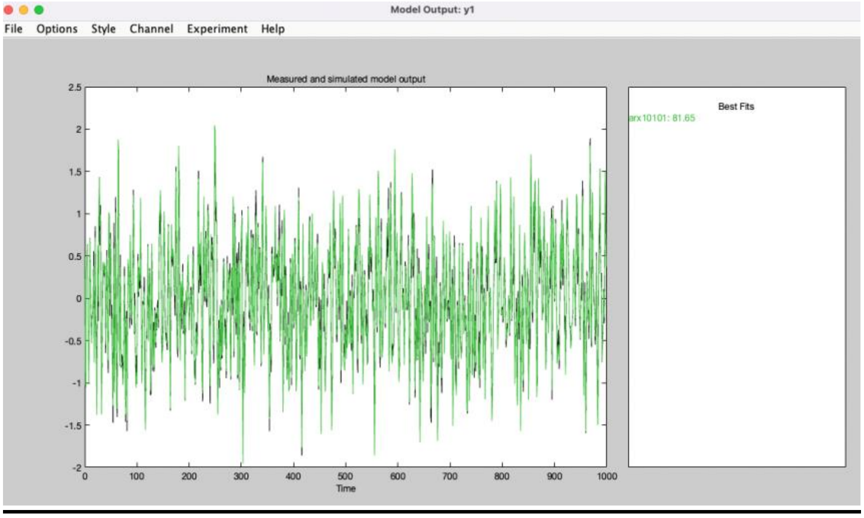


Fig14

Procedure(7)

For dataset Gr3 (1:1000): FFT

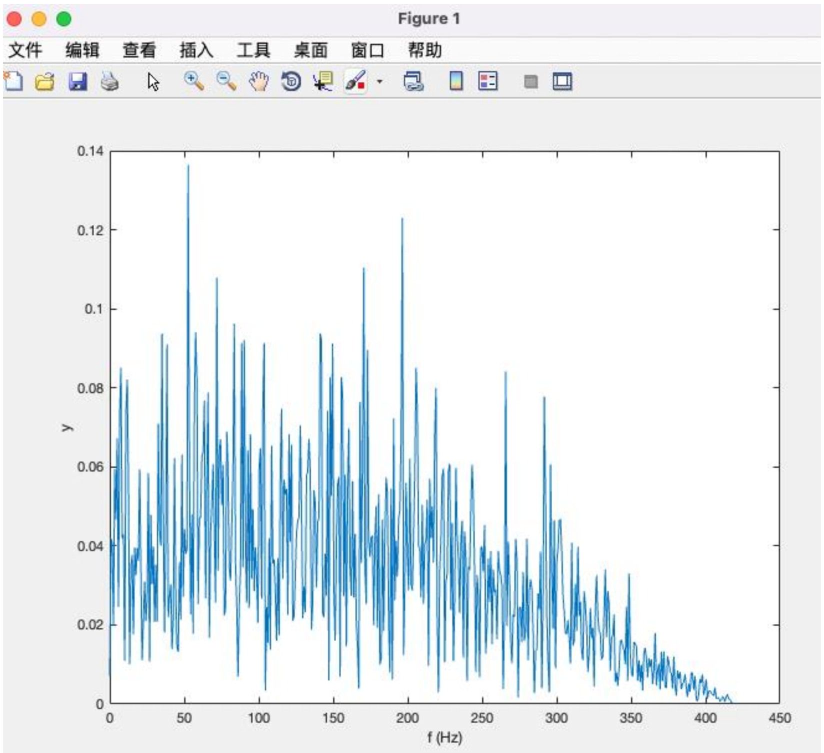


Fig15

For dataset Gr3 (1001:3000): FFT

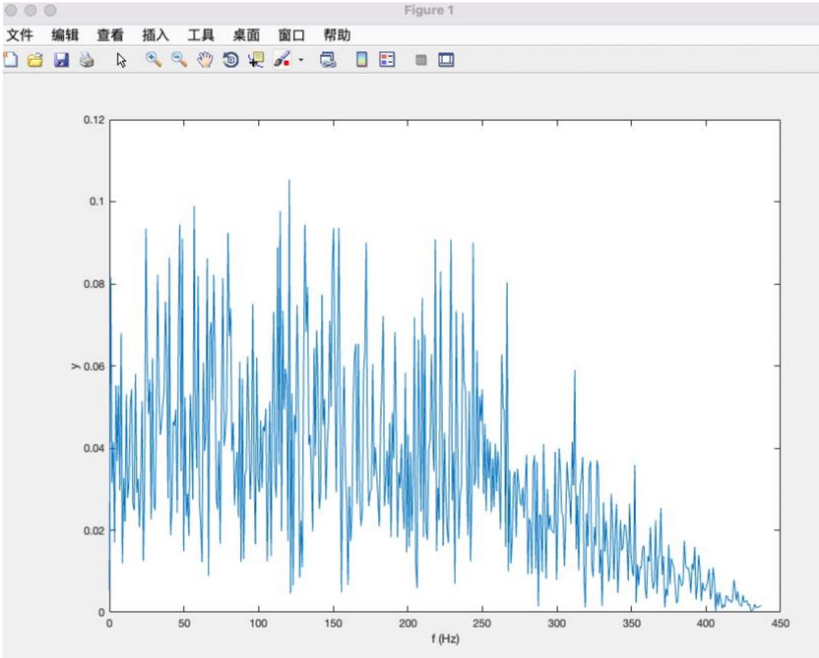


Fig16

Code1-3 :

Using Fast Fourier Transfor to Plot the spectrum of the data

```
%% Assign1-3 2022/05/03 Hanlin Cai
% FFT 快速傅立叶变换，处理函数部分
% Fast Fourier Transform

clear;clc;close all;

%% 1、导入建模训练集
% Import the modeling training set

data1 = importdata('2data/Gr3.txt');
data2 = data1.data;
data3 = data2(1:1000,:);
data4 = data2(1001:2000,:);

t1 = data3(:,1); %time_1
u1 = data3(:,2); %input_1
y1 = data3(:,3); %output_1

t2 = data4(:,1); %time_2
u2 = data4(:,2); %input_2
y2 = data4(:,3); %output_2
```

```
Ts = 1000;
ze = iddata(y1,u1,Ts);
zv = iddata(y2,u2,Ts);

NN = struc(1:3, 1:3, 0:2);
V = arxstruc(ze,zv,NN);

%% 验证模型精准度，同 A1-1

% order = selstruc(V,0);
% M = iv4(ze,order);


%% 增加噪音
% 1、均匀分布噪声
u2 = u1 + 0.1*(2*rand(size(u1))-1).*u1;

% 2、正态分布噪声
u3 = u1 + 0.1*randn(size(u1)).*(u1);

%% FFT 函数

% 1、对信号进行 fft 变换，获取信号频率分布
L=length(u1);
T=(u1(end)-u1(1))/L; % 采样周期等于采样长度除去采样点数
Fs1=1/T; % 采样频率
f1=Fs1*(0:(L/2))/L;

L=length(u2);
T=(u2(end)-u2(1))/L; % 采样周期等于采样长度除去采样点数
Fs2=1/T; % 采样频率
f2=Fs2*(0:(L/2))/L;


% 2、傅里叶变换
S1=y1(1:L);
Y1 = fft(S1);
P2 = abs(Y1/L);
P1 = P2(1:L/2+1);
P1(2:end-1) = 2*P1(2:end-1);

S2=y2(1:L);
Y2 = fft(S2);
```

```
P3 = abs(Y2/L);
P4 = P3(1:L/2+1);
P4(2:end-1) = 2*P4(2:end-1);

% 3、plot
figure;
plot(f1,P1)
% plot(f2,P4)
% title('FFT')
xlabel('f (Hz)')
ylabel('y')
```

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FZU 832002117
MU 20122161
2022/05/03