**大连理工大学实验报告**

学院（系）： 电子信息与电气工程学部 专业： 电子信息工程(英语强化) 班级： 电英1801

姓 名： 童博涵 学号： 201883032 组： \_\_\_

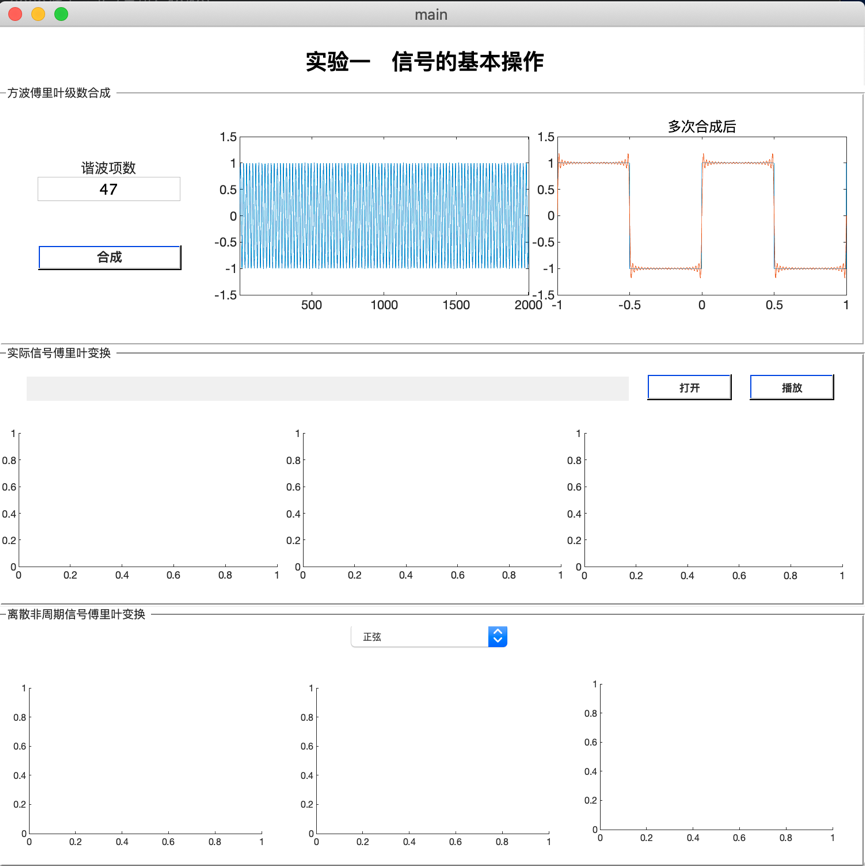
实验时间： 实验室： 实验台：

指导教师签字： 成绩：

**实验一 信号的分析**

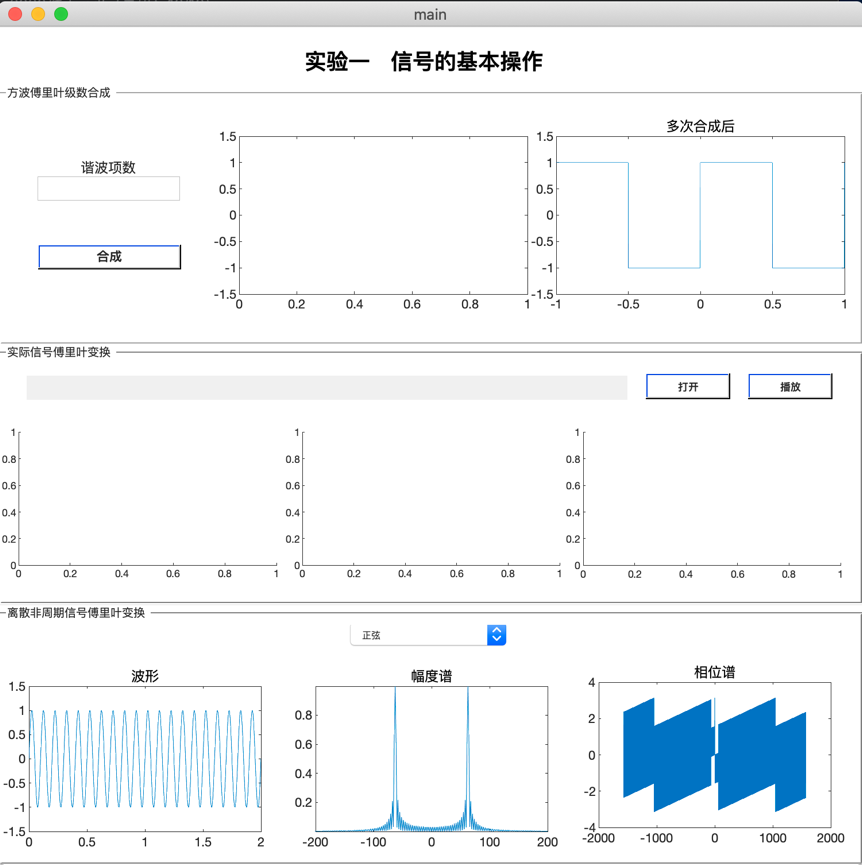
一、实验题目和结果

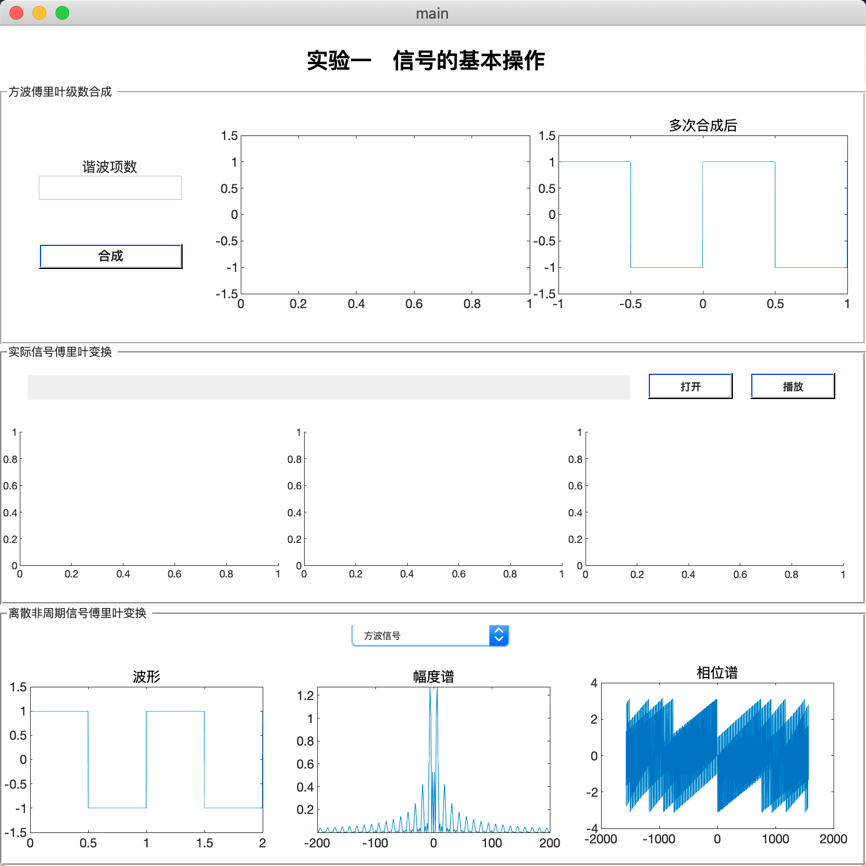
1.方波信号的多次谐波合成

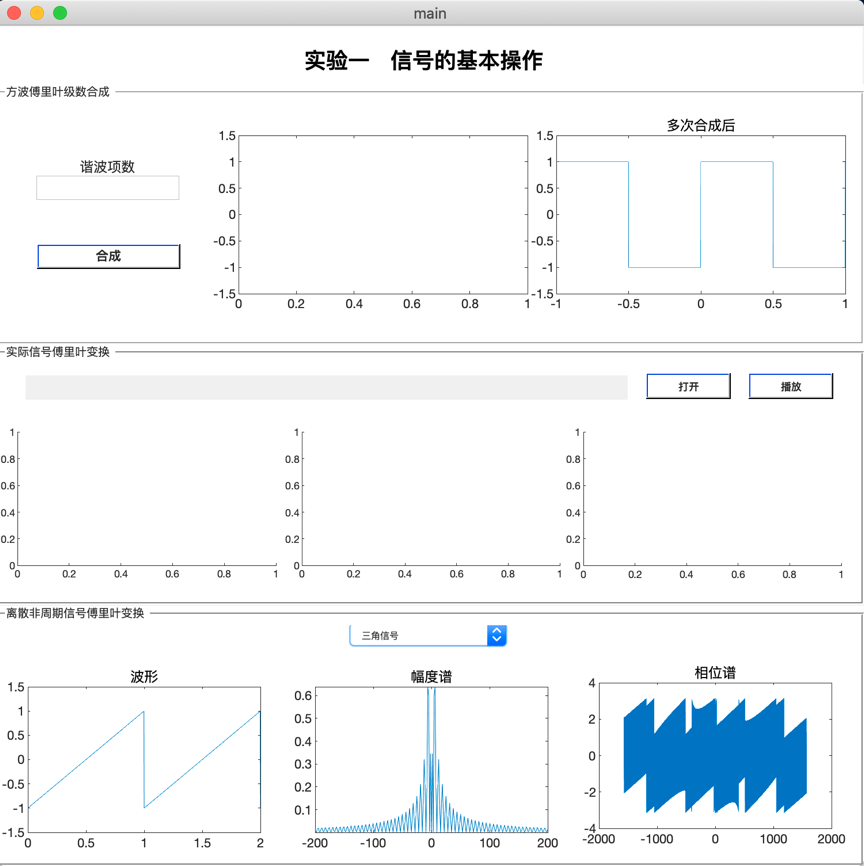
图1.合成结果

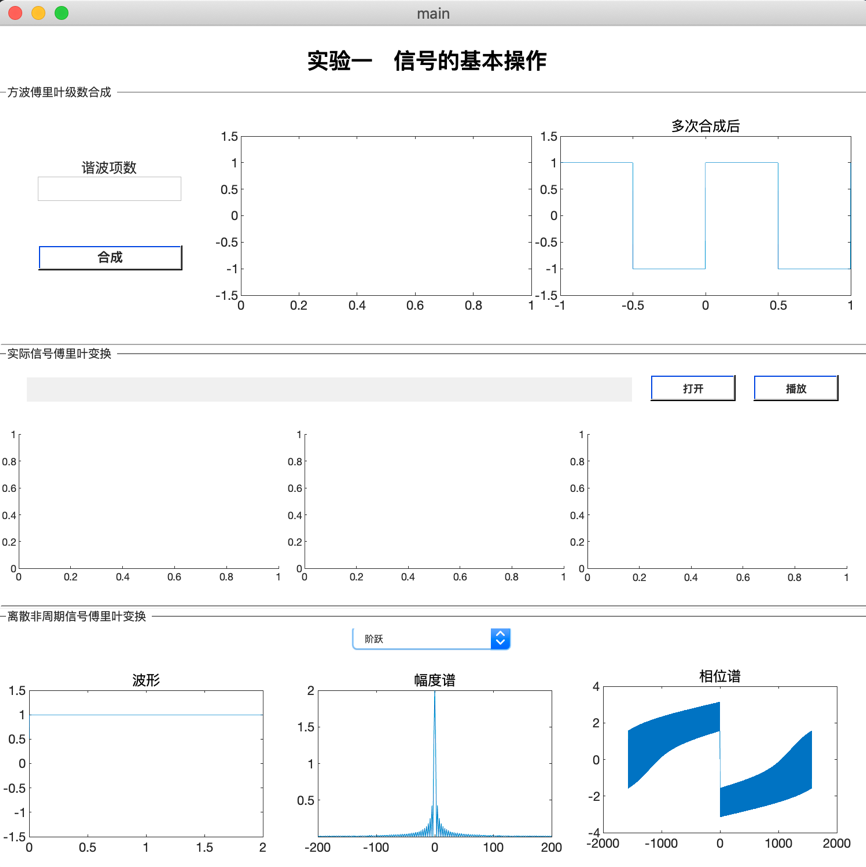
2.典型非周期信号的傅立叶变换

图2-图5分别为正弦信号、方波信号、三角波信号和阶跃信号的波形、幅度谱和相位谱。

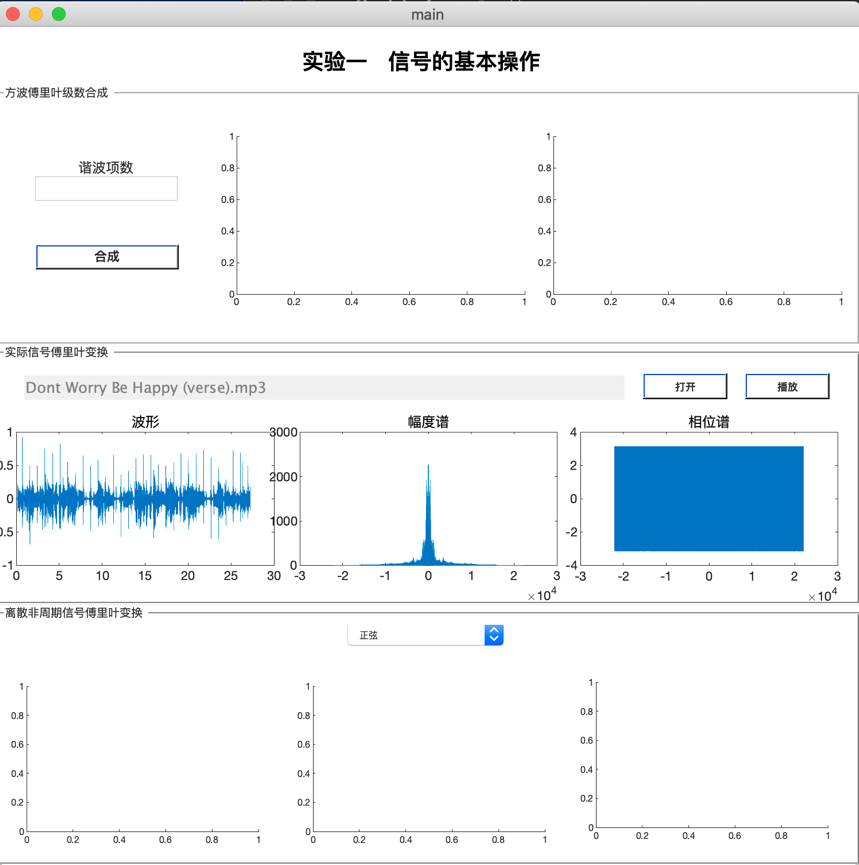
图2.正弦信号

图3.方波信号

图4.三角波信号

图5.阶跃信号

3.实际语音信号的傅立叶变换

图6.实际信号的傅立叶变换结果

4.源代码

function varargout = main(varargin)

% MAIN MATLAB code for main.fig

% MAIN, by itself, creates a new MAIN or raises the existing

% singleton\*.

%

% H = MAIN returns the handle to a new MAIN or the handle to

% the existing singleton\*.

%

% MAIN('CALLBACK',hObject,eventData,handles,...) calls the local

% function named CALLBACK in MAIN.M with the given input arguments.

%

% MAIN('Property','Value',...) creates a new MAIN or raises the

% existing singleton\*. Starting from the left, property value pairs are

% applied to the GUI before main\_OpeningFcn gets called. An

% unrecognized property name or invalid value makes property application

% stop. All inputs are passed to main\_OpeningFcn via varargin.

%

% \*See GUI Options on GUIDE's Tools menu. Choose "GUI allows only one

% instance to run (singleton)".

%

% See also: GUIDE, GUIDATA, GUIHANDLES

% Edit the above text to modify the response to help main

% Last Modified by GUIDE v2.5 29-Dec-2018 21:42:40

% Begin initialization code - DO NOT EDIT

gui\_Singleton = 1;

gui\_State = struct('gui\_Name', mfilename, ...

'gui\_Singleton', gui\_Singleton, ...

'gui\_OpeningFcn', @main\_OpeningFcn, ...

'gui\_OutputFcn', @main\_OutputFcn, ...

'gui\_LayoutFcn', [] , ...

'gui\_Callback', []);

if nargin && ischar(varargin{1})

gui\_State.gui\_Callback = str2func(varargin{1});

end

if nargout

[varargout{1:nargout}] = gui\_mainfcn(gui\_State, varargin{:});

else

gui\_mainfcn(gui\_State, varargin{:});

end

% End initialization code - DO NOT EDIT

% --- Executes just before main is made visible.

function main\_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 main (see VARARGIN)

% Choose default command line output for main

handles.output = hObject;

% Update handles structure

guidata(hObject, handles);

% UIWAIT makes main wait for user response (see UIRESUME)

% uiwait(handles.figure1);

% --- Outputs from this function are returned to the command line.

function varargout = main\_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;

% --- Executes on selection change in popupmenu1.

function popupmenu1\_Callback(hObject, eventdata, handles)

% hObject handle to popupmenu1 (see GCBO)

% eventdata reserved - to be defined in a future version of MATLAB

% handles structure with handles and user data (see GUIDATA)

% Hints: contents = cellstr(get(hObject,'String')) returns popupmenu1 contents as cell array

% contents{get(hObject,'Value')} returns selected item from popupmenu1

choice=get(handles.popupmenu1,'Value');

fs=500;

dt=1/fs;

t=0:dt:2;

N=length(t);

switch choice

case 1

%请产生10Hz正弦波，时间为上面定义的t，信号存储在变量x中

x = sin(20\*pi\*t);

case 2

%请产生周期为1的方波，时间为上面定义的t，信号存储在变量x中

x = square(2\*pi\*t,50);

case 3

x=sawtooth(2\*pi\*t);

case 4

x=heaviside(t);

end

plot(handles.wave,t,x);

set(handles.wave,'YLim',[-1.5 1.5]);

title(handles.wave,'波形');

%==================================

%请在下面输入对信号x进行傅里叶变换的代码，并显示变换后的幅度谱和相位谱

%角频率为变量W，傅里叶变换后的结果存放在F中

k = -N:N;

W = 2\*pi\*k/((2\*N+1)\*dt);

F = dt\*x\*exp(-j\*t'\*W);

%==========================================

plot(handles.magnitude,W,abs(F));

title(handles.magnitude,'幅度谱');

axis(handles.magnitude,[-200 200 -inf inf]);

plot(handles.phase,W,angle(F));

title(handles.phase,'相位谱');

% --- Executes during object creation, after setting all properties.

function popupmenu1\_CreateFcn(hObject, eventdata, handles)

% hObject handle to popupmenu1 (see GCBO)

% eventdata reserved - to be defined in a future version of MATLAB

% handles empty - handles not created until after all CreateFcns called

% Hint: popupmenu controls usually have a white background on Windows.

% See ISPC and COMPUTER.

if ispc && isequal(get(hObject,'BackgroundColor'), get(0,'defaultUicontrolBackgroundColor'))

set(hObject,'BackgroundColor','white');

end

% --- Executes on button press in pushbutton2.

function pushbutton2\_Callback(hObject, eventdata, handles)

% hObject handle to pushbutton2 (see GCBO)

% eventdata reserved - to be defined in a future version of MATLAB

% handles structure with handles and user data (see GUIDATA)

set(handles.panel,'Visible','on');

set(handles.panel1,'Visible','off');

set(handles.panel2,'Visible','off');

% --- Executes on button press in pushbutton3.

function pushbutton3\_Callback(hObject, eventdata, handles)

% hObject handle to pushbutton3 (see GCBO)

% eventdata reserved - to be defined in a future version of MATLAB

% handles structure with handles and user data (see GUIDATA)

set(handles.panel,'Visible','off');

set(handles.panel1,'Visible','on');

set(handles.panel2,'Visible','off');

% --- Executes on button press in pushbutton4.

function pushbutton4\_Callback(hObject, eventdata, handles)

% hObject handle to pushbutton4 (see GCBO)

% eventdata reserved - to be defined in a future version of MATLAB

% handles structure with handles and user data (see GUIDATA)

set(handles.panel,'Visible','off');

set(handles.panel1,'Visible','off');

set(handles.panel2,'Visible','on');

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)

% Hints: get(hObject,'String') returns contents of edit1 as text

% str2double(get(hObject,'String')) returns contents of edit1 as a double

% --- Executes during object creation, after setting all properties.

function edit1\_CreateFcn(hObject, eventdata, handles)

% hObject handle to edit1 (see GCBO)

% eventdata reserved - to be defined in a future version of MATLAB

% handles empty - handles not created until after all CreateFcns called

% Hint: edit controls usually have a white background on Windows.

% See ISPC and COMPUTER.

if ispc && isequal(get(hObject,'BackgroundColor'), get(0,'defaultUicontrolBackgroundColor'))

set(hObject,'BackgroundColor','white');

end

% --- Executes on button press in button1.

function button1\_Callback(hObject, eventdata, handles)

% hObject handle to button1 (see GCBO)

% eventdata reserved - to be defined in a future version of MATLAB

% handles structure with handles and user data (see GUIDATA)

%========请补充下面的代码=========================

%参考实验讲义，请在这里生成幅度为1，周期为1的方波信号，时间变量定义为t，方波信号为y

t = -1:0.001:1;

W = 2\*pi;

y = square(2\*pi\*t,50);

%============================================

%获取用户输入的谐波次数后，显示出最高次谐波的波形。

N\_str = get(handles.edit1,'String');

N = str2double(N\_str);

n = 1:2:N;

if rem(N,2) ~= 0

y\_max = sin(N\*W\*t);

else

y\_max = 0;

end

plot(handles.C\_harmonic,y\_max)

axis(handles.C\_harmonic,[-inf inf -1.5 1.5])

%======请补充下面的代码======================

%请在这里写代码，完成前max次谐波对方波信号的合成

%合成后的结果存放在x变量中

M = 4./(pi\*n);

H = sin(W\*n'\*t);

x = M\*H;

%============================

plot(handles.synthetic,t,y,t,x);

set(handles.synthetic,'YLim',[-1.5 1.5]);

title(handles.synthetic,'多次合成后')

% --- Executes on button press in pushbutton6.

function pushbutton6\_Callback(hObject, eventdata, handles)

% hObject handle to pushbutton6 (see GCBO)

% eventdata reserved - to be defined in a future version of MATLAB

% handles structure with handles and user data (see GUIDATA)

[filename,filepath,~]=uigetfile({'\*.mp3';'\*.mp4';'\*.wav'},...

'Select an audio file',...

'MultiSelect','off');

if(filename==0)

return

else

file=strcat(filepath,filename);

set(handles.ViewPath,'String',filename);

[tdata,fs]=audioread(file);%tdata是读入的音频信号，fs是音频采样频率

tdata=tdata(:,2);%取出右声道的数据进行处理，注意：也可以用左声道数据，或者两个声道都处理，都用

tdata=tdata';

t=0:1/fs:(length(tdata)-1)/fs;

plot(handles.wave1,t,tdata);

title(handles.wave1,'波形');

N=length(t);

fdata=abs(fft(tdata,N));

pdata=angle(fft(tdata,N));

df=fs/N;

f=(0:df:df\*(N-1))-fs/2;

plot(handles.magnitude1,f,fftshift(fdata));

title(handles.magnitude1,'幅度谱');

plot(handles.phase1,f,pdata);

title(handles.phase1,'相位谱');

end

% --- Executes on button press in play.

function play\_Callback(hObject, eventdata, handles)

% hObject handle to play (see GCBO)

% eventdata reserved - to be defined in a future version of MATLAB

% handles structure with handles and user data (see GUIDATA)

filename=get(handles.ViewPath,'String');

if length(filename)>0

[y Fs]=audioread(filename);

sound(y,Fs);

end

% --- Executes during object creation, after setting all properties.

function C\_harmonic\_CreateFcn(hObject, eventdata, handles)

% hObject handle to C\_harmonic (see GCBO)

% eventdata reserved - to be defined in a future version of MATLAB

% handles empty - handles not created until after all CreateFcns called

% Hint: place code in OpeningFcn to populate C\_harmonic

二、实验总结

1. 实验时，使用plot()函数绘制信号的频谱时，x坐标轴的跨度太大导致整个频谱图较难观察。解决方法：使用axis()命令，将坐标轴的范围进行设置，由于y轴不需要设置，则设置为axis([-200 200 -inf inf])。也可使用set函数将坐标区的范围‘XLim’进行设置。
2. 在合成多次谐波时，由于只将奇数次谐波进行合成，则不希望当输入谐波次数为偶数次时显示最高谐波的波形，可使用if语句对输入谐波次数进行判断，为奇数时显示最高次谐波。