电子科技大学 格拉斯哥 学院

UOG-UESTC Joint School of UESTC

标 准 实 验 报 告

Lab Report

（实验）课程名称： 信号与系统

(LAB) Course Name： Signals and Systems

电子科技大学教务处制表

UoG-UESTC Joint School

Lab-4 Report

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Instructor： Xu Bo

Location：

Date： 6/13/2019

一、 Laboratory name：

Signals and Systems

二、 Project name：

Represent signals using MATLAB

三、 Lab hours：4

3

四、 Theoretical background:

1. The basic concepts of signals and systems arise in a variety of contexts, from engineering design to financial analysis. In this lab1, you will learn how to represent, manipulate, and analyze basic signals and systems in MATLAB.
2. Some basic MATLAB commands for representing signals include: zeros, ones, cos, sin, exp, real, imag, abs, angle, linspace, plot, stem, subplot, xlabel, ylabel, title
3. Some useful commands in Symbolic Math Toolbox are as: sym, subs, ezplot.

五、 Objective：

1. Understand the sampling theorem, and verify the aliasing phenomeno due to undersampling.
2. Perform Single-Sideband AM with Hilbert Transform.
3. Make pole-zero plot for CT and DT system.
4. Understand the pole location’s influence on the frequency response of a system.

六、 Description：

1. Verify the aliasing phenomeno due to undersampling. 7.1 (a)(b)(c)(d)
2. Perform Single-Sideband AM with Hilbert Transform. 8.1 (c)(d)(e) (i)-(n)
3. Make pole-zero plot using MATLAB. 9.1 (a)(c) 10.1(a)(b)
4. Obtain the frequency response of a second-order system. 9.2 (a)(b)

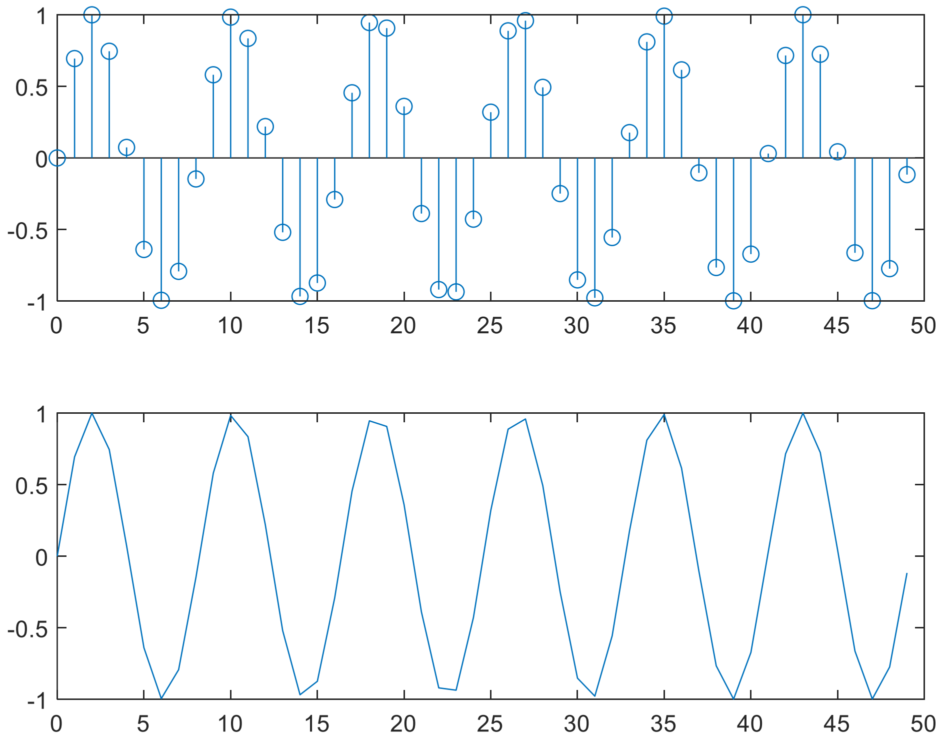
七、 Required instruments：

Computer, MATLAB

八、 Procedures, Analysis of Lab data & result and Conclusion:

7.1(a)(b)

```
n=0:8191;
omega_0=2000*pi;
T=1/8192;
t=n.*T;%t:[0:1],step1/8192
x=sin(omega_0.*t);
subplot(2,1,1)
stem(0:49,x(1:50))
subplot(2,1,2)
plot(0:49,x(1:50))
```



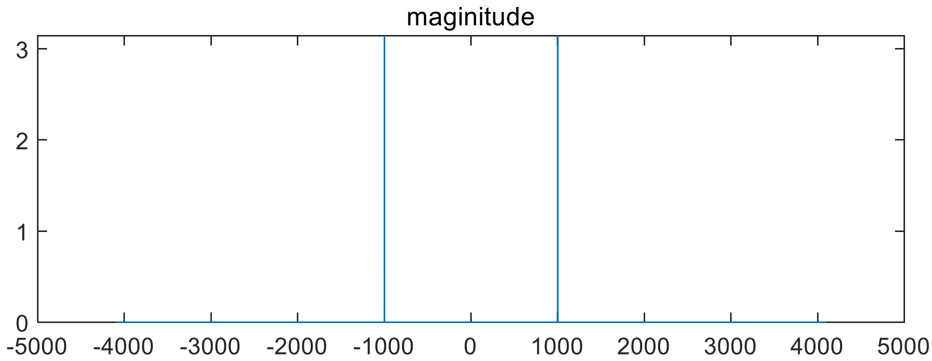
7.1(c)

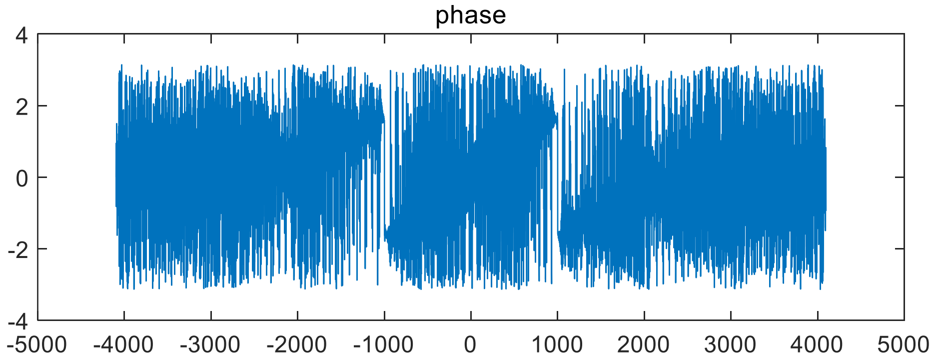
```
n=0:8191;
omega=2000*pi;
T=1/8192;
t=n.*T;%t:[0:1],step1/8192
x=sin(omega.*t);
[X,w]=ctfts (x,T);
subplot(2,1,1)
plot(w,abs(X),'r');
title('maginitude');
subplot(2,1,2)
plot(w,angle(X),'b');
title('phase');
```

function ctfts

```
function [X,w]=ctfts (x,T);
```

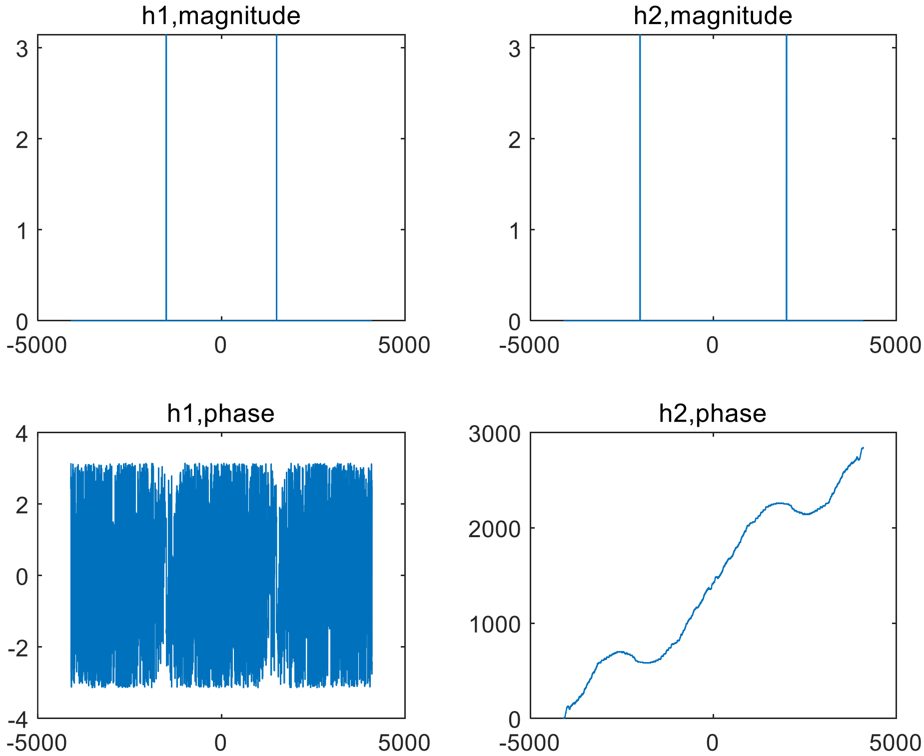
```
N=length(x);
X=fftshift(fft(x,N))*(2*pi/N);
w=linspace(-1,1-1/N,N)/(2*T);
end
```





The magnitude is correct, while the phase is not.

```
7.1(d)
n=0:8191;
omega1=3000*pi;
omega2=4000*pi;
T=1/8192;
t=n.*T;%t:[0:1],step1/8192
x1=sin(omega1.*t);
x2=sin(omega2.*t);
[X1,w1]=ctfts (x1,T);
[X2,w2]=ctfts (x2,T);
subplot(2,2,1)
plot(w1,abs(X1));
title('h1,magnitude')
subplot(2,2,3)
plot(w1,angle(X1))
title('h1,phase');
subplot(2,2,2)
plot(w2,abs(X2));
title('h2,magnitude')
subplot(2,2,4)
plot(w2,phase(X2))
title('h2,phase')
```



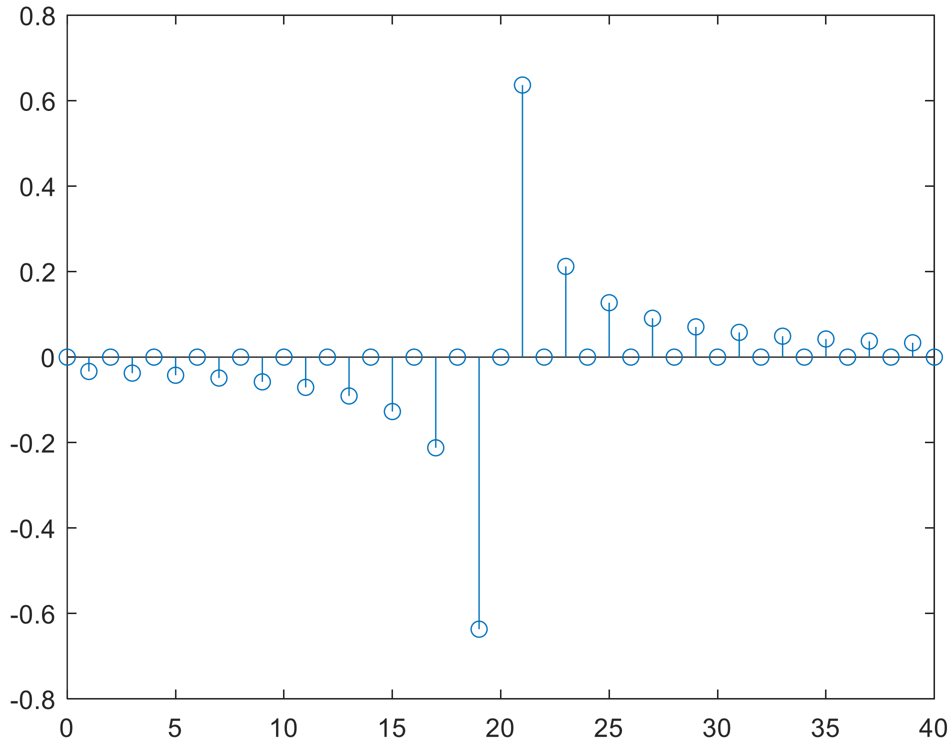
The magnitude is correct, while the phase is not.

8.1(c)

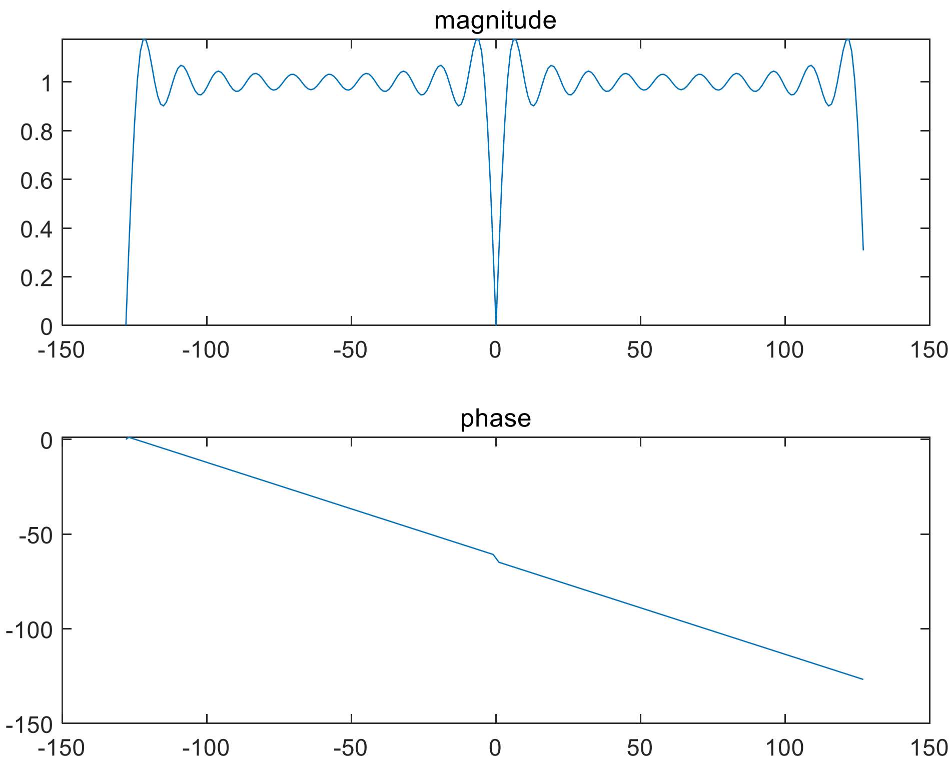
The inpulse response is $\frac{1-(-1)^{n-\alpha}}{\pi(n-\alpha)}$, and this is symmetric at $n=\alpha$

8.1(d)

```
n=0:40;
h(1:41)=1./(pi.*(n-20)).*(1-(-1).^(n-20));
h(21)=0;
stem(n,h)
```

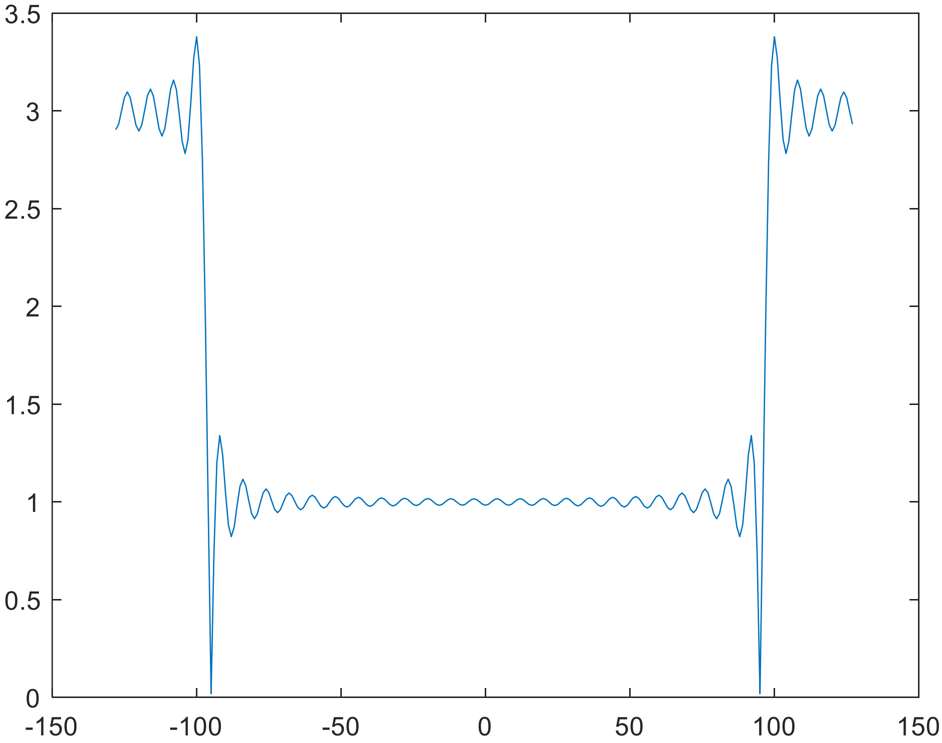


```
8.1(e)
n=0:40;
h(1:41)=1./(pi.*(n-20)).*(1-(-1).^(n-20));
h(21)=0;
H=fftshift(fft(h,256)); %the symmertic shoud be at omega=0
subplot(2,1,1);
plot(-128:127,abs(H));
title('magnitude');
subplot(2,1,2);
plot(-128:127,unwrap(angle(H)));
title('phase');
```



The magnitude and phase is similar to the ideal one.

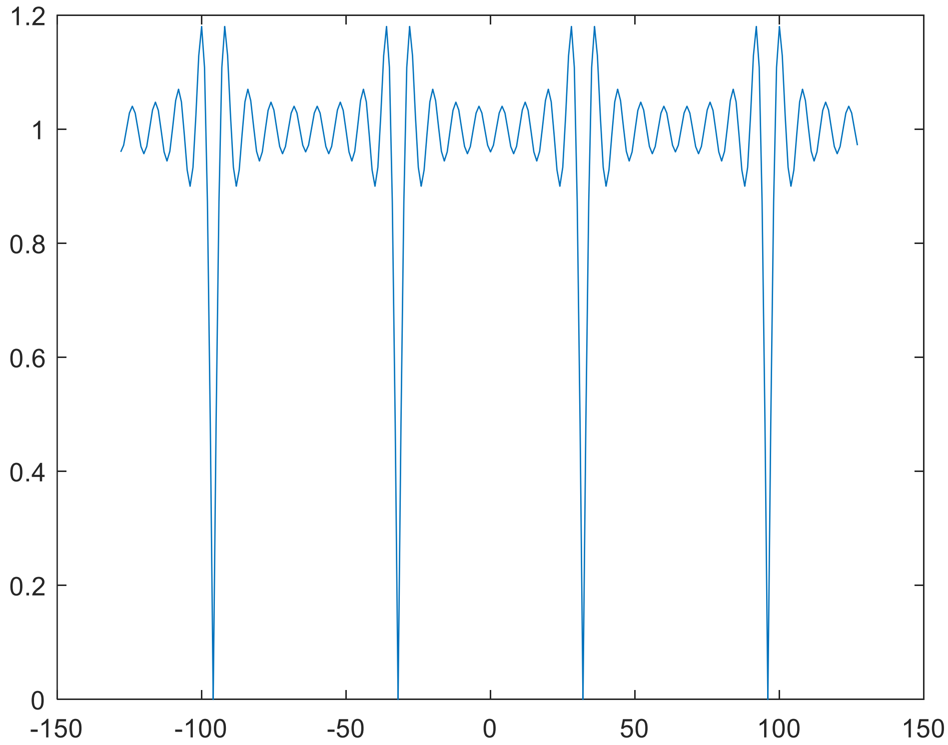
```
8.1(i)
n=0:64;
x(1:65)=sin(pi/4.*(n-32))./(pi/4.*(n-32));
x(33)=0;
X=fft(x,256);
plot(-128:127,abs(X));
```



The band limit is demonstrates in the plot.

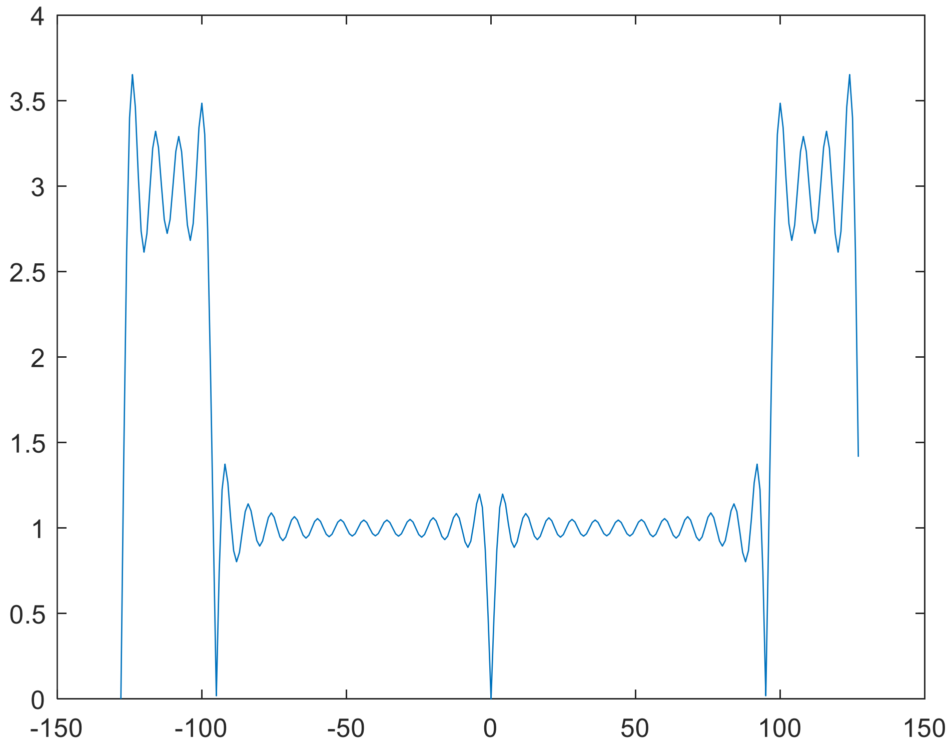
8.1 (j)

```
n=0:64;
x(1:65)=sin(pi/4.*(n-32))./(pi/4.*(n-32));
x(33)=0;
x1=x.*cos(pi/2.*n);
X1=fft(x1,256)
plot(-128:127,abs(X1));
```

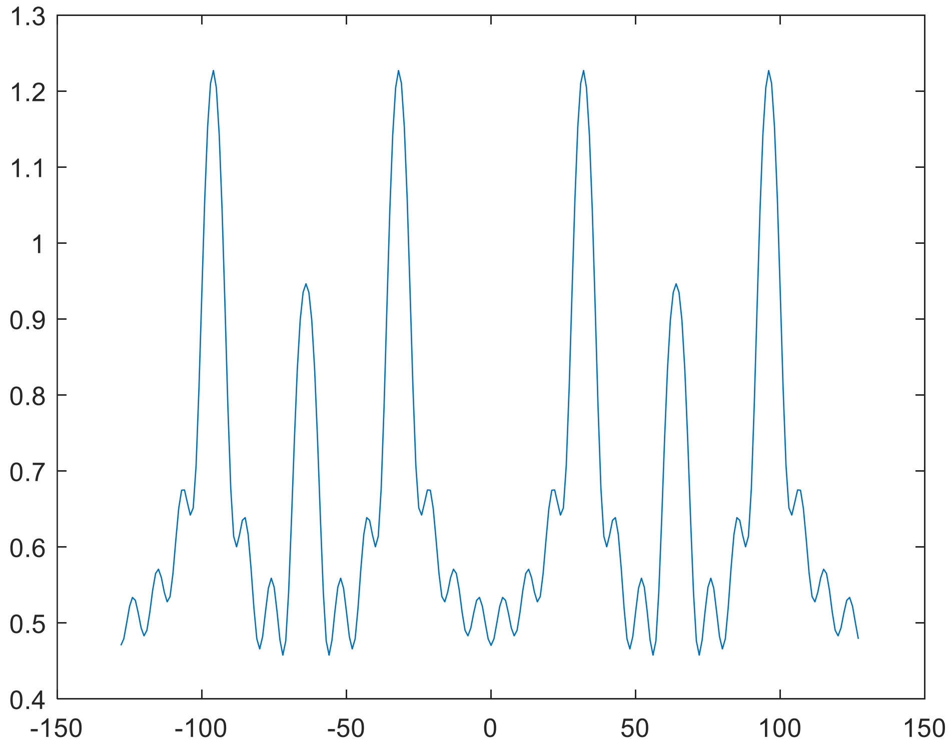


The plot is the compress and shifting of X.

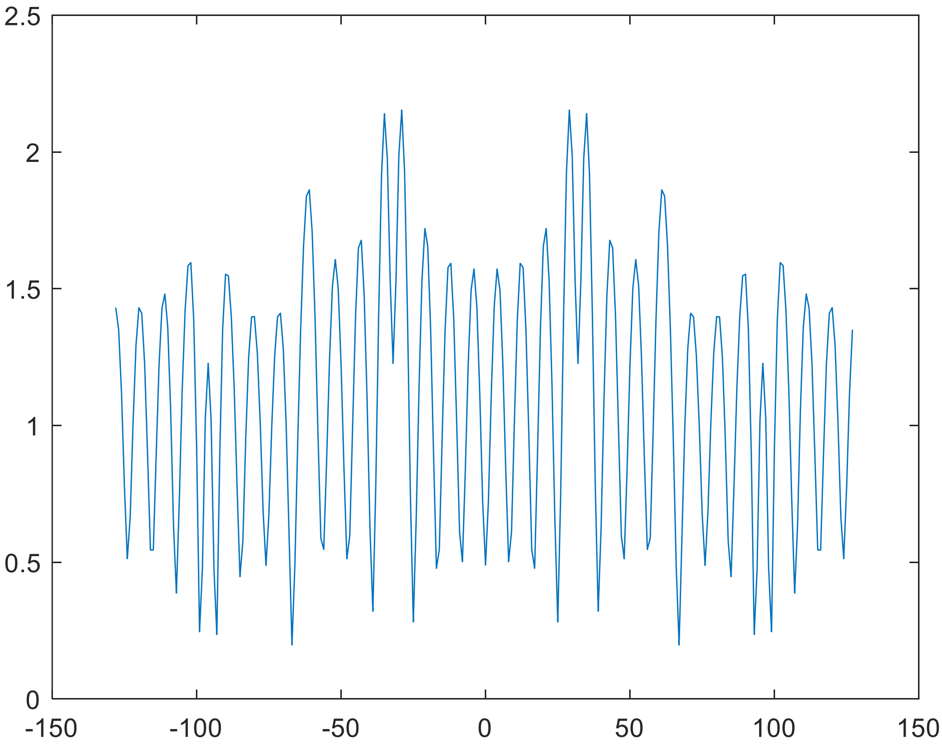
```
8.1(k)(l)
n=0:64;
h(1:65)=1./(pi.*(n-32)).*(1-(-1).^(n-32));
h(33)=0;%the hilbert
x(1:65)=sin(pi/4.*(n-32))./(pi/4.*(n-32));
x(33)=0;%the signal
xh=conv(h,x);
Xh=fft(xh,256);
plot(-128:127,abs(Xh))
```



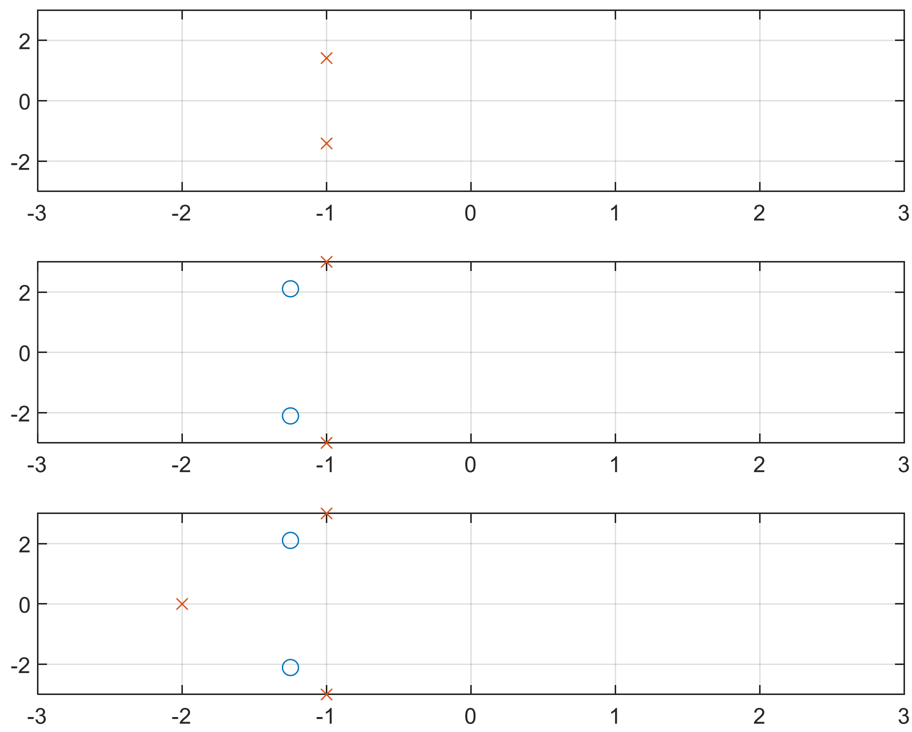

```
8.1(m)
n=0:64;
h(1:65)=1./(pi.*(n-32)).*(1-(-1).^(n-32));
h(33)=0;%the hilbert
x(1:65)=sin(pi/4.*(n-32))./(pi/4.*(n-32));
x(33)=0;%the signal
xh=conv(h,x);%after convolution
x2=xh(1:65).*sin(pi/2.*n);
X2=fft(x2,256);
plot(-128:127,abs(X2))
```




```
8.1(n)
n=0:64;
h(1:65)=1./(pi.*(n-32)).*(1-(-1).^(n-32));
h(33)=0;%the hilbert
x(1:65)=sin(pi/4.*(n-32))./(pi/4.*(n-32));
x(33)=0;%the signal
x1=x.*cos(pi/2.*n);%x1
xh=conv(h,x);
x2=xh(1:65).*sin(pi/2.*n);%x2
y=x1+x2;
Y=fft(y,256);
plot(-128:127,abs(Y))
```

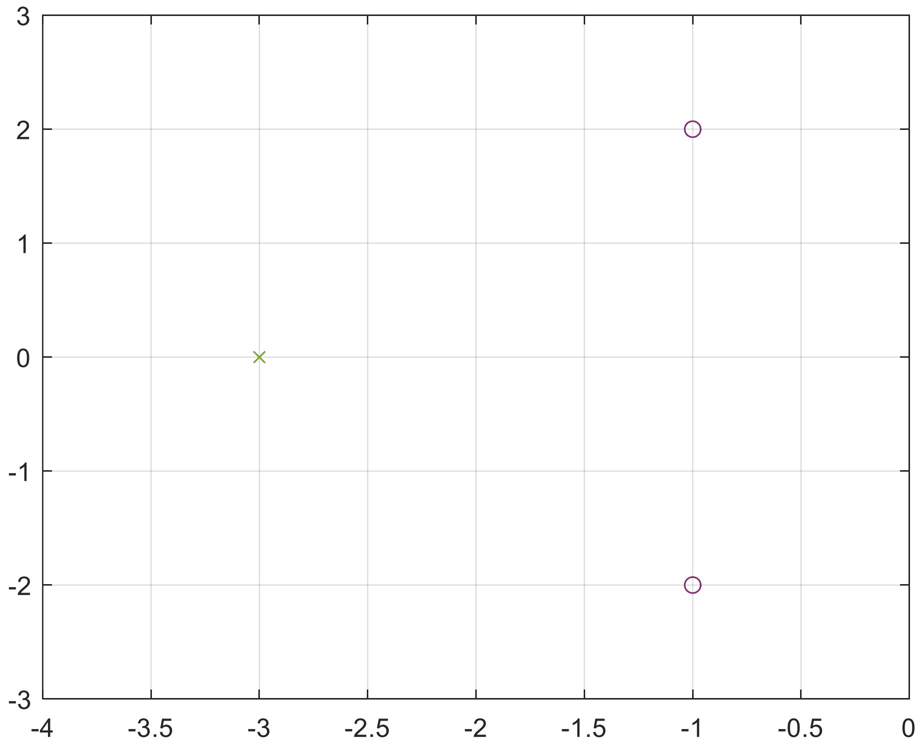



```
9.1(a)
b1= [1,5];%get the a&b
a1= [1,2,3];
b2= [2,5,12];
a2= [1,2,10];
b3= [2,5,12];
a3= [1,4,14,20];
zs1=roots(b1);%get the roots
ps1=roots(a1);
zs2=roots(b2);
ps2=roots(a2);
zs3=roots(b3);
ps3=roots(a3);
subplot(3,1,1)%plot
plot(real(zs1),imag(zs1),'o')
hold on
plot(real(ps1),imag(ps1),'x')
grid
axis([-3 3 -3 3])
subplot(3,1,2)
plot(real(zs2),imag(zs2),'o')
hold on
plot(real(ps2),imag(ps2),'x')
grid
axis([-3 3 -3 3])
subplot(3,1,3)
plot(real(zs3),imag(zs3),'o')
hold on
plot(real(ps3),imag(ps3),'x')
grid
axis([-3 3 -3 3])
```



9.1(c)

```
b=[1,2,5];%get the a&b
a=[1,3];
zs=roots(b);%get the roots
ps=roots(a);
plot(real(zs),imag(zs),'o');%plot
hold on
plot(real(ps),imag(ps),'x');
grid on
axis([-4 0 -3 3])
```

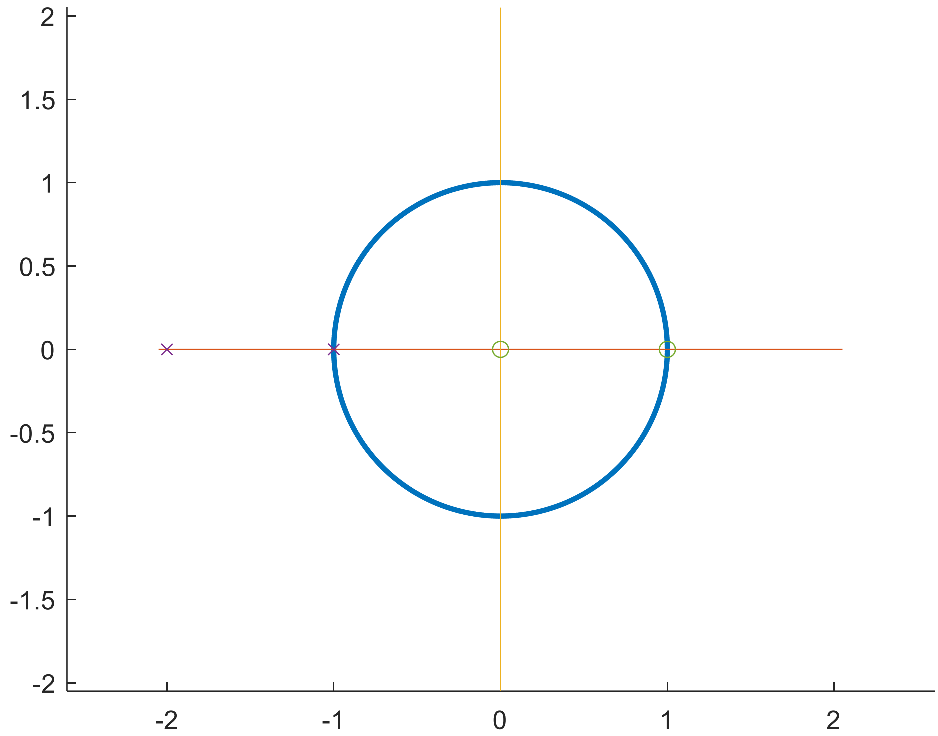



```
10.1(a)
b=[1,-1];
a=[1 3 2];
dpzplot(b,a)
```

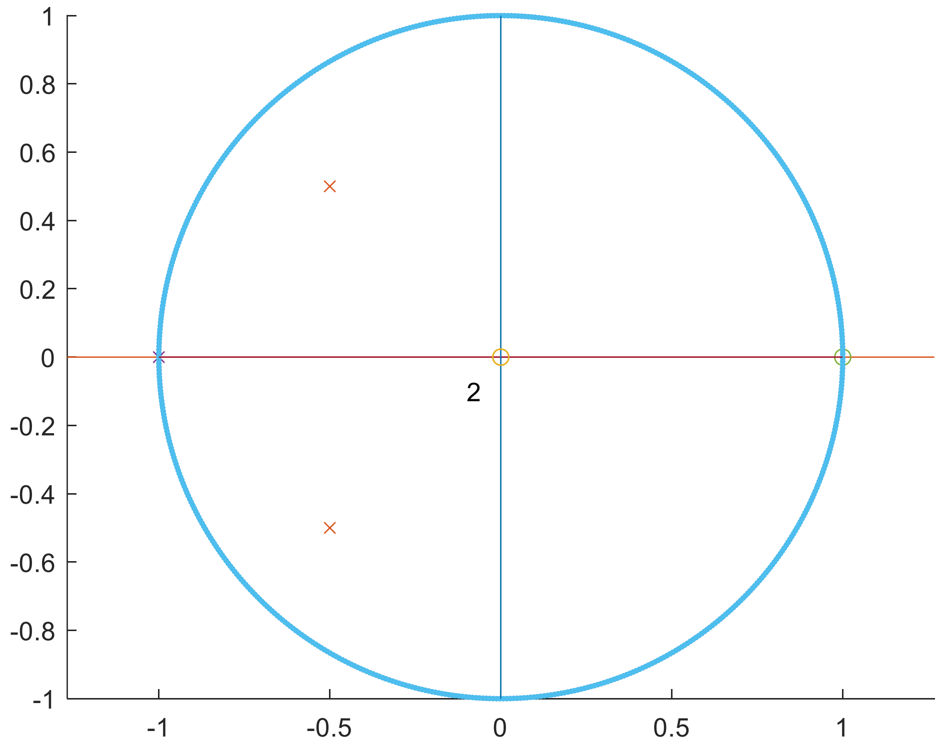
function dpzplot

```
function dpzplot(b,a);
% dpzplot (b, a)
% Plots the pole-zero diagram for the discrete-time system
function
% H(z)=b(z)/a(z) defined by numerator and denominator
polynomials b and a.
lb=length(b);
la=length(a);
if (la>lb)
b= [b zeros(1, la-lb) ] ;
else if (lb>la),
a= [a zeros(1, lb-la) ] ;
    end
end
ps = roots(a) ;
zs = roots (b) ;
mx = max( abs([ps' zs' .95]) ) + .05;
axis ( [-mx mx -mx mx] ) ;
axis('equal');
hold on
w = [0: 0.01:2*pi];
plot (cos (w) , sin(w) , ' . ' ) ;
plot ( [-mx mx] , [0 0] );
plot ( [0 0] , [-mx mx] ) ;
```

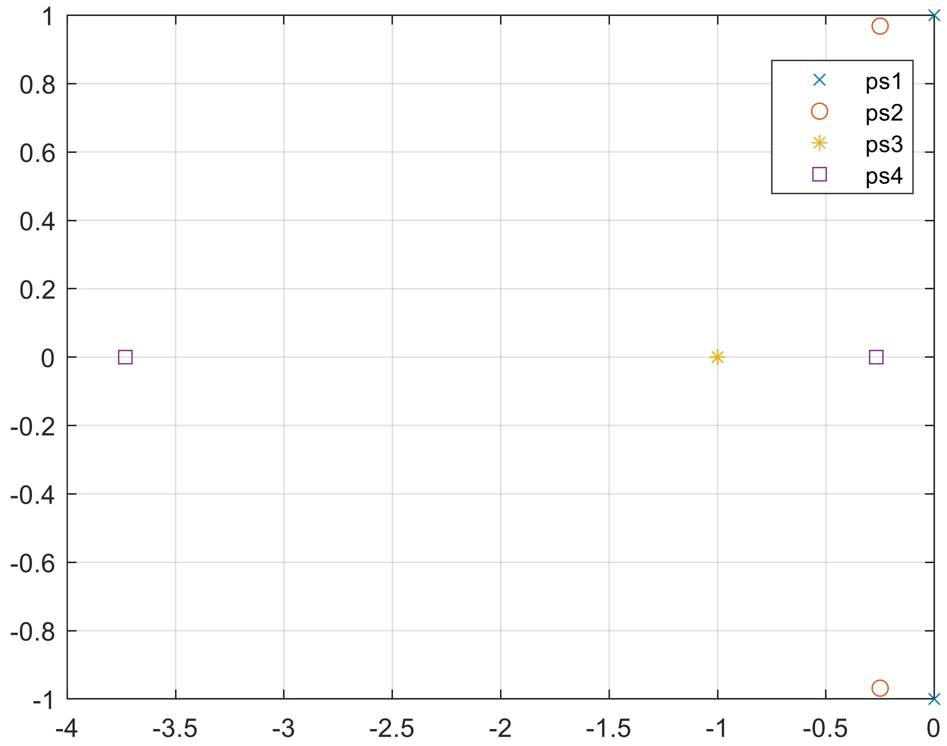
```
%text(O.l,l.l,'Im','sc');
%text(1.l,0.l,'Re','sc');
plot(real(ps) ,imag(ps) ,'x');
plot(real(zs), imag(zs) ,'o') ;
numz=sum(abs (zs)==0) ;
nump=sum(abs (ps)==0) ;
if numz>1
text(-0.1,-0.1,num2str(numz));
elseif nump>1
text(-0.1,-0.1,num2str(nump));
end
hold off ;
end
```



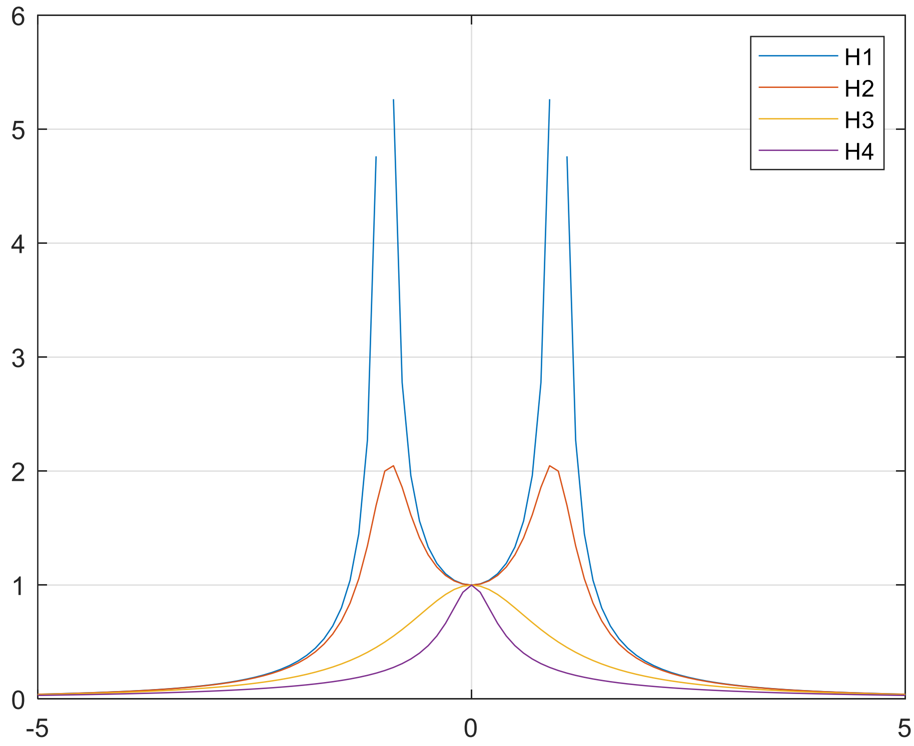

```
10.1(b)
b=[1];
a=[1,1,0.5];
dpzplot(b,a)
```




```
9.2(a)
b=1;%get the a&b
a1=[1,0,1];
a2=[1,0.5,1];
a3=[1,2,1];
a4=[1,4,1];
%no zeros for the numerator
ps1=roots(a1);
ps2=roots(a2);
ps3=roots(a3);
ps4=roots(a4);
plot(real(ps1),imag(ps1),'x');%plot
hold on;
plot(real(ps2),imag(ps2),'o');
hold on;
plot(real(ps3),imag(ps3),'*');
hold on;
plot(real(ps4),imag(ps4),'s');
grid on
legend('ps1','ps2','ps3','ps4')%label
```




```
9.2(b)
omega=[-5:0.1:5];
b=1;%get the a&b
a1=[1,0,1];
a2=[1,0.5,1];
a3=[1,2,1];
a4=[1,4,1];
h1=freqs(b,a1,omega);%find the frequency responses
h2=freqs(b,a2,omega);
h3=freqs(b,a3,omega);
h4=freqs(b,a4,omega);
plot(-5:0.1:5,abs(h1));%plot
hold on;
plot(-5:0.1:5,abs(h2));
hold on;
plot(-5:0.1:5,abs(h3));
hold on;
plot(-5:0.1:5,abs(h4));
grid on
legend('H1','H2','H3','H4')%label
abs(h1)
%from the graph, the H1 diverges to infinity at omega=-0.9 and
1.1
```



According to the plot, the highest value f frequency response for the $\zeta \geq 1$ is at $\omega = 0$, while that of the $\zeta \leq 1$ is not. And when $\omega = 0$, the equation (9.4) will no longer contain the ζ, so the value is all the same.

九、 Summary and comments:

The lab demonstrates the application of the knowledge we acquire from chapter 7 to chapter 10 in a very simple and clear way.

十、 Suggestion for this lab:

Score

Instructor: