Lab Assignment – 06 – Spring 2020

Signal & Systems

Atharva Deshpande || UG-**1** || CSE || S20190010043

Indian Institute of Information Technology, Sri City.

Sri City, Andhra Pradesh.

April 07, 2020.

Summary:

- This assignment mainly dealt with finding the Fourier transform and reconstructing the original signal using the obtained inverse Fourier transform.
- The main thing we learnt from this exercise was that we can create a signal from a given signal, which has discontinuities at certain points, by eliminating them.

1.)In its fundamental interval the aperiodic signal x1(t) is defined as:

   $x1(t) = \exp(-|t|)\ (u(t + 2\pi) - u(t - 2\pi))$

-> First, we'll create the code for finding the Fourier transform of the aperiodic signal x1(t).

->Finally, we'll reconstruct x1(t) using the inverse Fourier transform of x1(t).

->We'll also plot the magnitude and phase components of the spectrum versus frequency and compare the original & reconstructed signal.

Here's the code:

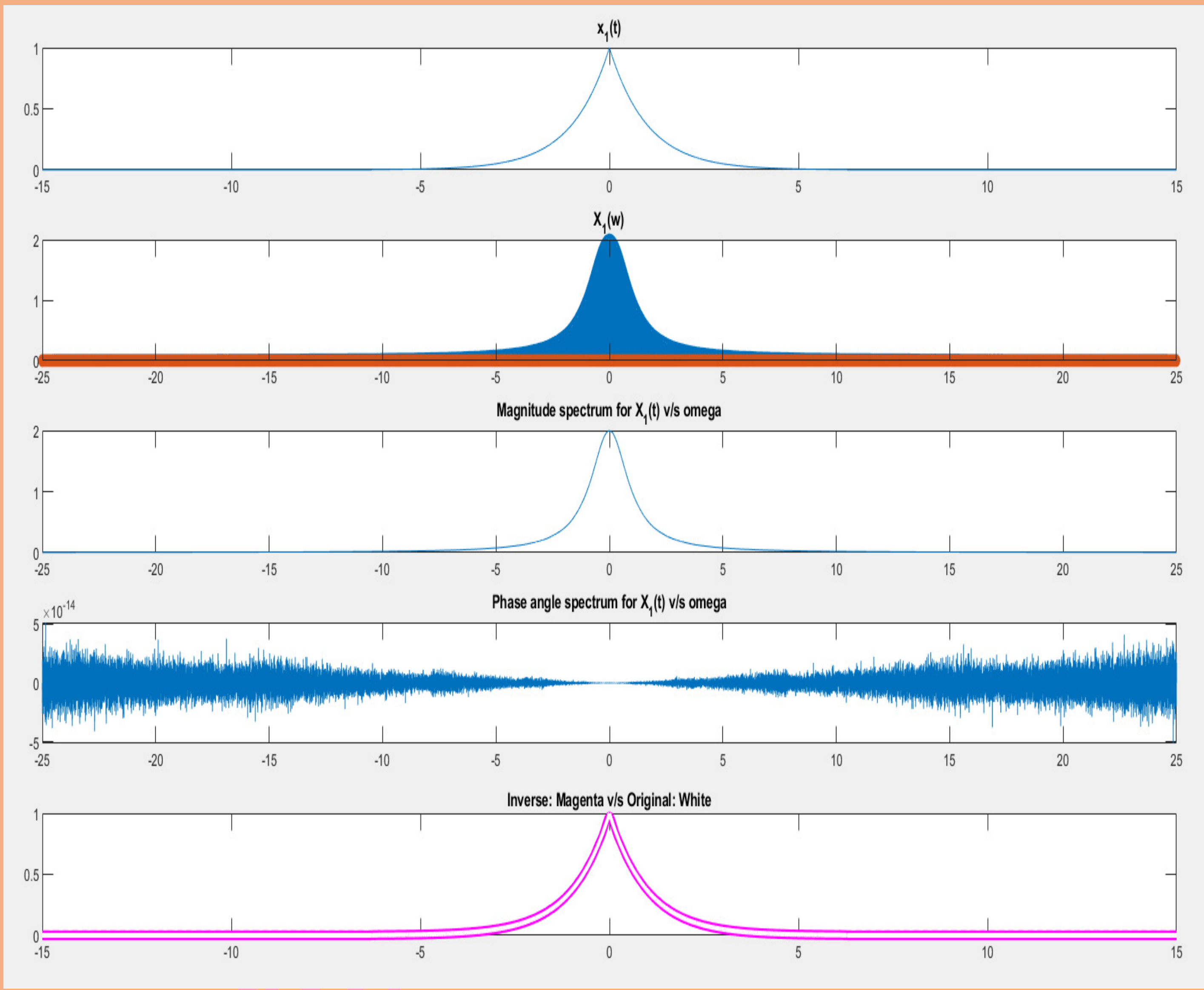
Users ▸ atharva deshpande ▸ Documents ▸ MATLAB

Editor - C:\Users\atharva deshpande\Documents\MATLAB\lab6.m

lab4one.m | lab4two.m | lab5.m | lab6.m | quiz1.m | Untitled*

```matlab
clear
clc
close all
%
m=15;del=0.001;t=-m:del:m;
%--------------x1-------------------%
x1=zeros(size(t));x1(t>=-2*pi & t<2*pi)=exp(-abs(t(t>=-2*pi & t<2*pi)));subplot(5,1,1),plot(t,x1),xlim([-m,m]),title('x_1(t)');
nomega=25;n=-nomega:del:nomega;
X_1=zeros(size(n));p=length(n);
for i=1:p
    X_1(i)=trapz(t,x1.*(exp(-1j*n(i)*t)));
end
subplot(5,1,2),stem(n,real(X_1)),hold on, stem(n,imag(X_1)),title('X_1(w)'),hold off;
mag_x1=zeros(size(n));
for i=1:p
    mag_x1(i)=abs(X_1(i));%(((real(X_1(i+nomega+1))).^2)+((imag(X_1(i+nomega+1))).^2));
end
subplot(5,1,3),plot(n,mag_x1),title('Magnitude spectrum for X_1(t) v/s omega');
angle_x1=zeros(size(n));
for i=1:p
    angle_x1(i)=angle(X_1(i));%Angle in radians from [-pi,pi];
end
subplot(5,1,4),plot(n,angle_x1),title('Phase angle spectrum for X_1(t) v/s omega');
x_1=zeros(size(t));o=length(t);
for i=1:o
    x_1(i)=trapz(n,X_1.*exp(1j*n*t(i)))/(2*pi);
end
subplot(5,1,5),plot(t,real(x_1),'LineWidth',5,'Color','m'),hold on,plot(t,x1,'LineWidth',2.5,'Color','w'),hold off,title('Inverse: Magenta v
```

Here's the output:



2.) In its fundamental interval the aperiodic signal x2(t) is defined as:

x2(t) = sinc(t) (u(t + 2π) − u(t − 2π))

-> First, we'll create the code for finding the Fourier transform of the aperiodic signal x2(t).

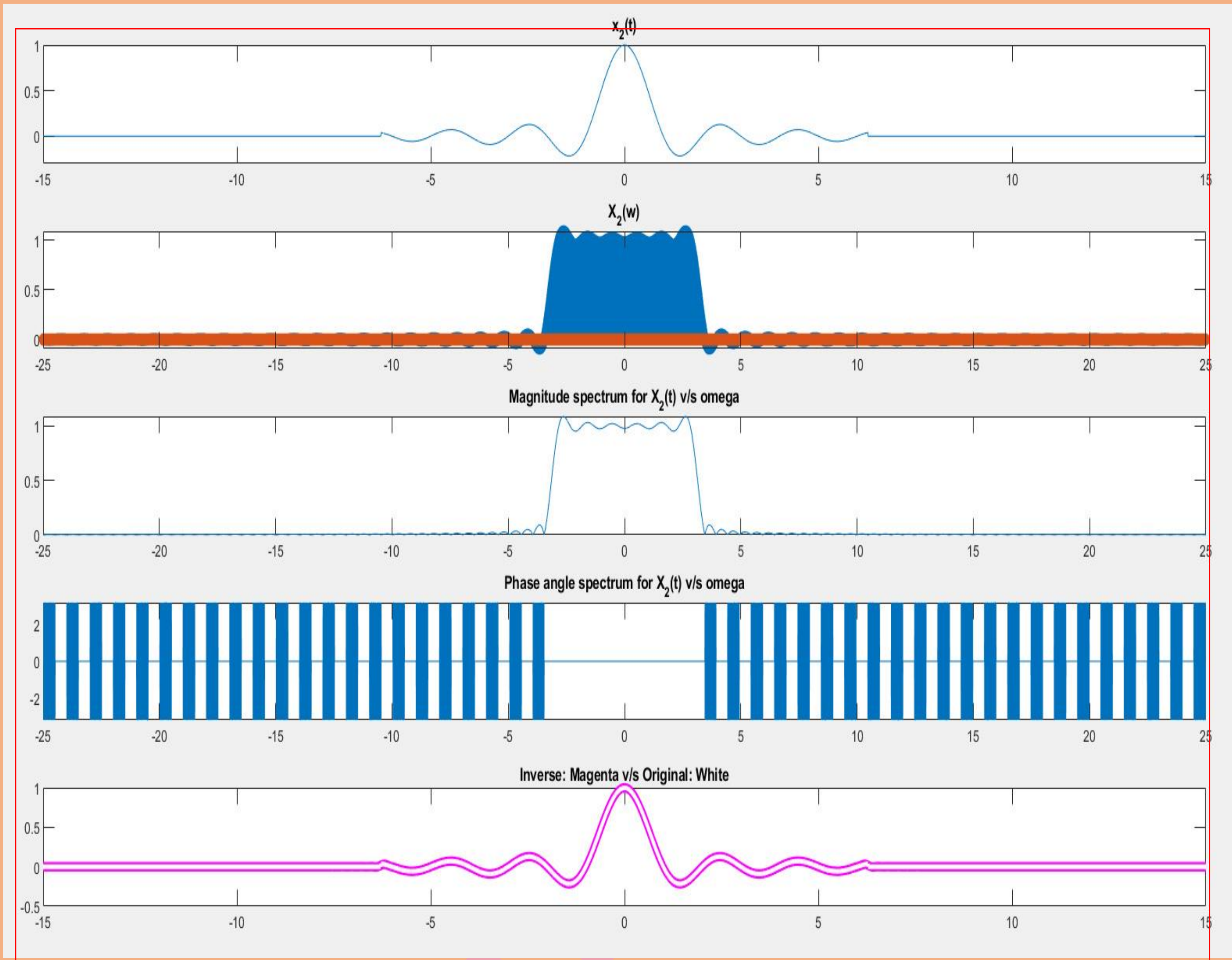
->Finally, we'll reconstruct x2(t) using the inverse Fourier transform of x2(t).

->We’ll also plot the magnitude and phase components of the spectrum versus frequency and compare the original & reconstructed signal.

Here’s the code:

```
%---------------x2-----------------%
x2=zeros(size(t));x2(t>=-2*pi & t<2*pi)=(sin(pi*t(t>=-2*pi & t<2*pi)))./(pi*t(t>=-2*pi & t<2*pi));x2(t==0)=1;
subplot(5,1,1),plot(t,x2),xlim([-m,m]),ylim([-0.3,1]),title('x_2(t)');
nomega=25;n=-nomega:del:nomega;
X_2=zeros(size(n));p=length(n);
for i=1:p
    X_2(i)=trapz(t,x2.*(exp(-1j*n(i)*t)));
end
subplot(5,1,2),stem(n,real(X_2)),hold on, stem(n,imag(X_2)),title('X_2(w)'),hold off;
mag_x2=zeros(size(n));
for i=1:p
    mag_x2(i)=abs(X_2(i));%(((real(X_1(i+nomega+1))).^2)+((imag(X_1(i+nomega+1))).^2));
end
subplot(5,1,3),plot(n,mag_x2),title('Magnitude spectrum for X_2(t) v/s omega');
angle_x2=zeros(size(n));
for i=1:p
    angle_x2(i)=angle(X_2(i));%Angle in radians from [-pi,pi];
end
subplot(5,1,4),plot(n,angle_x2),title('Phase angle spectrum for X_2(t) v/s omega');
x_2=zeros(size(t));o=length(t);
for i=1:o
    x_2(i)=trapz(n,X_2.*exp(1j*n*t(i)))/(2*pi);
end
subplot(5,1,5),plot(t,real(x_2),'LineWidth',5,'Color','m'),hold on,plot(t,x2,'LineWidth',2.5,'Color','w'),hold off,title('Inverse: Magenta v
```

Here’s the output:



3.) In its fundamental interval the aperiodic signal x3(t) is defined as:

$x3(t) = \exp(1/(1 + |t|))(u(t) - u(t - 2 * \pi))$

-> First, we'll create the code for finding the Fourier transform of the aperiodic signal x3(t).

->Finally, we'll reconstruct x3(t) using the inverse Fourier transform of x3(t).

->We'll also plot the magnitude and phase components of the spectrum versus frequency and compare the original & reconstructed signal.

Here’s the code:

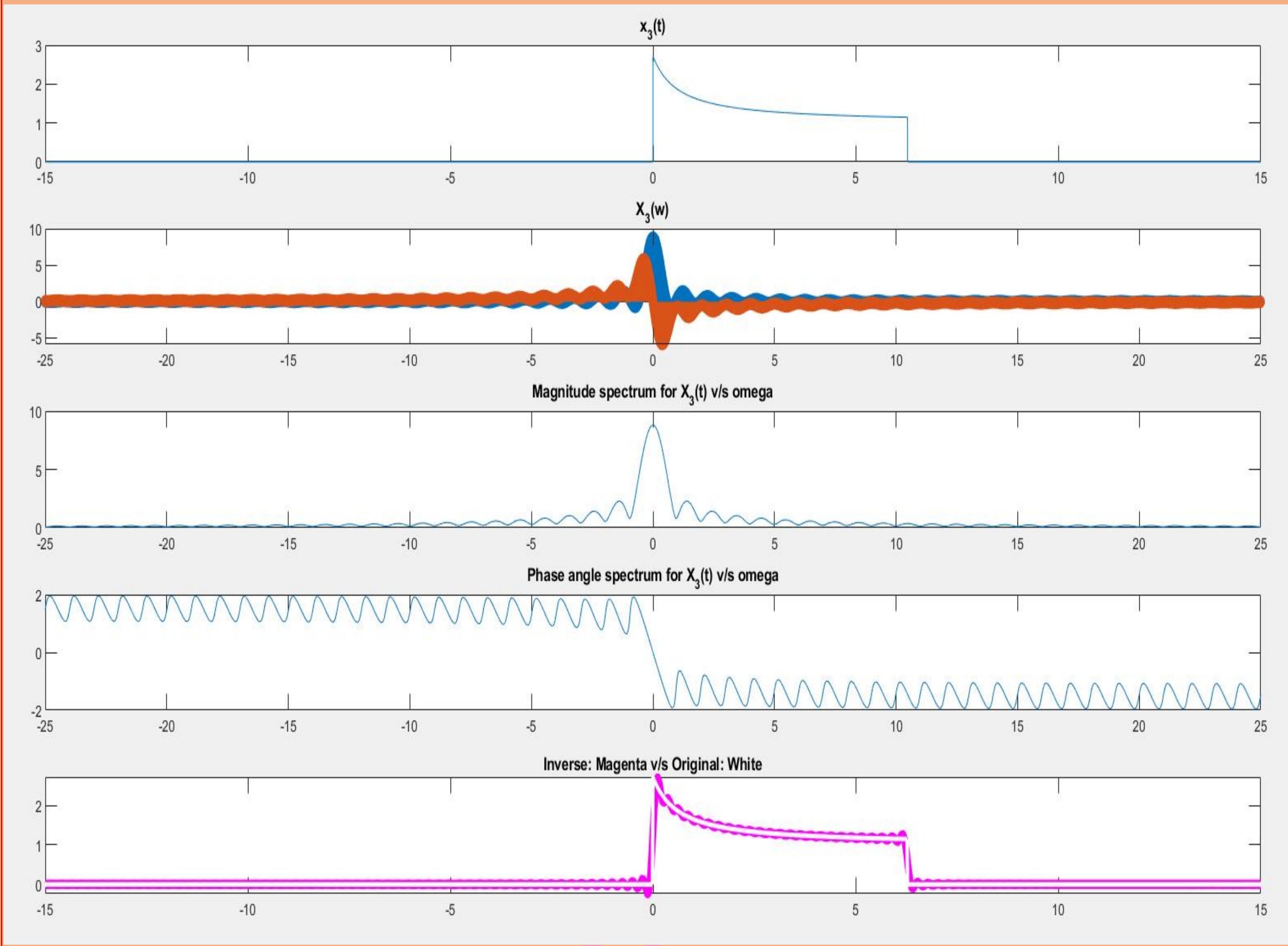
Users ▸ atharva deshpande ▸ Documents ▸ MATLAB

Editor - C:\Users\atharva deshpande\Documents\MATLAB\lab6.m

lab4one.m | lab4two.m | lab5.m | lab6.m | quiz1.m | Untitled*

```
%-------------x3---------------%
x3=zeros(size(t));x3(t>=0 & t<2*pi)=exp(1./(1+abs(t(t>=0 & t<2*pi))));subplot(5,1,1),plot(t,x3),xlim([-m,m]),title('x_3(t)');
nomega=25;n=-nomega:del:nomega;
X_3=zeros(size(n));p=length(n);
for i=1:p
    X_3(i)=trapz(t,x3.*(exp(-1j*n(i)*t)));
end
subplot(5,1,2),stem(n,real(X_3)),hold on, stem(n,imag(X_3)),title('X_3(w)'),hold off;
mag_x3=zeros(size(n));
for i=1:p
    mag_x3(i)=abs(X_3(i));%(((real(X_1(i+nomega+1))).^2)+((imag(X_1(i+nomega+1))).^2));
end
subplot(5,1,3),plot(n,mag_x3),title('Magnitude spectrum for X_3(t) v/s omega');
angle_x3=zeros(size(n));
for i=1:p
    angle_x3(i)=angle(X_3(i));%Angle in radians from [-pi,pi];
end
subplot(5,1,4),plot(n,angle_x3),title('Phase angle spectrum for X_3(t) v/s omega');
x_3=zeros(size(t));o=length(t);
for i=1:o
    x_3(i)=trapz(n,X_3.*exp(1j*n*t(i)))/(2*pi);
end
subplot(5,1,5),plot(t,real(x_3),'LineWidth',5,'Color','m'),hold on,plot(t,x3,'LineWidth',2.5,'Color','w'),hold off,title('Inverse: Magenta v
%----------------END-----------------%
```

Here’s the output:



Observation:

- Fourier transform is similar to Fourier series, just that, there we had number of coefficients while here we have omega w.
- There also we had to do trial and error until we got that number which gives us the most accurate plot. Here too we are doing the same thing but the number here is not large as compared to the Fourier series.
- Still it takes more time to obtain the output as we have a greater number of indices. For instance, w=[-15,15]->total numbers=(2*15+1)/0.001 .