EXPERIMENT 4

Linear Convolution and Circular Convolution

Aim: To obtain linear and circular convolution of two input sequence using scilab

A linear system has the property that the response to a linear combination of inputs is the same linear combination of the individual responses. The property of time invariance states that, in effect, the system is not sensitive to the time origin. More specifically, if the input is shifted in time by some amount, then the output is simply shifted by the same amount. The importance of linearity derives from the basic notion that for a linear system if the system inputs can be decomposed as a linear combination of some basic inputs and the system response is known for each of the basic inputs, then the response can be constructed as the same linear combination of the responses to each of the basic inputs. Signals (or functions) can be decomposed as a linear combination of basic signals in a wide variety of ways. For systems that are both linear and time-invariant, there are two particularly useful choices for these basic signals: delayed impulses and complex exponentials. The representation of both continuous time and discrete-time signals as a linear combination of delayed impulses and the consequences for representing linear, time-invariant systems. The resulting representation is referred to as convolution.

```
// Program for LINEAR CONVOLUTION
clc;
clf;
clear all;
 x = input("Enter the first sequence: ");
h = input("Enter the second sequence: ");
disp(conv(x, h), "Convolution = ");
 y = conv(x, h);
```

OUTPUT:

```
Enter the first sequence: [1 2 3 4 5 6 7 8 ]

Enter the second sequence: [ 5 4 5 2 1]

  "Convolution = "

   5.   14.   28.   44.   61.   78.   95.   112.   84.   60.   23.   8.
```

// program for circular convolution using concentric circle method

```
clc ;
clf ;
clear all;
g=input("enter the first sequence");
h=input("enter the second sequence");
N1=length (g);
N2=length(h);
N=max(N1,N2) ;
N3=N1-N2;
if(N3>=0)then
h =[h,zeros(1,N3)];
else
g =[g,zeros(1,- N3)];
end
for n=1:N
y(n)=0;
for i=1:N
j=n - i+1;
if(j<=0)
j= N + j;
end
y(n)=y(n)+g(i)*h(j);
end
end
disp(' sequence y =');
disp(y);
plot2d3(y);
```

Output

```
enter the first sequence[2 1 2 1]
enter the second sequence[ 1 2 3 4]
```

```
 " sequence y ="
  14.   16.   14.   16.
```

<u>// Program for Circular convolution using DFT computation</u>

```
clc ;
close ;
x1=[2 ,1 ,2 ,1];
x2=[1 ,2 ,3 ,4];
//DFT Compu tation
X1 =fft(x1,-1);
X2=fft(x2,-1);
X3=X1 .* X2 ;
//IDFT Computation
x3 =fft( X3 ,1);
// D i s p l a y s e q u e n c e x3 [ n ] i n command window
disp(x3);
```

Output

```
  14.   16.   14.   16.
```

Pre lab

1. Define linear convolution
2. Define circular convolution
3. what is convolution property of DFT

Post lab

1.Find the linear convolution of two sequence manual and check your answer with scilab

x(n)={3,-1,0,1,3,2,0,1,2,1}h(n)={1,1,1}

2.Find the linear convolution of two sequence manual and check your answer with scilab

x(n)={3,2,1,2}h(n)={1,2,1,2}

3.Find the circular convolution of two sequence manual and check your answer with scilab

$x_1(n)$={3,2,1,2}x2(n)={1,2,3,1}

RESULT:

EXPERIMENT 5

Experiment 5a: Autocorrelation and cross correlation

5.1 Aim: To obtain correlation of two input sequence using scilab

(i)Auto correlation

(ii) cross correlation.

Autocorrelation is the convolution of a time series with its time-reversed self. Fourier ransform of an autocorrelation is proportional to the Power Spectral Density of time series. The cross correlation of two sequences x[n] and y[n]=x[n-k] shows a peak at the value of k. Hence cross correlation is employed to compute the exact value of the delay k between the 2 signals. Used in radar and sonar applications, where the received signal reflected from the target is the delayed version of the transmitted signal (measure delay to determine the distance of the target)

```
//program for cross correlation
clc;
clear;
 close;
x = input("Enter First Sequence: ");
h = input("Enter Second Sequence: ");
y = xcorr(x, h);
disp(y, "Cross correlation  = ");


Enter First Sequence: [ 1 2 3 4]

Enter Second Sequence: [3 4 5 6]

  "Cross correlation  = "

   6.   17.   32.   50.   38.   25.   12.
```

```
//program for Auto correlation

clc;
clear; close;
x = input("Enter First Sequence: ");
```

```
//h = input("Enter Second Sequence: ");
y = xcorr(x);
disp(y, "Auto correlation  = ");
```

out put:

Enter First Sequence: [1 2 3 4]

"Auto correlation

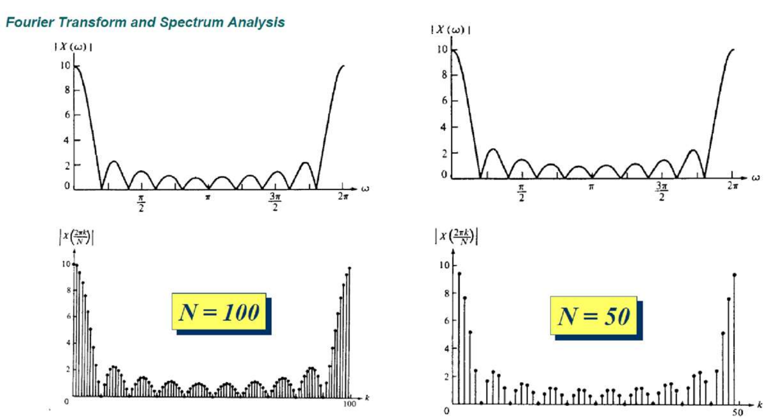
4.   11.   20.   30.   20.   11.   4.

Experiment 5b. Spectrum Analysis using DFT

Aim: To analyze the spectrum signal using DFT in scilab platform

Discrete Fourier Transform:

Spectrum of aperiodic discrete-time signals is periodic and continuous an it is difficult to handle by computer. Since the spectrum is periodic, there's no point to keep all periods – one period is enough. Computer cannot handle continuous data, we can only keep some samples of the spectrum. Interesting enough, such requirements lead to a very simple way to find the spectrum of signal is Discrete Fourier Transform. Discrete Fourier Transform (DFT) is exactly the output of the Fourier Transform of an aperiodic sequence at some particular frequencies.

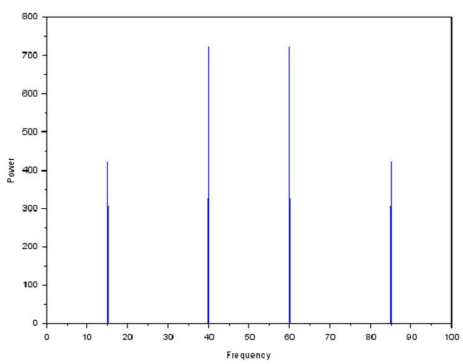


<u>//Spectrum analysis using DFT</u>

```
clc;
close;
clear;
fs=100;
t = 0:1/fs:10-1/fs;
x = ((1.3)*sin(2*%pi*15*t)+ (1.7)*sin(2*%pi*40*(t-2)))
y=fft(x)
n = length(x);
```

```
f = (0:n-1)*(fs/n);
power = abs(y).^2/n;
plot(f,power)
xlabel('Frequency')
ylabel('Power')
```

OUTPUT:



Pre lab

1. Define auto correlation?
2. Define correlation
3. Give the properties of auto correlation.
4. Draw the spectrum for periodic and aperiodic signal.

Post lab

1. List the dference between Auto correlation and convolution?
2. List the difference between Auto correlation and cross correlation?

3. What is the length of the resultant sequence of auto correlation?
4. List few applications of correlation.

RESULT