MAWLANA BHASHANI SCIENCE AND TECHNOLOGY UNIVERSITY

DEPARTMENT OF ICT

Lab Report No : 04

Course Code : ICT-4206

Course Title : Digital Signal Processing Lab

Lab Report name : Convolution, autocorrelation and cross-Correlation of a signal.

Submitted by

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Experiment No: 4

Experiment name: Perform convolution, autocorrelation and cross-correlation of a signal.

Objectives: Through this experiment we will learn how to perform convolution, autocorrelation and cross-correlation of a sequence.

i. Convolution of signal x(n):
Corresponding code:

```
clc; close all; clear all;
%program for convolution of two sequences
x=input('enter input sequence: ');
h=input('enter impulse response: ');
y=conv(x,h);
subplot(3,1,1);
stem(x);
xlabel('n');
ylabel('x(n)');
title('input sequence')
subplot(3,1,2);
stem(h);
xlabel('n');
ylabel('h(n)');
title('impulse response sequence')
subplot(3,1,3);
stem(y);
xlabel('n');
ylabel('y(n)');
title('linear convolution')
disp('linear convolution y=');
disp(y)
```

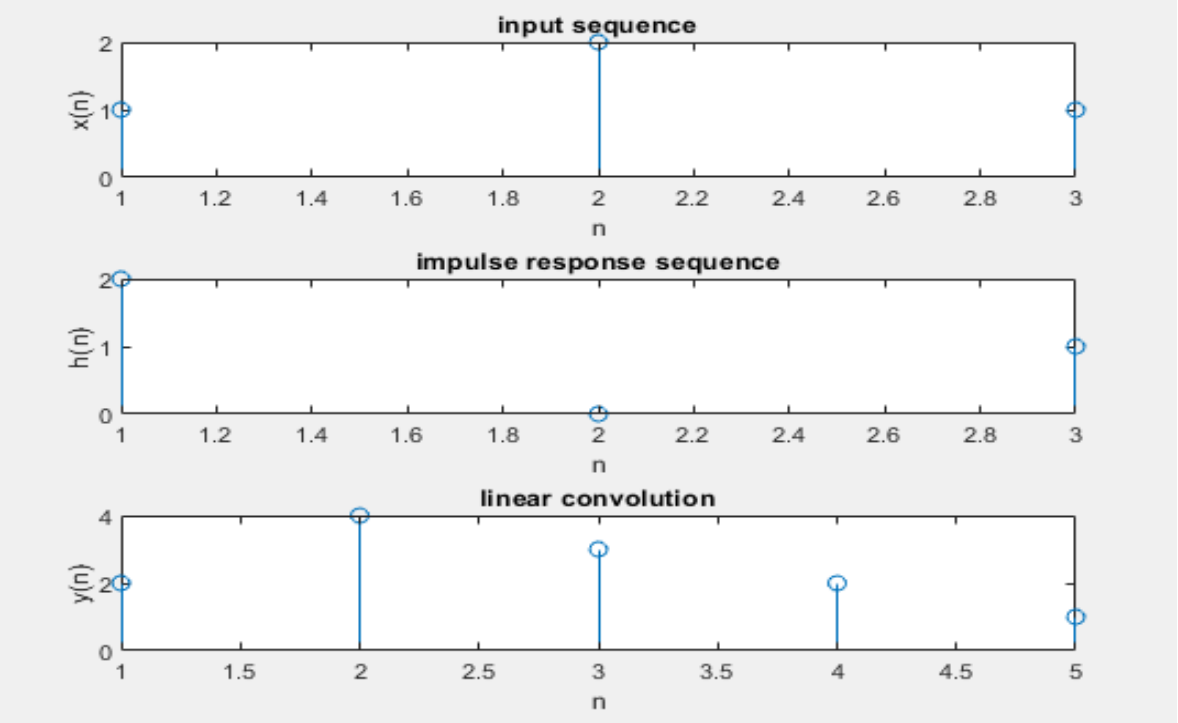
Output:

enter input sequence: [1 2 1]

enter impulse response: [2 0 1]

linear convolution y=

2 4 3 2 1



ii. Autocorrelation of signal x(n):

Corresponding code:

```
clc;
clear all;
close all;
x=input('Enter the sequence x[n]= ');
xsi=input('enter the starting index=');
Rxx=xcorr(x,x)
energy=sum(x.^2)
c_i=ceil(length(Rxx)/2)
Rxx_0=Rxx(c_i)
if Rxx_0==energy
disp('Eneregy property proved.');
else
disp('EnergyProperty not proved');
end
Rxxf=fliplr(Rxx)
if Rxx==Rxxf
disp('It is even.');
else
disp('It is not even.');
end
n1= xsi:length(x)+xsi-1;
n2= -(length(x)-1):(length(x)-1);
subplot(3,1,1),stem(n1,x),xlabel('n1'),ylabel('amplitude');
subplot(3,1,2),stem(n2,Rxx),xlabel('n2'),ylabel('amplitude');
subplot(3,1,3),stem(n2,Rxxf),xlabel('n2'),ylabel('amplitude');
```

Output:

Enter the sequence x[n]= [2 3 1 4]

enter the starting index=0

Rxx = 8 14 13 30 13 14 8

energy = 30

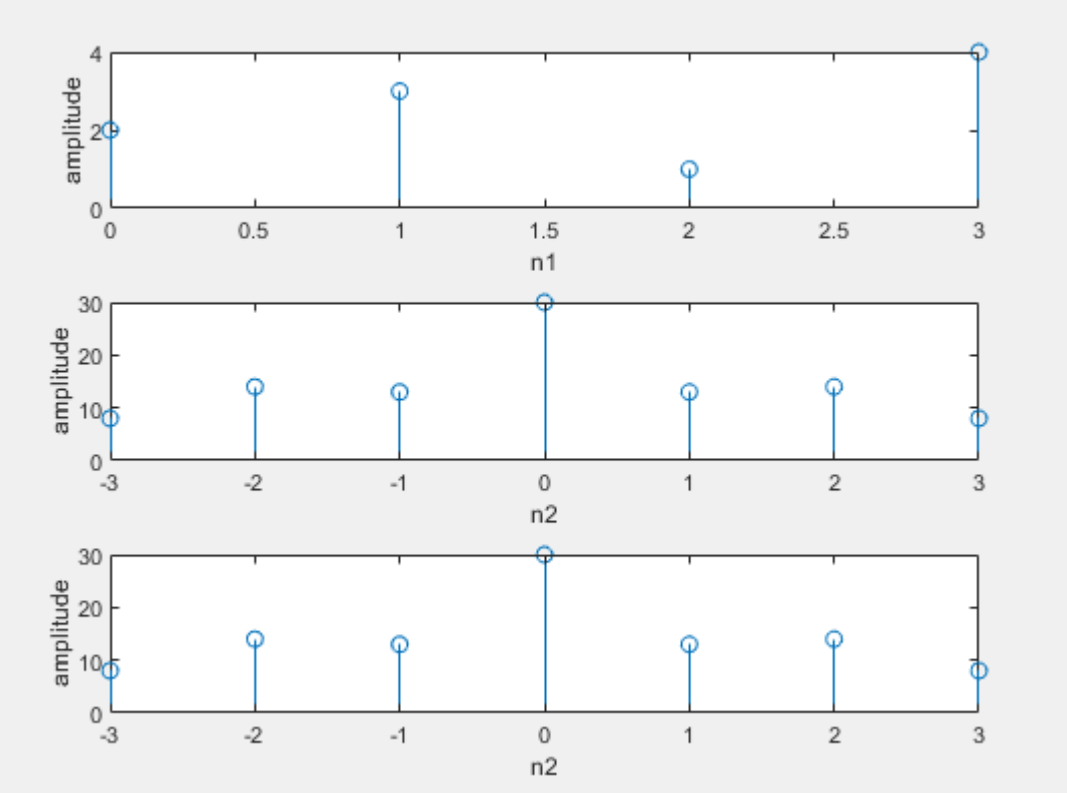
c_i = 4

Rxx_0 = 30

Eneregy property proved.

Rxxf = 8 14 13 30 13 14 8

It is even.



iii. Cross-correlation of signal x(n):

Corresponding code:

```
clc; clear all; close all;
x=input('Enter the first sequence=');
xsi=input('enter the starting index of x=');
xei=input('enter the ending index of x=');
y=input('Enter the second sequence= ');
ysi=input('enter the starting index of y=');
```

```
yei=input('enter the ending index of y=');
Ex=sum(x.^2);
Ey=sum(y.^2);
energy=sqrt(Ex*Ey);
Rxy=xcorr(x,y)
Ryx=xcorr(y,x)
Ryxf=fliplr(Ryx);
if Rxy==Ryxf
disp('Symmetry Property is proved');
else
disp('Symmetry property not proved');
end
n1=xsi:length(x)+xsi-1;
n2=ysi:length(y)+ysi-1;
n3=(xsi-yei):(xei-ysi)
subplot(1,4,1),stem(n1,x),xlabel('lag'),ylabel('amplitude');
subplot(1,4,2),stem(n2,y),xlabel('lag'),ylabel('amplitude');
subplot(1,4,3),stem(n3,Rxy),xlabel('lag'),ylabel('amplitude');
subplot(1,4,4),stem(n3,Ryxf),xlabel('lag'),ylabel('amplitude');
```

Output:

Enter the first sequence=[2 3 1 4]

enter the starting index of x=0

enter the ending index of x=3

Enter the second sequence= [1 3 2 1]

enter the starting index of y=0

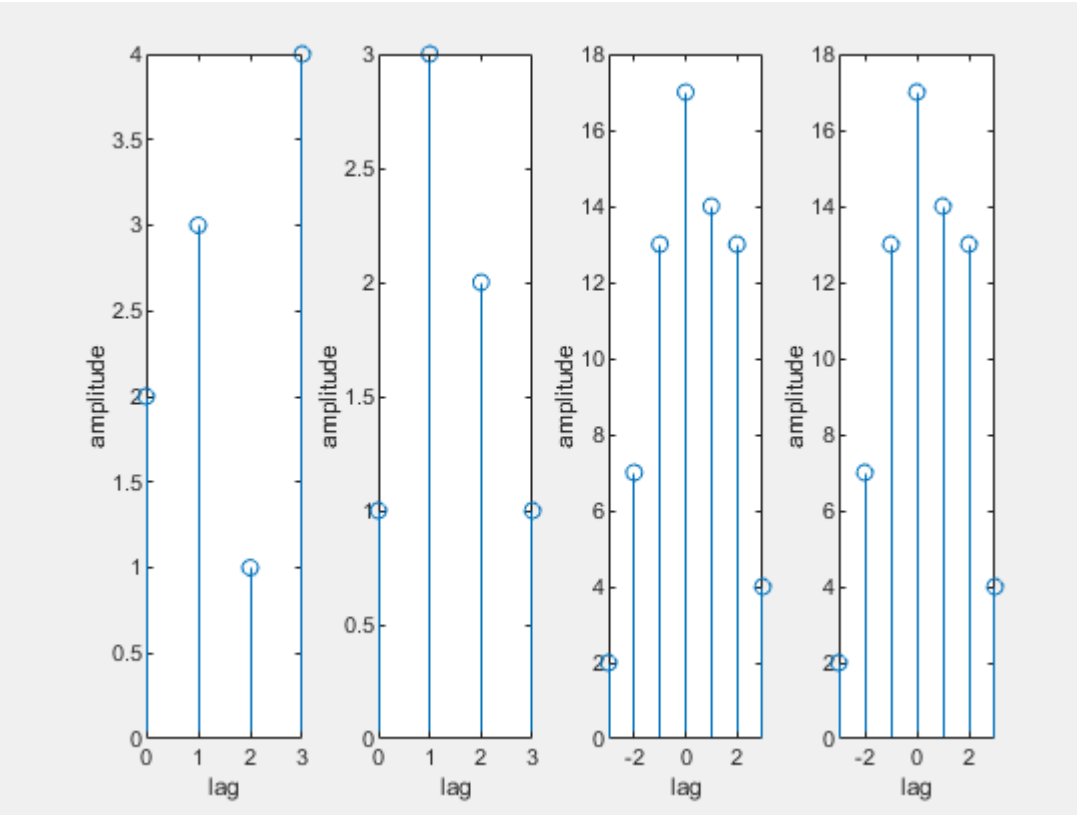
enter the ending index of y=3

Rxy =2 7 13 17 14 13 4

Ryx =4 13 14 17 13 7 2

Symmetry Property is proved

n3 = -3 -2 -1 0 1 2 3



Discussion: After completing this experiment, we have learnt, about how to evaluate convolution, autocorrelation and cross-correlation of a signal.