"Heaven's light is our guide"

Rajshahi University of Engineering & Technology

Department of Electrical & Computer Engineering

Course Name : Digital Signal Processing Sessional
Course No : ECE 4124

Lab Report

Submitted To	***Submitted By***
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Experiment No: 03

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Experiment Name: *i. Auto & Cross Correlation of signals.*
ii. Process of finding out the Periodicity of the signal.

Theory:

Correlation is the relation or combined form of a signal & time shifted form of another signal. This relation may perform on a single signal, where one of them is time shifted from. Which is called **Autocorrelation**. Or in between two different signals. Which is called **Cross Correlation**.

Correlation is a mathematical tool to find the relation between signals. Mathematical representation of Autocorrelation of the function **x(t)**:

$$R_{xx}(\tau) = \int_{-\infty}^{\infty} x(t)x'(t-\tau)dt$$

Cross Correlation is almost similar to Autocorrelation. But instead of using a single signal, there is two signal **x(t)** & **y(t)** have been used. Mathematical representation of Autocorrelation of is:

$$R_{xy}(\tau) = \int_{-\infty}^{\infty} x(t)y'(t-\tau)dt$$

In Graphical Method of calculating the Correlation, there are two number of sequences of discreate signal. Fix one of the signals & sliding the other signal from one side to another. In each step, multiply the corresponding columns & add the multiplied row to get the particular results.

Code with corresponding Output:

- ***Code for Auto Correlation:***

```
%input section

%x=[2 5 3 4];
x = input("Input Signal values: ");

```

```
lenx=length(x);
h=zeros(1,length(x));
for i=1:lenx
    h(i)=x(i);
end



%custom code section

lenh=length(h);
N=lenx+lenh-1;
X=zeros(1,N);

count=lenx-1;
for t=1:lenx
    for i=1:lenx
       j=i+count;
       X(t)=X(t)+(x(i)*h(j));
        if(i==t)
            count=count-1;
            break;
        end
    end
end

count=1;
index=2;
for t=lenx+1:N
    for i=index:lenx
       j=i-count;
       X(t)=X(t)+(x(i)*h(j));
    end
    index=index+1;
    count=count+1;
end



%plotting section

subplot(3,1,1);
stem(x);
title('Input Signal: x(n)');

subplot(3,1,2);
stem(xcorr(x,x));
title('Auto Corrrelation using build in function');

subplot(3,1,3);
stem(X);
title('Auto Corrrelation using customized code');
```

- ***Output of Auto Correlation:***

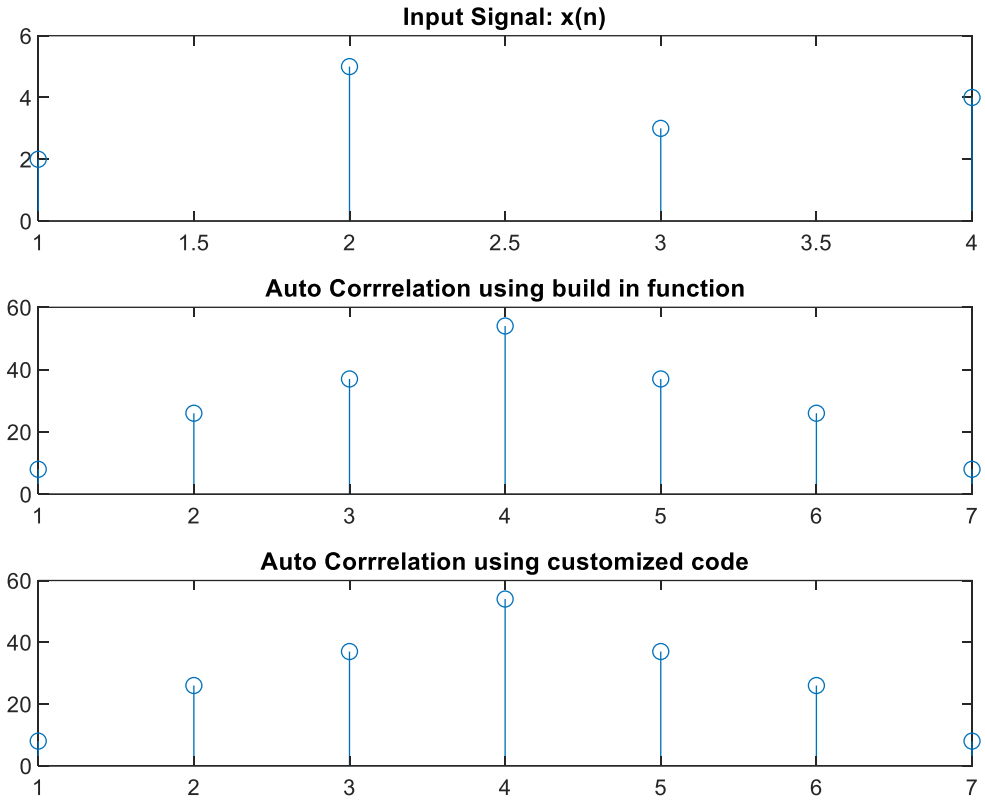

Fig. 1: Output of Auto Correlation.

- ***Code for Cross Correlation:***

```
%input section

%x=[2 5 -3 4];
x = input("Input First Signal values x(n): ");
%h=[3 -1 3 2];
h = input("Input Second Signal values h(n): ");




%custom code section

lenx=length(x);
lenh=length(h);
N=lenx+lenh-1;
X=zeros(1,N);

count=lenx-1;
```

```
for t=1:lenx
    for i=1:lenx
       j=i+count;
       X(t)=X(t)+(x(i)*h(j));
        if(i==t)
            count=count-1;
            break;
        end
    end
end

count=1;
index=2;
for t=lenx+1:N
    for i=index:lenx
       j=i-count;
       X(t)=X(t)+(x(i)*h(j));
    end
    index=index+1;
    count=count+1;
end




%plotting section

subplot(4,1,1);
stem(x);
title('First Input Signal: x(t)');

subplot(4,1,2);
stem(h);
title('Second Input Signal: h(t)');

subplot(4,1,3);
stem(xcorr(x,h));
title('Cross Corrrelation using build in function');

subplot(4,1,4);
stem(X);
title('Cross Corrrelation using customized code');
```

- ***Output of Cross Correlation:***

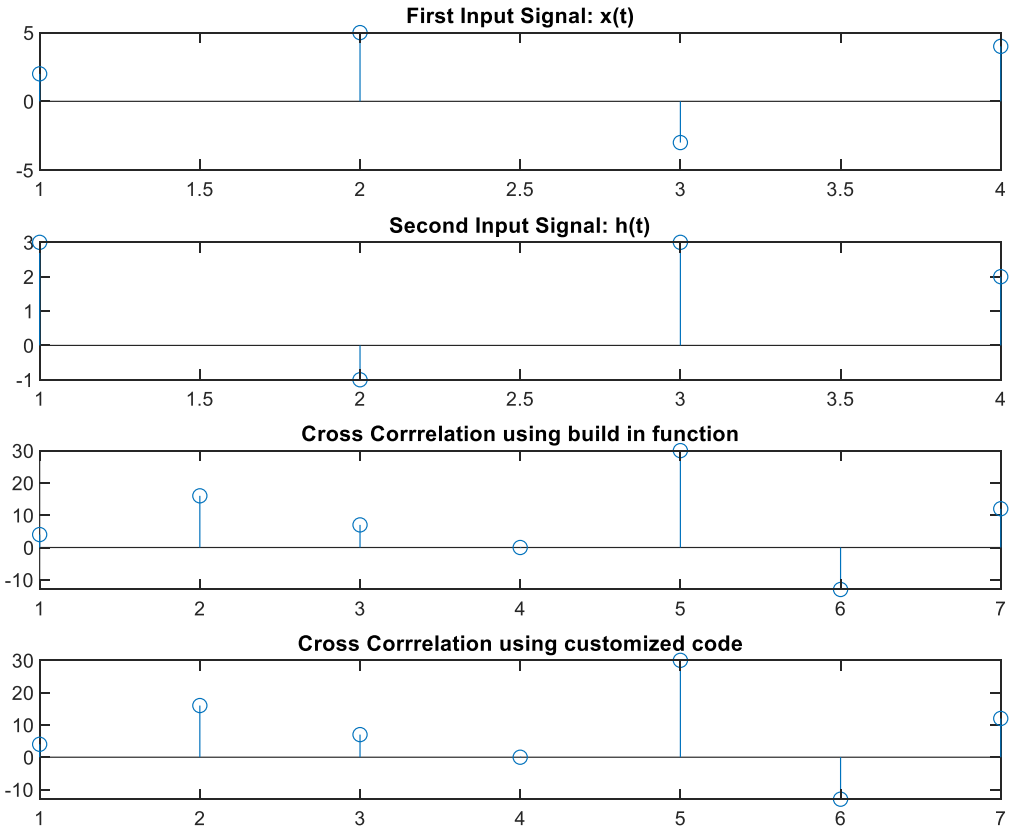

Fig. 2: Output of Cross Correlation.

- ***Code for Finding Periodicity:***

```
%input section

%x=[2 1 3 6];
x = input("Input Signal values: ");
n=5;                        %times of repeatation
lenx=length(x);
L=n*lenx;
h=zeros(1,L);
for t=1:L
   if(mod(t,lenx)==0)
       h(t)=x(lenx);
   else
       h(t)=x(mod(t,lenx));
   end
end



%custom code section

N=L-(lenx-1);
X=zeros(1,N);

```

```
    count=L;
    for t=1:N
        temp=count;
        for i=lenx:-1:1
            X(t)=X(t)+(x(i)*h(temp));
            temp=temp-1;
        end
        count=count-1;
    end



    %plotting section

    subplot(3,1,1);
    stem(x);
    title('First Input Signal: x(t)');


    subplot(3,1,3);
    stem(X);
    title('Periodicity');
```

- ***Output of Finding Periodicity:***

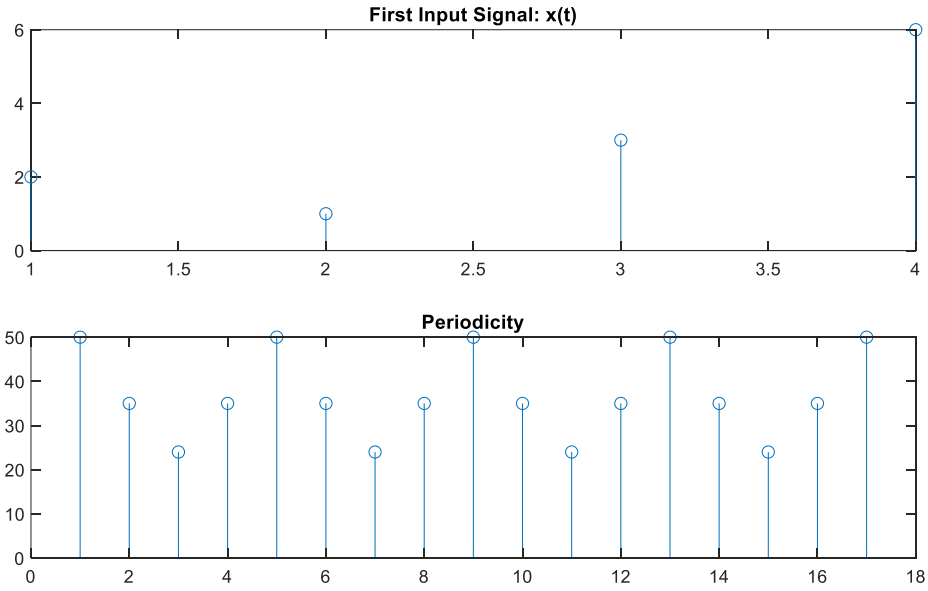

Fig. 3: Output of Periodic Signal.

Discussion:

This experiment is based on MATLAB simulation. Here we have plotted a signal then perform its Auto Correlation of that signal & plotted two discreate signal then perform its Cross Correlation. After that, while performing Auto Correlation, Periodicity of the signal is measured. The program has been completed successfully & ran in MATLAB without any warning or Error.