Heaven's Light is Our Guide

# Rajshahi University of Engineering & Technology


## Department of Electrical & Computer Engineering

**Course No: ECE 4124**

**Course Title: Digital Signal Processing Sessional**

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

**Experiment Date:** 08.05.2023

**Experiment Name**: Study of autocorrelation and cross correlation in digital signal processing.

**Theory:**

In digital signal processing, autocorrelation refers to the computation of the correlation between a signal and a delayed version of itself. It is commonly used to analyze the similarity or repetitive patterns within a signal. Autocorrelation is calculated by multiplying corresponding samples of the signal and its delayed version, and then summing these products over a certain time interval. The resulting autocorrelation function provides information about the periodicity, periodic components, or spectral content of the signal.

On the other hand, cross-correlation is a measure of similarity between two signals by comparing their respective time shifts. It determines the degree of correlation between two signals as a function of the time delay or lag between them. Cross-correlation is computed by multiplying corresponding samples of the two signals and summing these products over a certain time interval. It is often used to detect similarities, time delays, or phase differences between signals, and has applications in fields such as audio processing, image recognition, and communication systems.

**Code:**

i) <u>For Autocorrelation:</u>

```
x=input('Enter Input: ');
N=length(x);
n = 2*N-1;
y = zeros(1, n);
for i=1:N
    for j=1:i
        y(i) = y(i)+x(N-i+j)*x(j);
    end
end
for i=1:N-1
    for j=i+1:N
        y(N+i) = y(N+i)+x(j)*x(j-i);
    end
end
subplot(3,1,1);
stem(x);
title('Input Signal');
subplot(3,1,2);
disp(xcorr(x));
stem(xcorr(x));
title('Output With Build-in Function');
subplot(3,1,3);
disp(y);
stem(y);
title('Output Without Build-in Function');
```

ii) For Cross Correlation:

```
x=input('Enter First Input: ');
h=input('Enter Second Input: ');
N=length(x);
n = 2*N-1;
y = zeros(1, n);
for i=1:N
    for j=1:i
        y(i) = y(i)+h(N-i+j)*x(j);
    end
end
for i=1:N-1
    for j=i+1:N
        y(N+i) = y(N+i)+x(j)*h(j-i);
    end
end
subplot(4,1,1);
stem(x);
title('First Input Signal');
subplot(4,1,2);
stem(h);
title('Second Input Signal');
subplot(4,1,3);
disp(xcorr(x,h));
stem(xcorr(x,h));
title('Output With Build-in Function');
subplot(4,1,4);
disp(y);
stem(y);
title('Output Without Build-in Function');
```

**Input & Output:**

```
Enter Input: [1 2 3 4]
    4.0000   11.0000   20.0000   30.0000   20.0000   11.0000    4.0000

     4    11    20    30    20    11     4
```

Figure-1: Input and output for autocorrelation.

```
Enter First Input: [1 2 3 4]
Enter Second Input: [4 3 -1 2]
    2.0000    3.0000    7.0000   15.0000   13.0000   24.0000   16.0000

     2     3     7    15    13    24    16
```

Figure-2: Input and output for cross correlation.

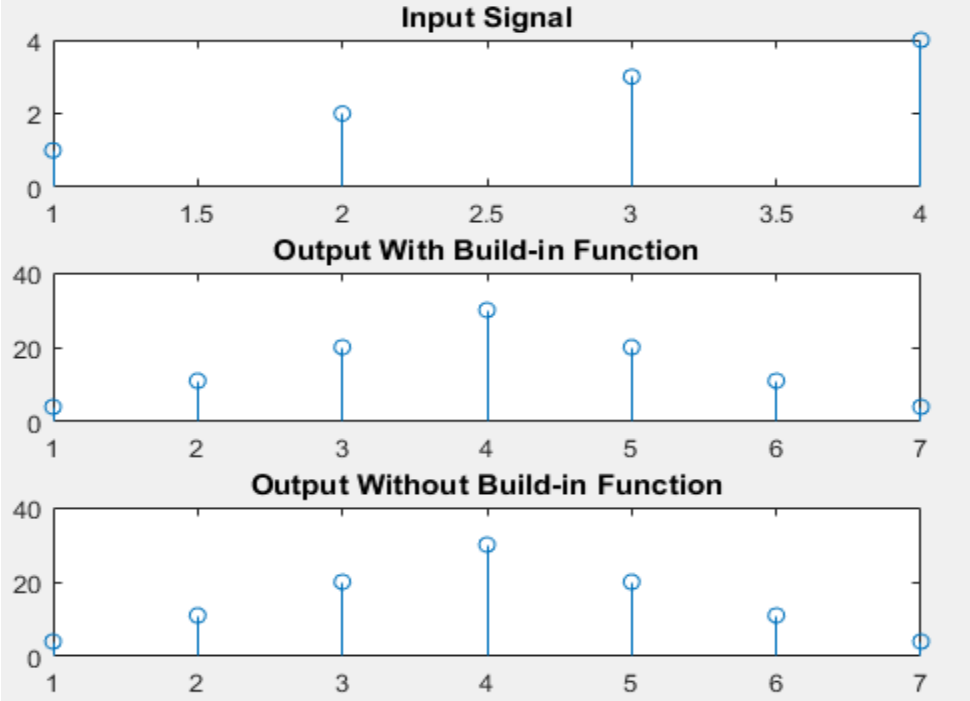


Figure-3: Input and output signals for autocorrelation.

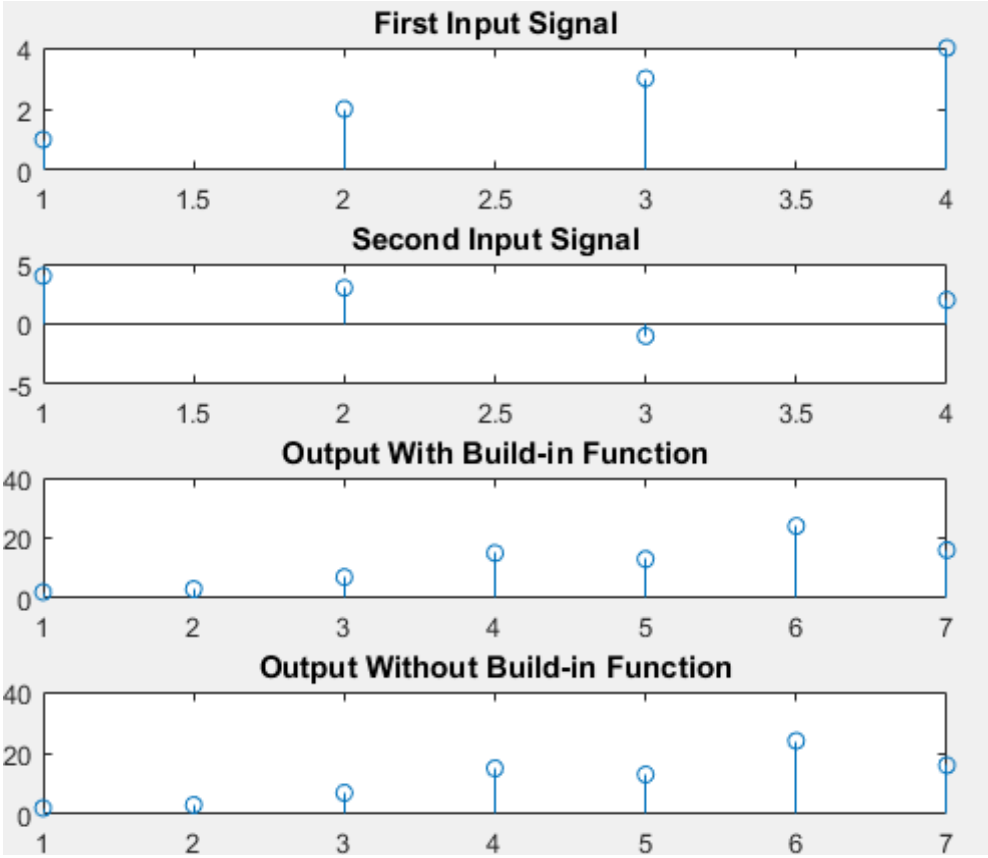


Figure-4: Input and output signals for cross correlation.

**Discussion & Conclusion:**

From this experiment, I had learnt about the autocorrelation and cross correlation convolution and I had implemented both of them by using build in function and without using build in function to compare these two signals. Here, it should be mentioned that the signals that I had got similar output by using build in function and without using build in function in both of experiment. I had also displayed the calculated results and I found that the outputs were as same as the manually calculated results. So it can be said that the experiment had successfully completed.