Heaven's Light is Our Guide

Rajshahi University of Engineering& Technology

Department of Electrical & Computer Engineering

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

Submitted by:
Name: Tanvir Rahman Meraz
Roll: 1810046

Submitted to:
Hafsa Binte Kibria
Lecturer,
Dept. of ECE
RUET

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Experiment Name: Calculation and representation of auto-correlation and cross-correlation using MATLAB.

Theory: Correlation is like a way to measure how alike two things are. If two things are very much alike, then their correlation is high.

The correlation and convolution are similar, but correlation is simpler. In correlation, two functions are compared to check if they are similar. This is different from the convolution, which looks for a signal and response relationship between two functions.

$$\mathrm{Corr}(p, q) = \int_{-\infty}^{\infty} p(\tau + t)q(\tau)d\tau$$

Autocorrelation means comparing a function with itself. Correlation uses same math and numbers as other techniques. The Weiner-Khinchin Theorem is a rule that explains something.

$$\mathrm{Corr}(p, p) \leftrightarrow |P(\omega)|^2$$

Software used: MATLAB

Code:

Autocorrelation:

```
clc;
clear all;
close all;


x=[1 2 -1 -3 2 2 5 6 2 4 5 2 1 6 8];
subplot(3,1,1);
stem(x);
title('Signal x(n)');


len=length(x);
sz=len+2*(len-1);
y = zeros(1,sz);


s = len;
for i=1:len
    y(s)=x(i);
    s=s+1;
end;


z = zeros(1,sz);
for i=1:len
    z(i) = x(i);
end;
```

```
val=0;
sig=[];
for i=1:len+len-1
    for j=1:sz
        val=val+y(j)*z(j);
    end;
    sig(i)=val;
    val=0;
    z=circshift(z,[0 1]);
    z(1)=0;
end;


subplot(3,1,2);
stem(sig);
title('Correlated Signal');


subplot(3,1,3);
sig1= xcorr(x);
stem(sig1);
title('Correlated Signal using built in function');
```

Output:

Autocorrelation:

Fig. 1: Result of autocorrelation.

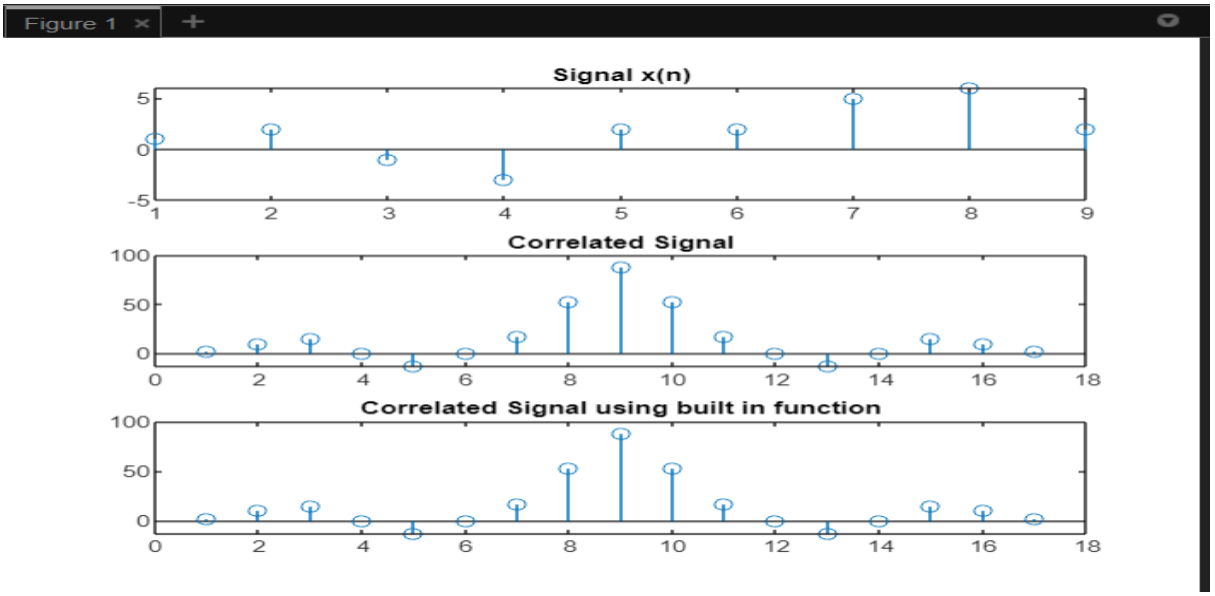

Fig 2: Result of plotting auto correlation.

2 3 4 5 6 7

2 3 4 5 6 7

Discussion: In our study, we looked at how two different signals are related to each other. We looked at how a signal is related to a delayed version of itself. Next, we looked at how two signals were related to each other. Both times, we got the same answer whether we used the built-in function or we figured it out ourselves.

Conclusion: The experiment worked well without any mistakes or problems with the computer instructions or pictures.