Heaven's Light is Our Guide

Rajshahi University of Engineering & Technology

Department of Electrical & Computer Engineering

Lab Report

Course Title	: Digital Signal Processing Sessional
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Experiment No: 03

Experiment Name:

Study of Auto-Correlation & Cross-Correlation in Matlab

Theory:

Autocorrelation, sometimes known as serial correlation in the discrete time case, is the correlation of a signal with a delayed copy of itself as a function of delay. The analysis of auto-correlation is a mathematical tool for finding repeating patterns, such as the presence of a periodic signal obscured by noise, or identifying the missing fundamental frequency in a signal implied by its harmonic frequencies.

The discrete autocorrelation R at lag l for a discrete-time signal y(n) is

$$R_{yy}(l)=\sum_{n\in Z} y(n)*\overline{y(n-l)}$$

cross-correlation is a measure of similarity of two series as a function of the displacement of one relative to the other.

$$f*g(n)=\sum_{m=-\infty}^{\infty} \overline{f(m-1)}g(m)$$

Code:

Auto-Correlation:

```
clc
x = input('Enter the matrix element within [ ] bracket\n');
size_x = length(x);
disp(size_x);

x_c = zeros(1,(size_x+ (size_x-1)));
for i=1:size_x
   x_c(i+size_x-1) = x(i);
end

subplot(4,1,1);
stem(x_c);
title('x signal');

```

```
shift_x = circshift(x_c,size_x);

subplot(4,1,2);
stem(shift_x);
title('shifted signal');

res = zeros(1,2*size_x-1);
j=1;
for k=(size_x-1):-1:0

    for i=1:size_x
        if i+k > size_x
            break
        end
       res(j)= res(j)+ x(i)*x(i+k);
    end
    j = j+1;
end

for k=1:(size_x-1)

    for i=1:size_x
        if i+k> size_x
            break
        end
        res(j) =  res(j)+ x(i)*x(i+k);
    end
     j=j+1;
end

disp(res);

```

```
ress = xcorr(x);
disp(res);

subplot(4,1,3);
stem(ress);
title('xcorr() function output');


subplot(4,1,4);
stem(res);
title('my function output');
```

Cross-Correlation:

```
clc
x = input('Enter the elements of x within [ ] bracket\n');
y = input('Enter the elements of y within [ ] bracket\n');
l = length(x);
m = length(y);
disp(l);

s = xcorr(x,y);
disp(s);

%n = l+m-1;

x_c = zeros(1,(l+m-1));
y_c = zeros(1,(l+m-1));
for i=1:l
   x_c(i+m-1) = x(i);
end

for i=1:m
   y_c(i) = y(i);
end
```

```
22
23
24 subplot(4,1,1);
25 stem(x_c);
26 title('x signal');
27
28
29 subplot(4,1,2);
30 stem(y_c);
31 title('shifted signal');
32
33 res = zeros(1,(l+m-1));
34 j=1;
35 for k=(m-1):-1:0
36
37    for i=1:l
38       if i+k > m
39          break
40       end
41       res(j)= res(j)+ x(i)*y(i+k);
42    end
43    j = j+1;
44 end
45
46 for k=1:(l-1)
47
48    for i=1:m
49       if i+k> l
50          break
51       end
52       res(j) =  res(j)+ y(i)*x(i+k);
53    end
54     j=j+1;
55 end
```

```
56
57 disp(res);
58
59 ress = xcorr(x,y);
60 disp(ress);
61
62 subplot(4,1,3);
63 stem(ress);
64 title('xcorr() function output');
65
66
67 subplot(4,1,4);
68 stem(res);
69 title('my function output');
```

Output:

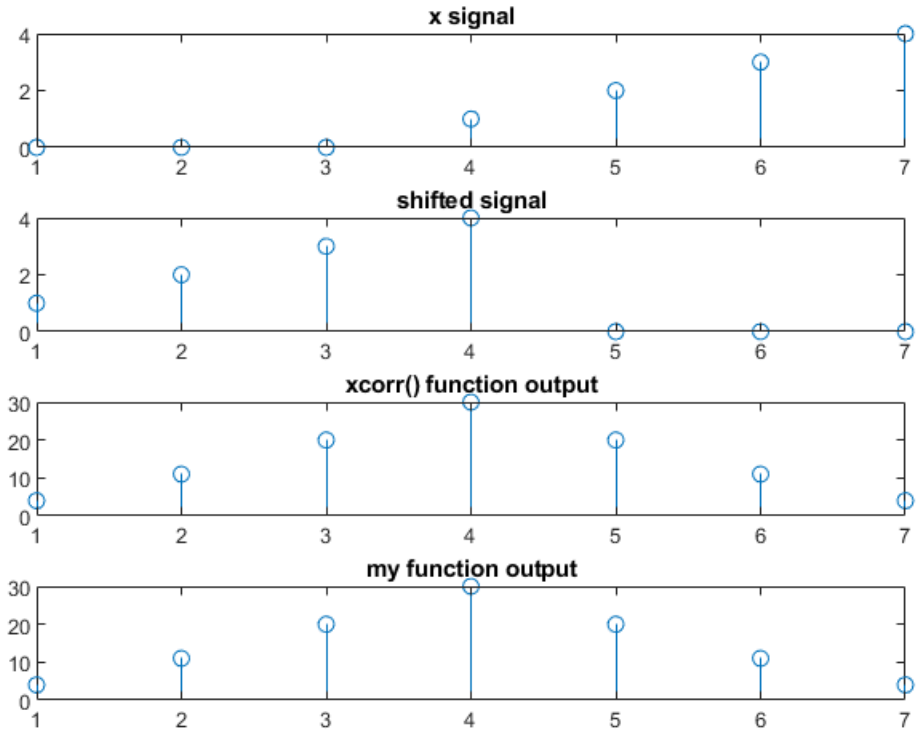

Fig. 1 Plot of auto-correlation

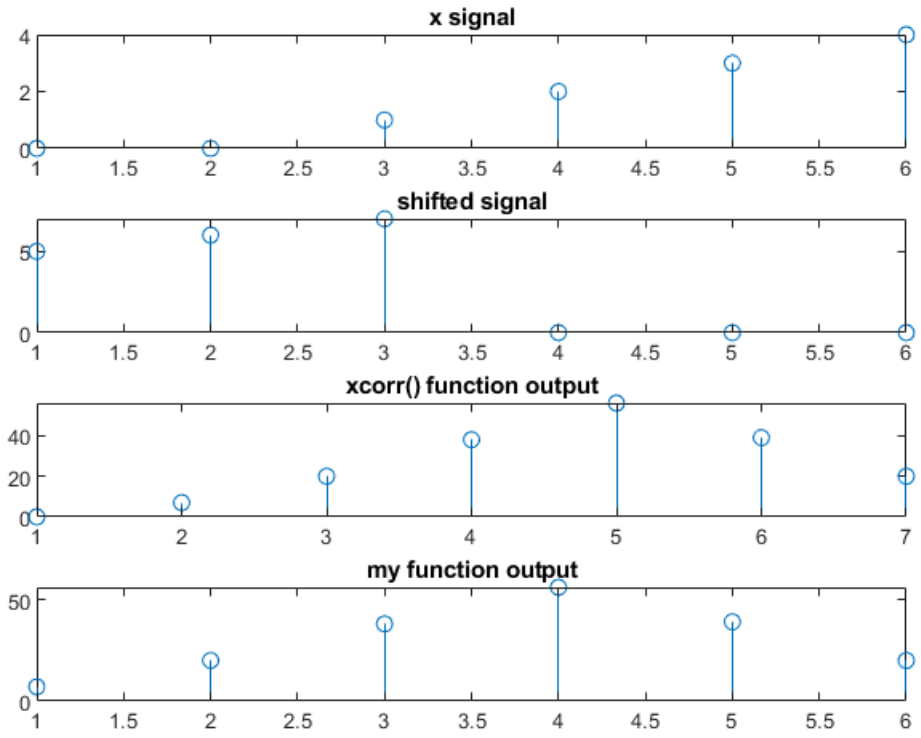

Fig. 2 Plot of cross-correlation

Discussion:

All program showed expected output and all the plots were accurate.

Conclusion:

I have learned about auto-correlation and cross-correlation in this experiment.