RAJSHAHI UNIVERSITY OF ENGINEERING AND TECHNOLOGY

LAB REPORT

Dept: Electrical and Computer Engineering

SUBMITTED BY:

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Course no : ECE 4124

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Experiment no: 03

Experiment Name : Write a code for correlation using MATLAB
Objective : To learn a code for correlation using MATLAB

Theory : correlation describes the mutual relationship which exists between two or more things. The same definition holds good even in the case of signals. That is, correlation between signals indicates the measure up to which the given signal resembles another signal.

Depending on whether the signals considered for correlation are same or different, we have two kinds of correlation: autocorrelation and cross-correlation.

Autocorrelation

This is a type of correlation in which the given signal is correlated with itself, usually the time-shifted version of itself. Mathematical expression for the autocorrelation of continuous time signal $x(t)$ is given by

$$R_{xx}(\tau) = \int_{-\infty}^{\infty} x(t)\, x^{\star}(t-\tau)\, dt$$

Similarly the autocorrelation of the discrete time signal $x[n]$ is expressed as

Next, the autocorrelation of any given signal can also be computed by resorting to graphical technique. The procedure involves sliding the time-shifted version of the given signal upon itself while computing the samples at every interval. That is, if the given signal is digital, then we shift the given signal by one sample every time and overlap it with the original signal. While doing so, for every shift and overlap, we perform multiply and add.

Cross-Correlation

This is a kind of correlation, in which the signal in-hand is correlated with another signal so as to know how much resemblance exists between them. Mathematical expression for the cross-correlation of continuous time signals $x(t)$ and $y(t)$ is given by

$$R_{xy}[m] = \sum_{n=-\infty}^{\infty} x[n]\, y^{\star}[n-m]$$

Next, just as is the case with autocorrelation, cross-correlation of any two given signals can be found via graphical techniques. Here, one signal is slid upon the other while computing the samples at every interval. That is, in the case of digital signals, one signal is shifted by one

sample to the right each time, at which point the sum of the product of the overlapping samples is computed.

Code :

Autocorrelation:

```
1. clc
2. clear all
3. close all
4. x=input('Enter the sequence');
5. subplot(3,1,1)
6. stem(x)
7. title('Given Function')
8. xh=xcorr(x,x)
9. subplot(3,1,2)
10. stem(xh)
11. title('Using Built in Function ')
12. z=[];
13. h=fliplr(x);
14. for i=1:length(x)
15. g=h.*x(i);
16. z=[z;g];
17. end
18. [r c]=size(z);
19. k=r+c;
20. t=2;
21. y=[];
22. cd=0;
23. while(t<=k)
24. for i=1:r
25. for j=1:c
```

```
26. if((i+j)==t)
27. cd=cd+z(i,j);
28. end
29. end
30. end
31. t=t+1;
32. y=[y cd];
33. cd=0;
34. end
35. subplot(3,1,3)
 36. stem(y);
37. title('Manual')
```

Cross-correlation:

```
1. clc
2. clear all
3. close all
4. x=input('Enter the first sequence');
5. n1=input('Enter the time sample range:');
 6. h=input('Enter the second sequence');
7. n2=input('Enter the time sample range:');
8. subplot(4,1,1)
9. stem(x)
10. title('Given First Function')
11. subplot(4,1,2)
12. stem(x)
13. title('Given Second Function')
14. xh=xcorr(x,h)
15. subplot(4,1,3)
16. stem(xh)
17. title('Using Built in Function ')
```

```
18. n2=-fliplr(n2);
19. z=[];
20. h=fliplr(h);
21. for i=1:length(x)
22. g=h.*x(i);
23. z=[z;g];
 24. end 25.
[r c]=size(z);
26. k=r+c;
27. t=2;
 28. y=[];
29. cd=0;
30. while(t<=k)
31. for i=1:r
32. for j=1:c
33. if((i+j)==t)
34. cd=cd+z(i,j);
35. end
36. end
37. end
38. t=t+1;
39. y=[y cd];
40. cd=0;
41. end
42. nl=min(n1)+min(n2);
43. nh=max(n1)+max(n2);
44. t=nl:1:nh;
 45. subplot(4,1,4)
 46. stem(y);
47. title('Manual')
```

Output :

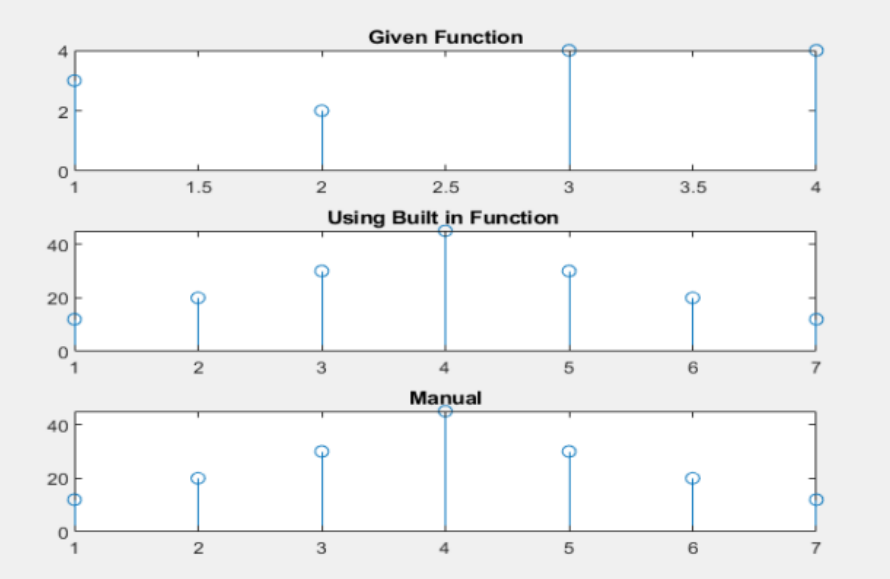

Figure 1: Autocorrelation

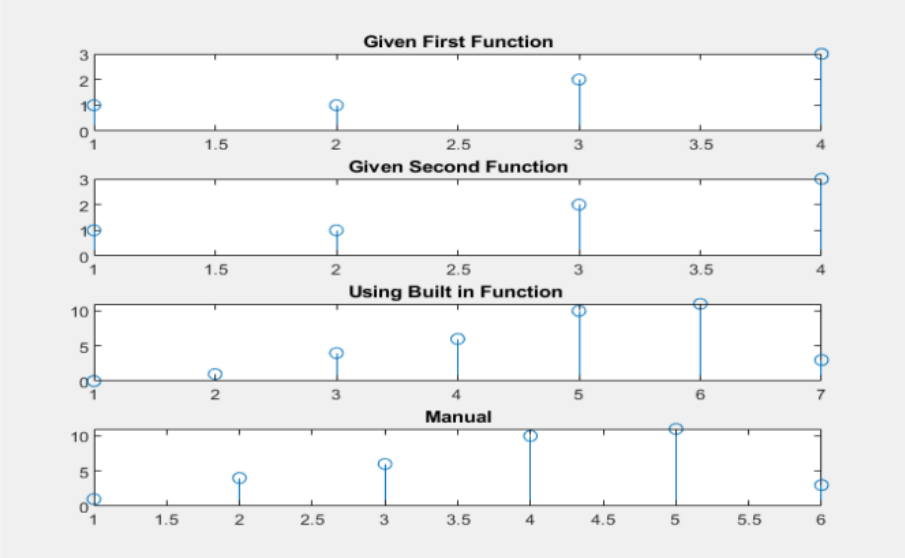

Fig 2: Cross-correlation

Discussion :

In the experiment using matlab code autocorrelation and cross correlation is implemented. Autocorrelation measures how similar a signal is to a delayed version of itself, while cross-correlation measures the similarity between two different signals as a function of the time lag between them. Both autocorrelation and cross-correlation have numerous applications, including detecting repeating patterns, aligning signals, detecting echoes, and measuring time delays.

Conclusion :

The code is successfully implemented .