

Rajshahi University of Engineering and Technology

Department of Electrical and Computer Engineering(ECE)

Course Title: Digital Signal Processing Sessional

Course No: ECE 4124

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Experiment No: 03

Name of the Experiment: Write a code for auto correlation and cross-correlation and plot the signal using MATLAB.

Theory: The correlation of two functions or signals or waveforms is defined as the measure of similarity between those signals. There are two types of correlations. They are

1. Autocorrelation
2. Cross-correlation

The autocorrelation function is defined as the measure of similarity or coherence between a signal and its time delayed version. Therefore, the autocorrelation is the correlation of a signal with itself.

The cross-correlation between two different signals or functions or waveforms is defined as the measure of similarity or coherence between one signal and the time-delayed version of another signal. The cross-correlation are done between two different signals .

Code:

Code for autocorrelation:

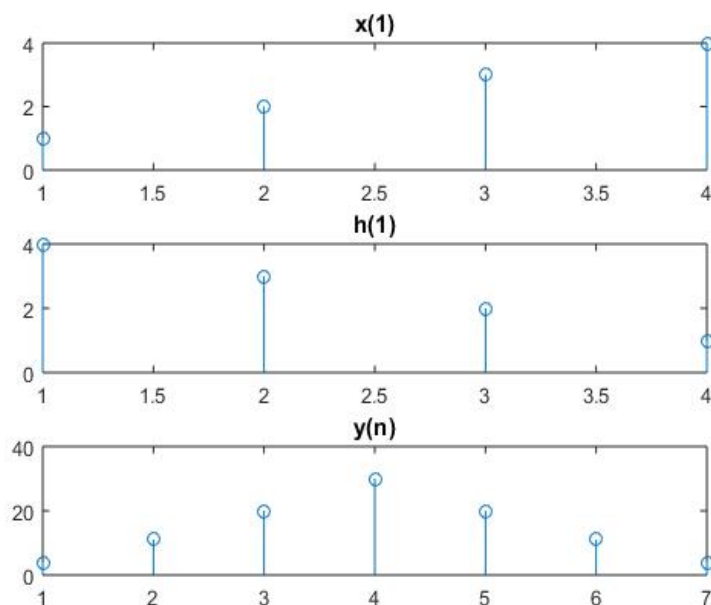
```
1. clc
2. clear all
3. close all
4. x1 = [1 2 3 4];
5. h1 = [4 3 2 1];
6. n = length(x1);
7. m = length(h1);
8. k = n+m-1;
9. x = [x1 zeros(1,k-n)]';
10.    h = [h1 zeros(1,k-m)]';
11.    for i=1:k
12.        c(:,i) = circshift(x,i-1)
13.    end
14.    y = c*h
15.
16.    subplot(3,1,1)
17.    stem (x1)
18.    title('x(1)')
19.    subplot(3,1,2)
20.    stem (h1)
21.    title('h(1)')
22.    subplot(3,1,3)
23.    stem (y)
24.    title('y(n)')
```

Code for cross-correlation:

```
1. clc
2. clear all
3. close all
4. x1 = [1 2 3 4];
5. h1 = [1 2 3 4];
6. n = length(x1);
7. m = length(h1);
8. k = n+m-1;
9. x = [x1 zeros(1,k-n)]';
10.    h = [h1 zeros(1,k-m)]';
11.    for i=1:k
12.        c(:,i) = circshift(x,i-1)
13.    end
14.    y = c*x
15.    subplot(3,1,1)
16.    stem (x1)
17.    title('x(1)')
18.    subplot(3,1,2)
19.    stem (h1)
20.    title('h(1)')
21.    subplot(3,1,3)
22.    stem (y)
23.    title('y(n)')
```

Output:

Output for autocorrelation:



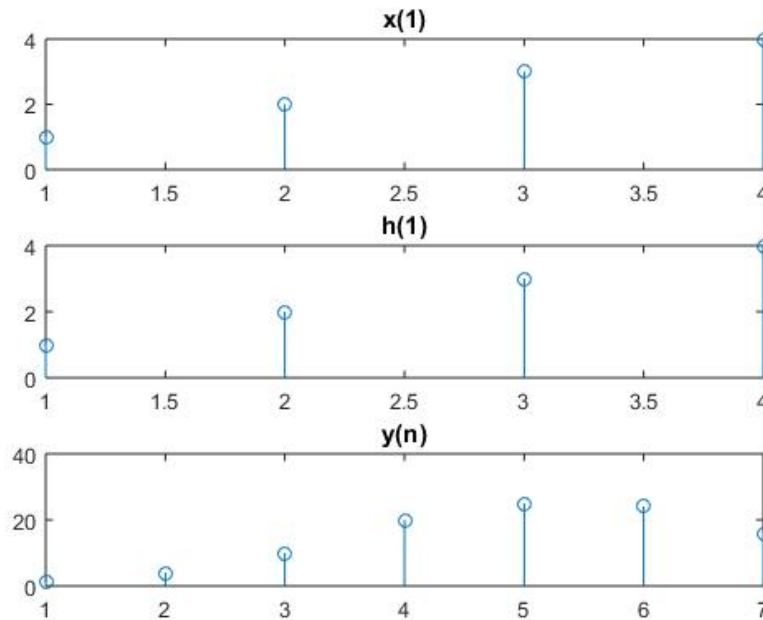
y =

4
11
20
30
20
11
4

Output for cross-correlation:

y =

1
4
10
20
25
24
16



Discussion: By using MATLAB we implement Autocorrelation and cross-correlation. To implement the autocorrelation code, two 1×4 matrix was taken. Then length function determined the length of the matrix. After that, a for loop was used. It was used for shifting the one matrix values. After the for loop a multiplication was written for the output. As the signal was discrete, I used stem function to plot the signal. For the Implementation of cross-correlation, the code was almost similar to the autocorrelation. A little bit changes were created in the multiplication section.

Conclusion: Finally we executed the code successfully and no errors were created. Form this session , we had enriched our knowledge (theoretical & practical) about autocorrelation and cross-correlation and how to plot the signal using MATALB.

References:

[1]"Correlation – tutorialspoint", tutorialspoint, 2023. [Online].
Available: <https://www.tutorialspoint.com/what-is-correlation-in-signals-and-systems>
[Accessed: 13 - May - 2023]