Heaven's Light is Our Guide

Rajshahi University of Engineering & Technology

Department of Electrical & Computer Engineering

Lab Report

Course Title: Digital Signal Processing Sessional

Course No: ECE 4124

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Experiment No: 04

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Experiment Name: Study of -

1. Auto Correlation
2. Cross Correlation

Theory:

Auto Correlation: The auto correlation of a signal is the correlation of a signal with itself. It is a mathematical tool for finding repeating patterns, such as the presence of a periodic signal which has been buried under noise, or identifying the missing fundamental frequency in a signal implied by its harmonic frequencies. It is often used in signal processing for analyzing functions or series of values, such as time domain signals.
Cross Correlation: Cross correlation is a measure of similarity of two waveforms as a function of a time-lag applied to one of them. This is also known as a sliding dot product or sliding inner-product. It is commonly used for searching a long signal for a shorter, known feature. It has applications in pattern recognition, single particle analysis, electron tomography, averaging, cryptanalysis, and neurophysiology.

Code of Auto Correlation:

```
size = input('size of x = ');
x = input('x = ');
y = x;
r = zeros(1, size * 2 - 1);
p = 1;
for k = size:-1:1
   for i = k:size
      r(p) = r(p) + y(i) * x(i - k + 1);
   end
   p = p + 1;
end

for k = 2:size
   for i = k:size
       r(p) = r(p) + x(i) * y(i - k + 1);
   end
   p = p + 1;
end

r
rfun = xcorr(x)
subplot(3, 1, 1); stem(x); title('X[n]');
subplot(3, 1, 2); stem(r); title('R[n]');
subplot(3, 1, 3); stem(rfun); title('R[n] from function');
```

Input:

```
size of x = 3
x = [1 3 2]
```

Output of Auto Correlation:

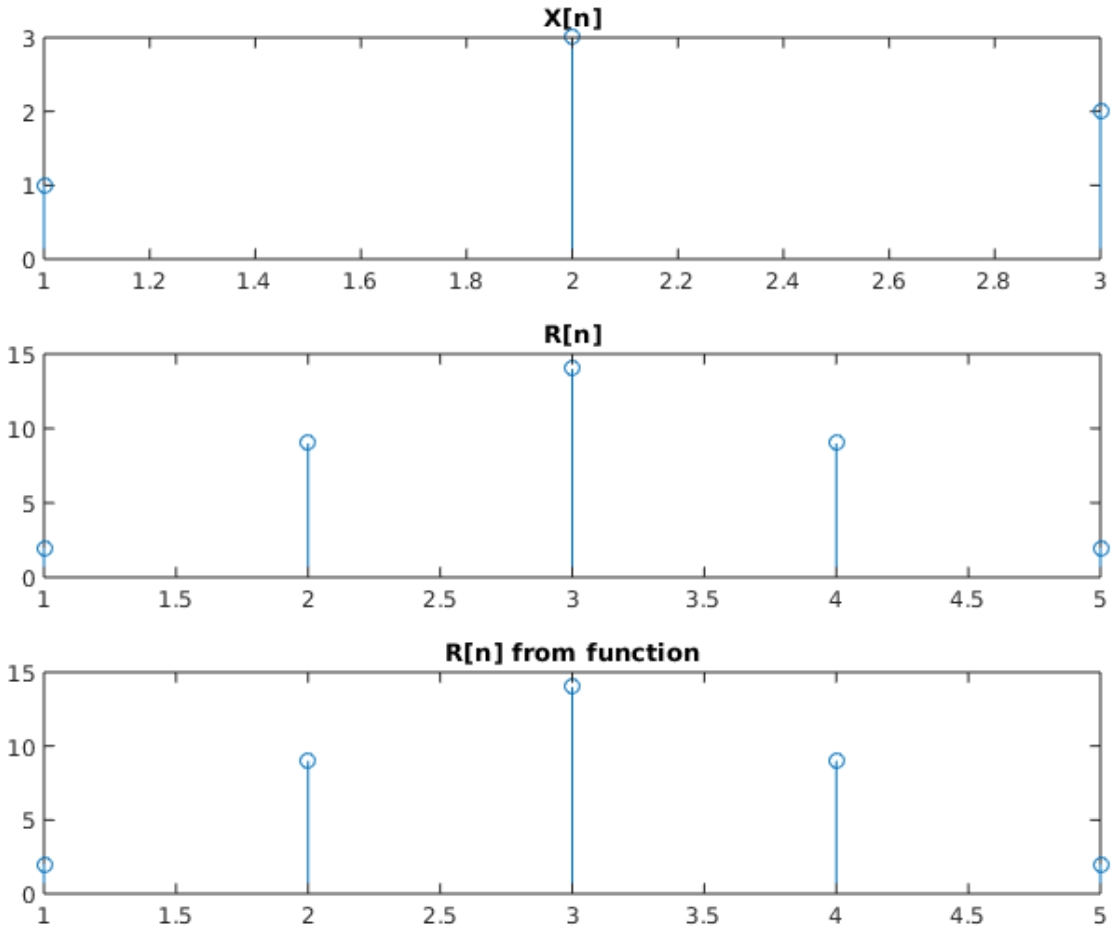

Fig. 1: Output of auto correlation of a signal.

Code of Cross Correlation:

```
size = input('size of x = ');
x = input('x = ');
size2 = input('size of y = ');
y = input('y = ');
r = zeros(1, size + size2 - 1);
p = 1;
for k = size2:-1:1
   for i = k:size2
       if i - k + 1 > size
           break
       end
      r(p) = r(p) + y(i) * x(i - k + 1);
   end
   p = p + 1;
end

for k = 2:size
   for i = k:size
        if i - k + 1 > size2
           break
       end
       r(p) = r(p) + x(i) * y(i - k + 1);
   end
   p = p + 1;
end

r
rfun = xcorr(x, y)
subplot(2, 2, 1); stem(x); title('X[n]');
subplot(2, 2, 2); stem(y); title('Y[n]');
subplot(2, 2, 3); stem(r); title('R[n]');
subplot(2, 2, 4); stem(rfun); title('R[n] from function');
```

Input:

```
size of x = 4
x = [1 1 2 2]
size of y = 6
y = [2 4 5 2 3 3]
```

Output of Cross Correlation:

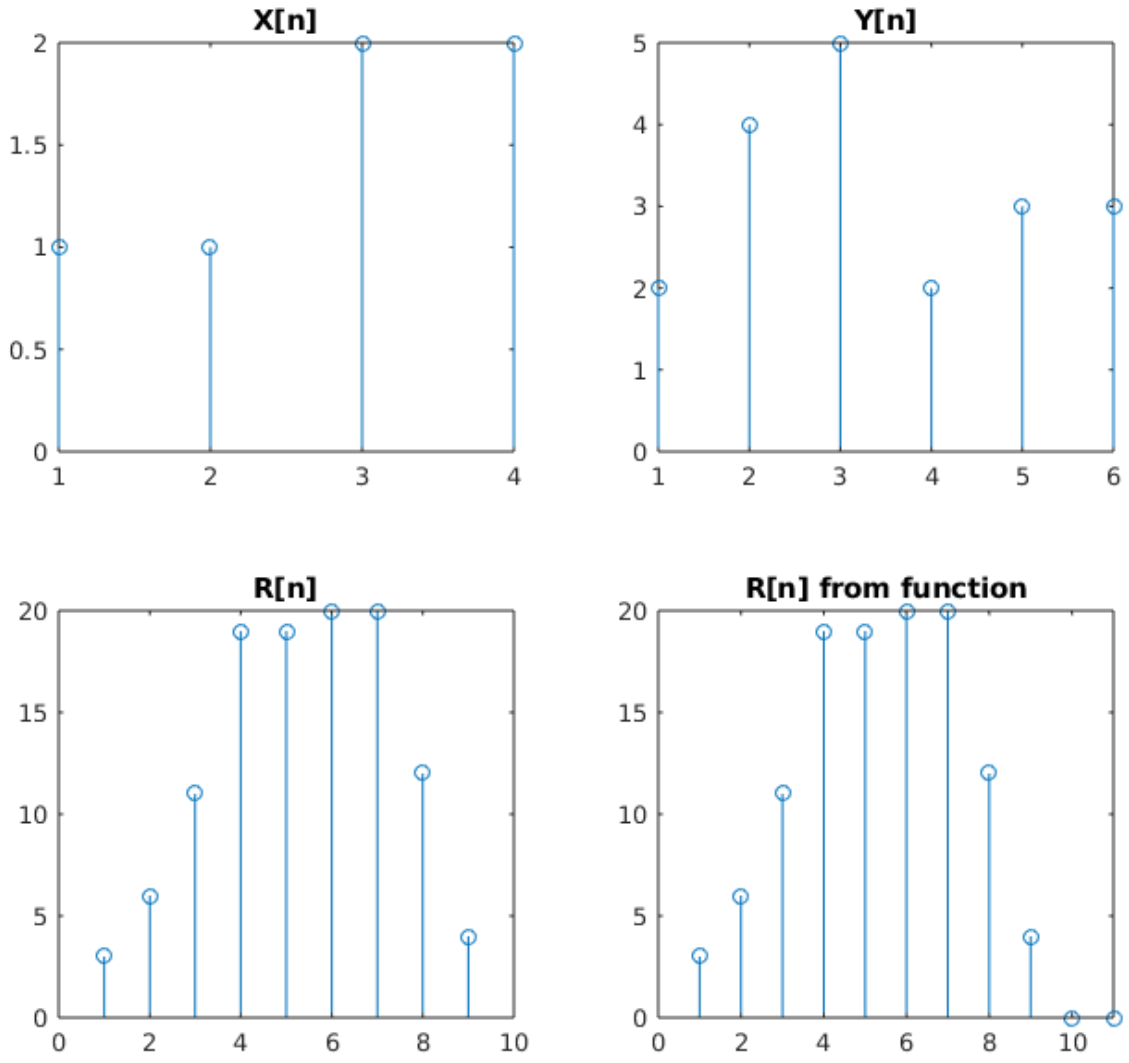

Fig. 2: Output of cross correlation of two signals.

Discussion:

In this experiment, we have studied about auto correlation and cross correlation. We have implemented the algorithm of auto correlation and cross correlation in MATLAB. We have plotted the input signals and the output signals. We have seen that the output of auto correlation is symmetric and the output of cross correlation is not symmetric. We have also seen that the output of auto correlation and cross correlation from our algorithm and the inbuilt function of MATLAB are same.