Heaven's Light is Our Guide

Rajshahi University of Engineering & Technology

Sessional Course Code: ECE 4124

Course name: Digital Signal Processing Sessional

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Experiment Name: Correlation of a signal with its delayed function and find the x ordinate value.

Objective:
- Familiar with the correlation concept
- Problem solving with & without using function
- Realtime implementation and visualization of 2 outputs
-Find the X value of highest correlation

Theory: Correlation coefficient is a measure of how well two signals are related to each other in terms of their similarity, alignment, and dependence. It is widely used in digital signal processing (DSP) for various purposes, such as signal detection, estimation, compression, enhancement, and classification. 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 −

- Cross-correlation

  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 between two different signals indicates the degree of relatedness between one signal and the time-delayed version of another signal.

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

- Autocorrelation

  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.

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

Required Tools: MATLAB 2015a.

Code & Output:

```
clc;
clear;
t=0:0.5:20
x=sin(t);
y=sin(t-39);
z=x+2;
y=wrev(y);
a=xcorr(x,y);
XL=length(x);
YL=length(y);
z=zeros(1,XL+YL-1);
ZL=length(z);
for i=1:ZL
    for k=1:XL
        if i-k+1>0 && i-k+1 <= XL
            z(i) = z(i)+y(k)*x(i-k+1);
        end
    end
end
display(z);
l=max(z);
for i=1:ZL
    if(z(i)==l)
        m(i)=i;
    end
end
m(m==0)=[];
display(m);
subplot(3,1,1);
plot(x);
title('INPUT SIGNAL');
grid on
subplot(3,1,2);
plot(y);
title('DELAYED SIGNAL');
grid on
subplot(3,1,3);
plot(z);
title('CORRELATION');
grid on
```

```
m =

    38
```

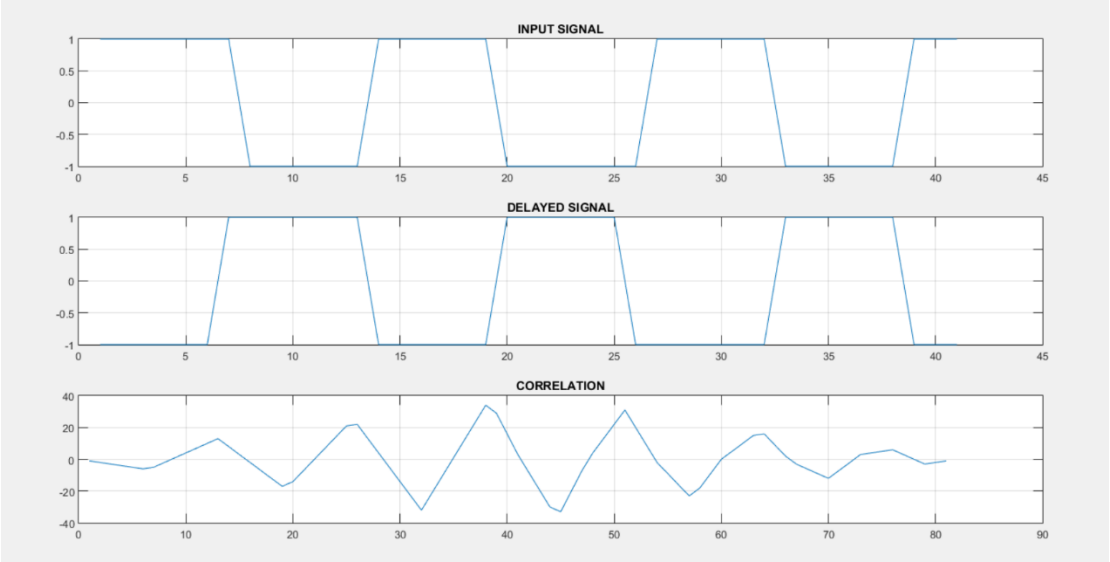

Figure4: Finding the X position of highest correlation in continuous signal

Discussion: This experiment is mainly focused on the correlation of 2 signals. The code gave the desired output. Later the position of X value is calculated.

Conclusion: We tried to find out the correlation of 2 signals. The output resembles our theory.

References:

1. What is Correlation in Signals and Systems?
https://www.tutorialspoint.com/what-is-correlation-in-signals-and-systems [Online]. [Accessed May 18, 2023]

2. Understanding Correlation
https://www.allaboutcircuits.com/technical-articles/understanding-correlation/ [Online].
[Accessed May 18, 2023]

3.correlation coefficient in DSP

https://www.linkedin.com/advice/0/what-some-common-applications-correlation [Online].
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