Introduction to Convolution Sum of Signal Processing Using Matlab

Samshul Islam

Id:1902166

Department of EEE

Chittagong University of Engineering and Technology

Abstract

We have done some important thing in this experiment. We have learn about convolution. We have done shifting in this function . We have done convolution after shifting and then plotted.

1. Plot convolution of x(n)*h(n) without shifting
2. Plot convolution of x(n)*h(n) with left shifting of x(n)
3. Plot convolution of x(n)*h(n) with left shifting of h(n)
4. Plot convolution of x(n)*h(n) with left shifting of x(n) and h(n)

Keywords: Convolution, Shifting

1. Required Software

Required Software are -

1. Matlab
2. Latex

2. Introduction

One of the basic operations performed in image and signal processing is an operation called convolution. In image processing, many noise reduction filters utilize the convolution operation in order to perform their tasks.From a purely mathematical standpoint, convolution is an integral. Imagine two functions f and g. The purpose of the operation is to shift g over f. The resulting amount overlap that occurs when g is shifted over f is the convolution of f and g. Because of the nature of convolution, the resulting integral is a "blending" of f and g.

Equation:

$$\sum_{n=-\infty}^{\infty} x(k)h(n0-k) = y(n0)$$

3. Plot convolution of x(n)*h(n) without shifting

Code:

```
clc;clear all;
A = 0.5
n = -10:10
subplot(2,2,1)
x1 = A.*sin(A*n).*(n>=0);
stem(n,x1)
xlabel('n')
ylabel('x(n)')
title('Sinusoidal Function')
box on;grid on;

subplot(2,2,2)
h2 = A.*exp(A*-n).*(-n>=0);
stem(n,h2)
xlabel('n')
ylabel('h(n)')
title('Exponential Function')
box on;grid on;



m=length(x1);
n=length(h2);
X=[x1,zeros(1,n)];
H=[h2,zeros(1,m)];
for i=1:n+m-1
    Y(i)=0;
    for j=1:m
        if(i-j+1>0)
            Y(i)=Y(i)+X(j)*H(i-j
                +1);
        else
        end
    end
end
subplot(2,2,3)
stem(Y)
xlabel('n')
ylabel('x(n)*h(n)')
title('Convulation using formula
    ')
box on;grid on;


Z = conv(x1,h2)
subplot(2,2,4)
stem(Z)
xlabel('n')
```

```
ylabel('x(n)*h(n)')                    )
title('Convulation using matlab'  box on;grid on;
```

Output:

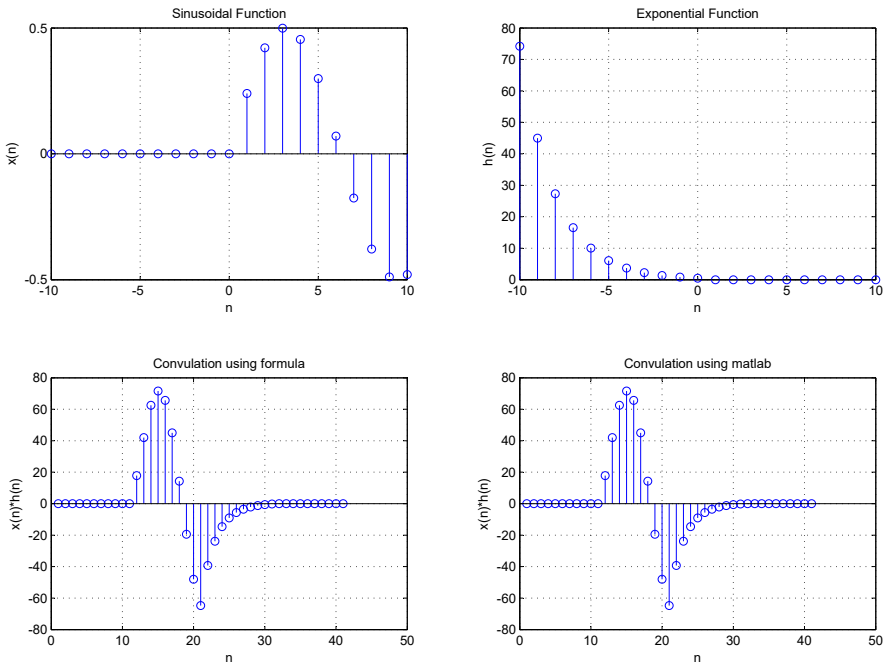

Figure 1: Convolution without shifting

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4. Plot convolution of x(n)*h(n) with left shifting of x(n)

Code:

```
clc;clear all;
A = 0.5
n = -10:10
subplot(2,2,1)
x1 = A.*sin(A*n).*(n>=-10);
stem(n,x1)
xlabel('n')
ylabel('x(n)')
title('Sinusoidal Function')
box on;grid on;

subplot(2,2,2)
h2 = A.*exp(A*-n).*(-n>=0);
stem(n,h2)
xlabel('n')
ylabel('h(n)')
title('Exponential Function')
box on;grid on;

m=length(x1);
n=length(h2);
X=[x1,zeros(1,n)];
H=[h2,zeros(1,m)];
for i=1:n+m-1
    Y(i)=0;
    for j=1:m
        if(i-j+1>0)
            Y(i)=Y(i)+X(j)*H(i-j+1);
        else
        end
    end
end
subplot(2,2,3)
stem(Y)
xlabel('n')
ylabel('x(n)*h(n)')
title('Convulation using formula')
box on;grid on;

Z = conv(x1,h2)
subplot(2,2,4)
stem(Z)
xlabel('n')
ylabel('x(n)*h(n)')
title('Convulation using matlab')
box on;grid on;
```

Output:

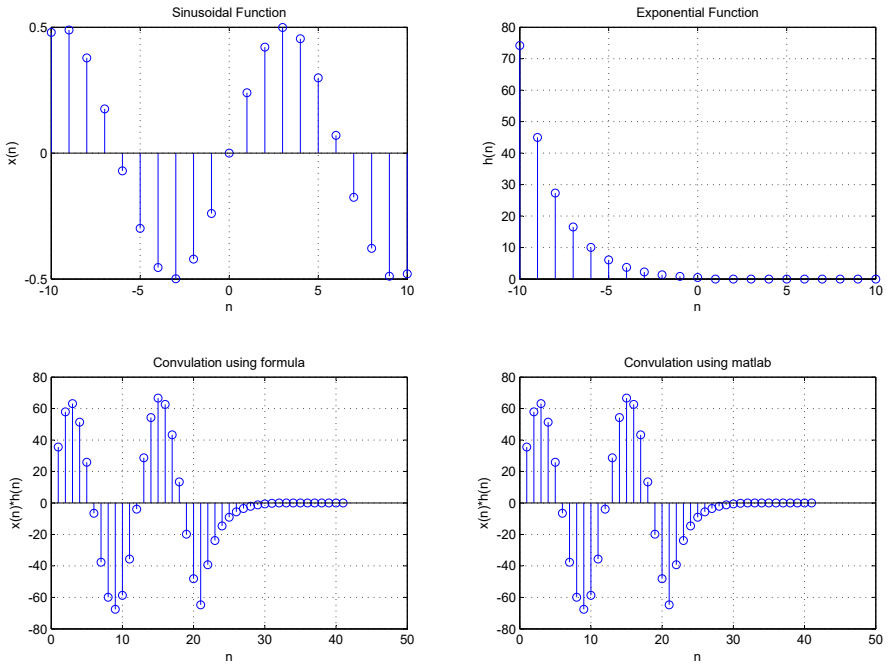

Figure 2: Convolution with x(n) scaling

5. Plot convolution of x(n)*h(n) with left shifting of h(n)

Code:

```
clc;clear all;
A = 0.5
n = -10:10
subplot(2,2,1)
x1 = A.*sin(A*n).*(n>=0);
stem(n,x1)
xlabel('n')
ylabel('x(n)')
title('Sinusoidal Function')
box on;grid on;

subplot(2,2,2)
h2 = A.*exp(A*-n).*(-n>=5);
stem(n,h2)
xlabel('n')
ylabel('h(n)')
title('Exponential Function')
box on;grid on;

m=length(x1);
n=length(h2);
X=[x1,zeros(1,n)];
H=[h2,zeros(1,m)];
for i=1:n+m-1
    Y(i)=0;
    for j=1:m
        if(i-j+1>0)
            Y(i)=Y(i)+X(j)*H(i-j
                +1);
        else
        end
    end
end
subplot(2,2,3)
stem(Y)
xlabel('n')
ylabel('x(n)*h(n)')
title('Convulation using formula
    ')
box on;grid on;

Z = conv(x1,h2)
subplot(2,2,4)
stem(Z)
xlabel('n')
ylabel('x(n)*h(n)')
title('Convulation using matlab'
    )
box on;grid on;
```

Output:

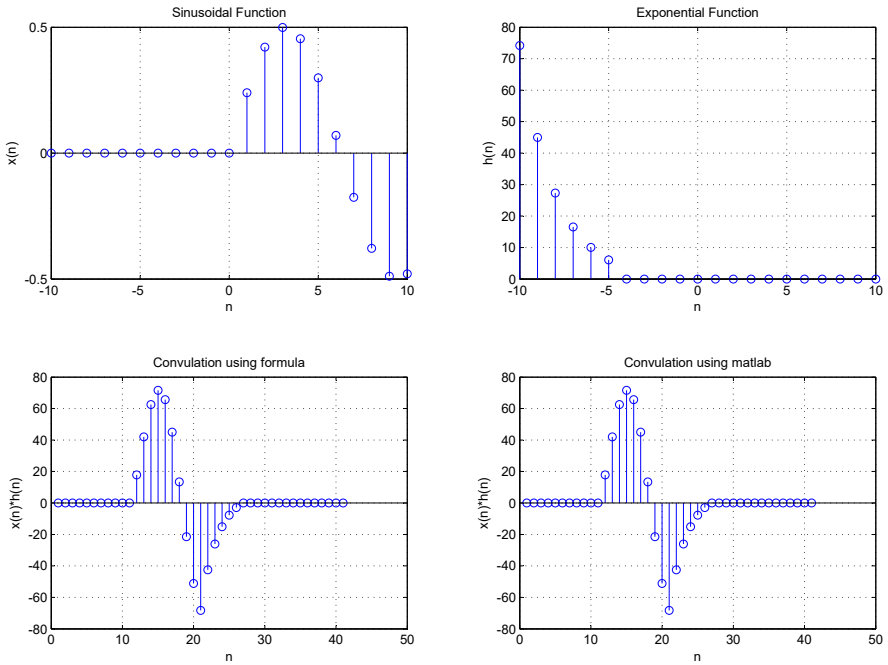

Figure 3: Convolution with h(n) scaling

6. Plot convolution of x(n)*h(n) with x(n) & h(n) shifting

Code:

```
clc;clear all;
A = 0.5
n = -10:10
subplot(2,2,1)
x1 = A.*sin(A*n).*(n>=5);
stem(n,x1)
xlabel('n')
ylabel('x(n)')
title('Sinusoidal Function')
box on;grid on;

subplot(2,2,2)
h2 = A.*exp(A*-n).*(-n>=5);
stem(n,h2)
xlabel('n')
ylabel('h(n)')
title('Exponential Function')
box on;grid on;

m=length(x1);
n=length(h2);
X=[x1,zeros(1,n)];
H=[h2,zeros(1,m)];
for i=1:n+m-1
    Y(i)=0;
    for j=1:m
        if(i-j+1>0)
            Y(i)=Y(i)+X(j)*H(i-j
               +1);
        else
        end
    end
end
subplot(2,2,3)
stem(Y)
xlabel('n')
ylabel('x(n)*h(n)')
title('Convulation using formula
   ')
box on;grid on;

Z = conv(x1,h2)
subplot(2,2,4)
stem(Z)
xlabel('n')
ylabel('x(n)*h(n)')
title('Convulation using matlab'
   )
box on;grid on;
```

Output:

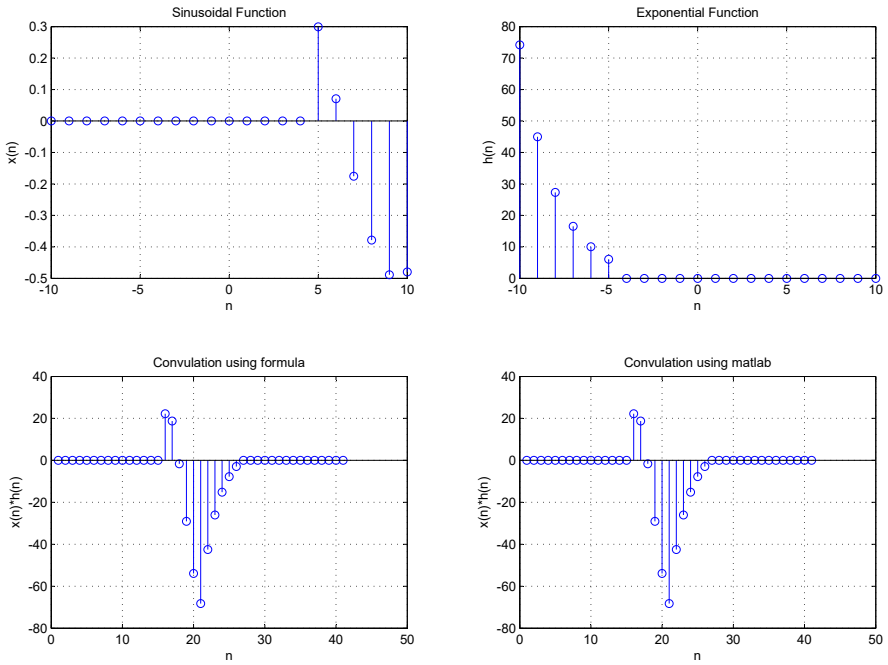

Figure 4: Convolution with shifting x(n) and h(n)

7. Biography

SAMSHUL ISLAM was born in Mohammadpur Village. Feni, Bangladesh in 2001. He completed SSC from FENI CENTRAL HIGH SCHOOL in 2017 and HSC from HAMDARD PUBLIC COLLEGE in 2019. Currently, he is a student at department of Electrical and Electronic Engineering(EEE) in Chittagong University of Engineering and Technology(CUET). His student ID is 1902166. His field of interests are: Microelectronics - Telecommunication - Bio-Medical - Solar Energy

Here are two sample references: [1, 2].

References

[1] J. G. Proakis, Digital signal processing: principles, algorithms, and applications, 4/E, Pearson Education India, 2007.

[2] A. V. Oppenheim, A. S. Willsky, S. H. Nawab, J.-J. Ding, Signals and systems, Vol. 2, Prentice hall Upper Saddle River, NJ, 1997.