

Introduction to Convolution Sum of Signal Processing Using Matlab

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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

5 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
10 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:

```
15  clc;clear all;                                H=[h2,zeros(1,m)];
    A = 0.5                                       for i=1:n+m-1
    n = -10:10                                  40      Y(i)=0;
    subplot(2,2,1)                               for j=1:m
    x1 = A.*sin(A*n).*(n>=0);                   if(i-j+1>0)
20  stem(n,x1)                                   Y(i)=Y(i)+X(j)*H(i-j
    xlabel('n')                                  +1);
    ylabel('x(n)')                               45      else
    title('Sinusoidal Function')                 end
    box on;grid on;                             end
25                                              end
    subplot(2,2,2)                               subplot(2,2,3)
    h2 = A.*exp(A*-n).*(-n>=0);                 50  stem(Y)
    stem(n,h2)                                   xlabel('n')
    xlabel('n')                                  ylabel('x(n)*h(n)')
30  ylabel('h(n)')                               title('Convulation using formula
    title('Exponential Function')                ')
    box on;grid on;                             55  box on;grid on;

                                              Z = conv(x1,h2)
35  m=length(x1);                               subplot(2,2,4)
    n=length(h2);                               stem(Z)
    X=[x1,zeros(1,n)];                          60  xlabel('n')
```

```

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

```

Output:

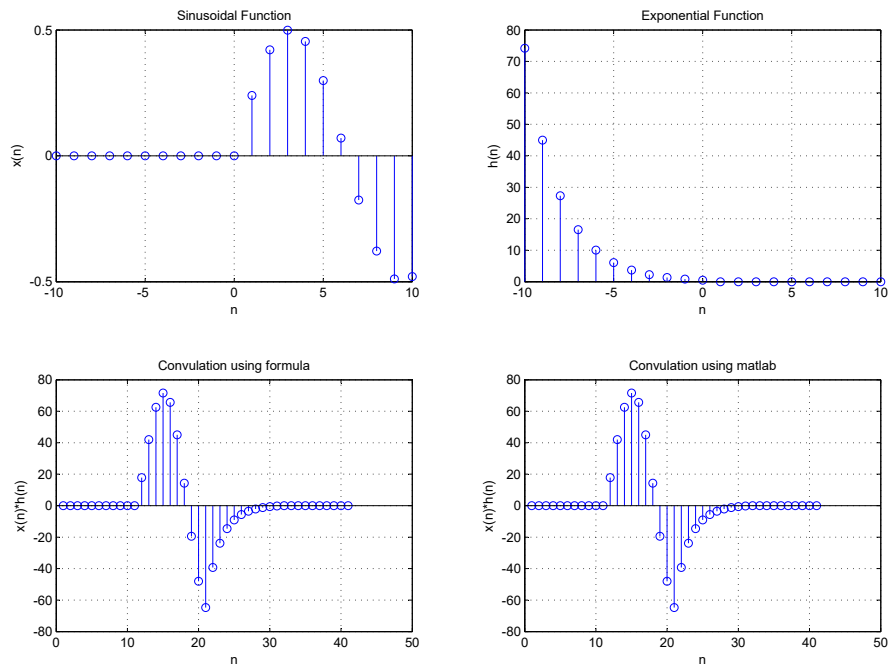


Figure 1: Convolution without shifting

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

Code:

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

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

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

    Z = conv(x1,h2)
110 subplot(2,2,4)
    stem(Z)
    xlabel('n')
    ylabel('x(n)*h(n)')
    title('Convulation using matlab'
115 )
    box on;grid on;
```

Output:

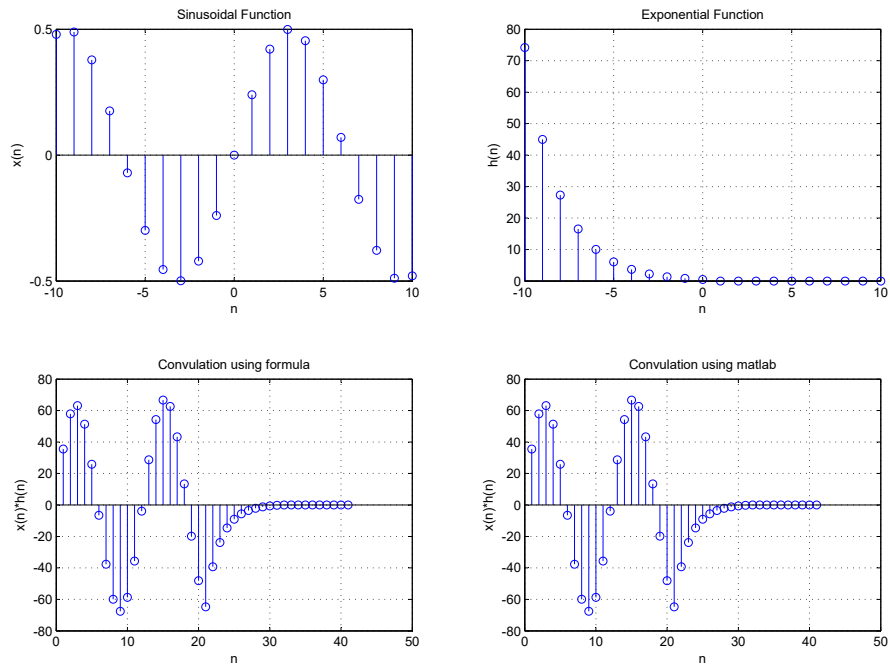


Figure 2: Convolution with $x(n]$ scaling

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

Code:

```
120 clc;clear all;
    A = 0.5
    n = -10:10
    subplot(2,2,1)
    x1 = A.*sin(A*n).*(n>=0);
125 stem(n,x1)
    xlabel('n')
    ylabel('x(n)')
    title('Sinusoidal Function')
    box on;grid on;
130 subplot(2,2,2)
    h2 = A.*exp(A*-n).*(-n>=5);
    stem(n,h2)
    xlabel('n')
135 ylabel('h(n)')
    title('Exponential Function')
    box on;grid on;

    m=length(x1);
140 n=length(h2);
    X=[x1,zeros(1,n)];
    H=[h2,zeros(1,m)];
    for i=1:n+m-1
        Y(i)=0;
145         for j=1:m
            if(i-j+1>0)
                Y(i)=Y(i)+X(j)*H(i-j
                    +1);
            else
150                 end
            end
        end
        subplot(2,2,3)
        stem(Y)
155 xlabel('n')
        ylabel('x(n)*h(n)')
        title('Convulation using formula
            ')
        box on;grid on;
160 Z = conv(x1,h2)
        subplot(2,2,4)
        stem(Z)
        xlabel('n')
165 ylabel('x(n)*h(n)')
        title('Convulation using matlab'
            )
        box on;grid on;
```

Output:

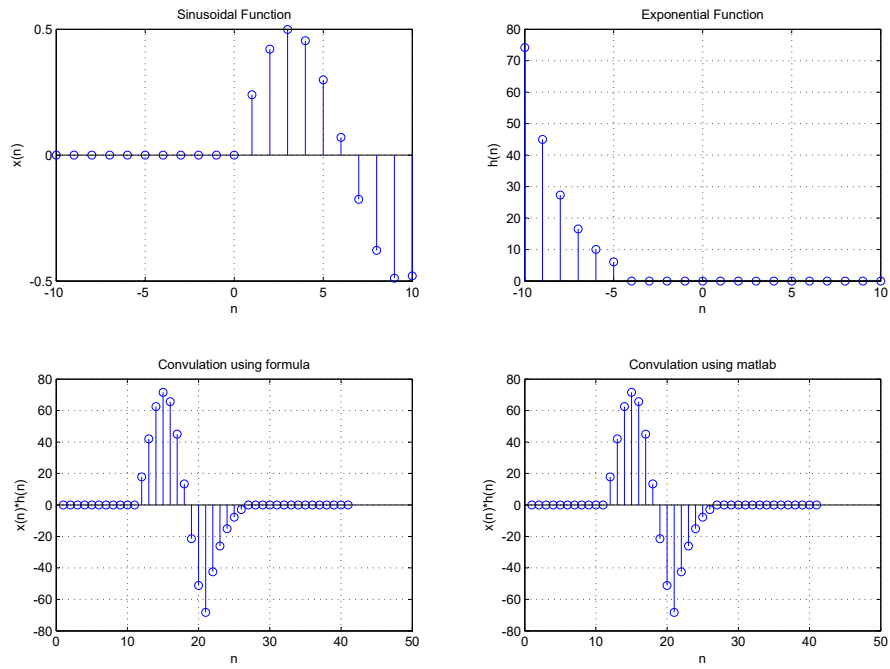


Figure 3: Convolution with $h(n)$ scaling

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

Code:

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

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

190 m=length(x1);
n=length(h2);
X=[x1,zeros(1,n)];
H=[h2,zeros(1,m)];
195 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
200             +1);
        else
            end
        end
    end
205 subplot(2,2,3)
stem(Y)
xlabel('n')
ylabel('x(n)*h(n)')
title('Convulation using formula
210 ')
box on;grid on;

Z = conv(x1,h2)
subplot(2,2,4)
215 stem(Z)
xlabel('n')
ylabel('x(n)*h(n)')
title('Convulation using matlab'
220 )
box on;grid on;
```


Output:

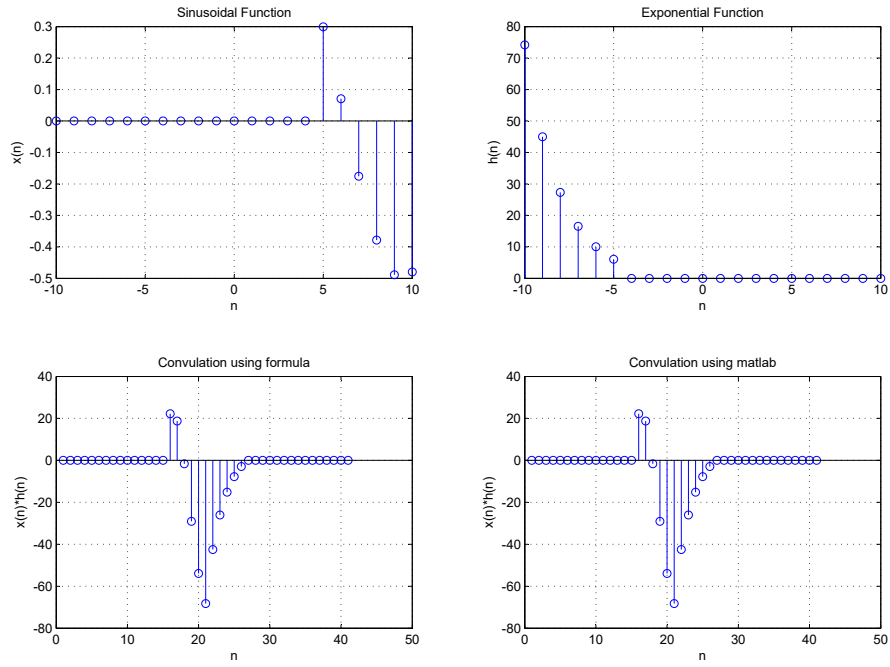


Figure 4: Convolution with shifting $x(n]$ and $h(n]$

7. Biography



SAMSHUL ISLAM was born in
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240 Here are two sample references: [1, 2].

References

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