SIGNAL PROCESSING LABORATORY RECORD (EE314)

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INDEX

SL NO.	NAME OF EXPERIMENT	PAGE NO.	DATE OF EXPERIMENT	DATE OF SUBMISSION	REMARKS
1	GENERATION OF BASIC SIGNALS USING MATLAB	3-9	07/09/2021	16/09/2021	
2	VERIFICATION OF SAMPLING THEOREM AND ALIASING	3-10	16/09/2021	22/09/2021	
3	LINEAR AND CICULAR CONVOLUTION	3-9	23/09/2021	29/09/2021	

EXP NO : 03

TITLE: LINEAR AND CIRCULAR CONVOLUTION

Date :23/09/2021

Objective:

To generate linear and circular convolution of given sequences using MATLAB

Hardware and Software required:

Computer

MATLAB R2021a

Theory:

Circular Convolution:

The Circular convolution, also known as cyclic convolution, of two periodic functions occurs when one of them is convolved in the normal way with a periodic summation of the other function. Circular convolution is only defined for finite length functions (usually equal in length), continuous or discrete in time. In circular convolution, it is as if the finite length functions repeat in time, periodically. Because the input functions are now periodic, the convolved output is also periodic.
Circular convolution sum can be calculated using the formula:

$$y(n) = x_1(n) * x_2(n) = \sum_{k=0}^{N-1} x_1(k)x_2((n-k))_N$$

For $n = 0,1, \ldots, N-1$

Linear Convolution:

Convolution is the process used to find the response of a Linear Time Invariant system to a given input, assuming we already know the impulse response of that system. In case of continuous-time signals, we can find the system response using the Convolution Integral, while in case of discrete-time systems; the response can be calculated using the Convolution Sum.

Let $x_1(n)$ and $x_2(n)$ be two discrete-time signals. The convolution sum of the two signals can be calculated using the formula:

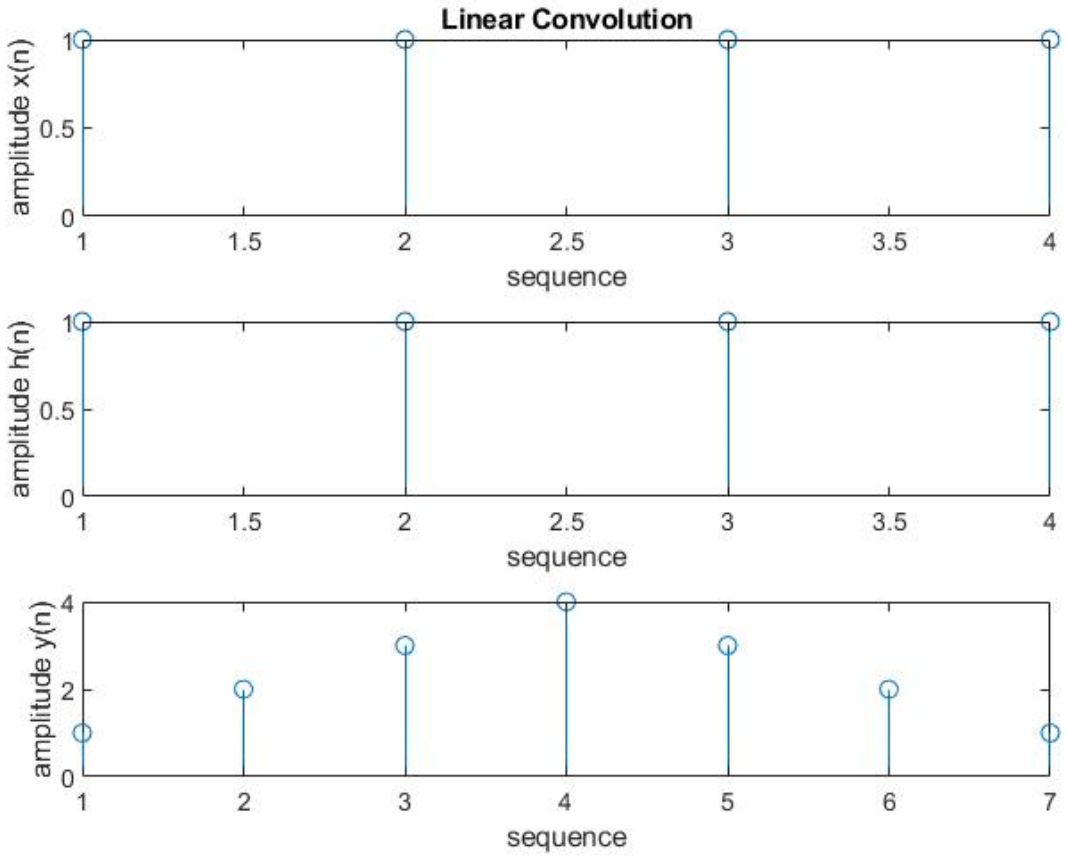
$$y(n) = x_1(n) * x_2(n) = \sum_{k=-\infty}^{\infty} x_1(k)x_2(n-k)$$

If $x1(n)$ is a M- point sequence and $x2(n)$ is an N – point sequence, then the convolved sequence, $y(n)$ is a (M+N-1) – point sequence.

Program:

```
%LINEAR CONVOLUTION
x=[1 1 1 1];
h=[1 1 1 1];
y=conv(x,h);
disp(y);
subplot(3,1,1);
stem(x);
xlabel('sequence');
ylabel('amplitude x(n)');
title('Linear Convolution');
subplot(3,1,2);
stem(h);
xlabel('sequence');
ylabel('amplitude h(n)');
subplot(3,1,3);
stem(y);
xlabel('sequence');
ylabel('amplitude y(n)');
```

OUTPUT:




```
%CIRCULAR CONVOLUTION
clc;
clear all;
N=4;
x=[1,2,2,0];
h=[1,2,3,4];
n=0;
disp('The result of circular convolution is');
for m=1:N;
sum=0;
for k=1:N;
if((m-k)>=0)
n=m-k+1;
else
n=m-k+N+1;
end
```

```
sum=sum+x(k)*h(n);
end
disp(sum);
end
```

OUTPUT:


```
%Assignment 1
N=4;
x=[1 2 2 0];
h=[1 2 3 4];
c=cconv (x, h, N);
disp(c);
```

OUTPUT:

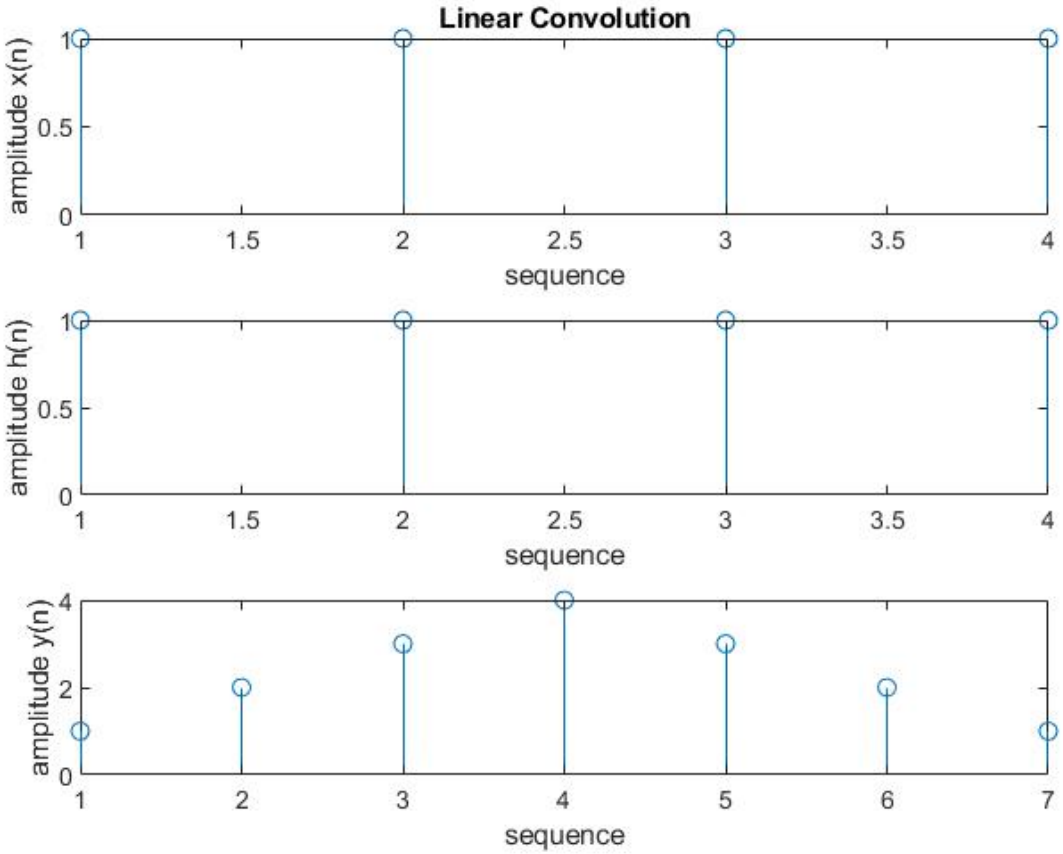
```
   15    12     9    14
```

```
%Assignment 2
%Linear Convolution function
function y=convu(x, h)
L1=length(x);
L2=length(h);
Ny=L1+L2-1;
y = zeros(1,Ny);
```

```
for i = 1:L1
      for k = 1:L2
       y(i+k-1) = y(i+k-1) + h(k)*x(i);
      end
end

%%Linear Convolution using matlab function
clc
clear all;
x=[1 1 1 1];
h=[1 1 1 1];
disp("Result of convolution is: ");
y=convu(x,h);
disp(y);
subplot(3,1,1);
stem(x);
xlabel('sequence');
ylabel('amplitude x(n)');
title('Linear Convolution');
subplot(3,1,2);
stem(h);
xlabel('sequence');
ylabel('amplitude h(n)');
subplot(3,1,3);
stem(y);
xlabel('sequence');
ylabel('amplitude y(n)');
```

OUTPUT:




```
%Assignment 3
```

Result and Discussion:

In this experiment we learned to perform Linear and Circular Convolution both using .m file and Simulink. We also plotted the result in the graph as well.

Conclusion:

Linear and Circular Convolution was performed using .m file and Simulink successfully and conv and convc function was used for performing the same.