Rajshahi University of Engineering & Technology

Department of Electrical and Computer Engineering

Submitted by

Md Alif

Roll: 1810028

ECE,RUET

Submitted to

Hafsa Binte Kibria

Lecturer

ECE,RUET

Experiment No: 1
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Experiment Name: Study of Linear convolution and implementation by MATLAB code.

Theory:
In the case of the two finite duration sequences x (n) and h (n), x(n) has a duration of n1 samples in the range $0 \leq n \leq (n1 - 1)$. The duration of h (n) is n2 samples, meaning that it is non-zero only between $0 \leq n \leq (n2 - 1)$ samples. The sequence y (n), defined as follows, is produced by the linear or periodic convolution of x (n) and h (n). It is obvious that y (n) is a finite length series of samples of duration (n1+n2 -1). The procedures listed below can be used to get the convolution sum of two sequences:

Step 1: Choosing an initial value for n, the moment at which the output sequence y (n) will be evaluated. N = n1+ n2-1 is a suitable choice if x(n) starts at n=n1 and h(n) starts at n=n2.
Step 2: Putting both sequences in terms of the index m in step two.
Step 3: To produce h (-m), fold h (m) about m=0 and shift h (n-m) by n to the right if n is positive or to the left if n is negative.
Step 4: Add the results of multiplying two sequences, x (n-m) and h (m), element by element to obtain   y (n).
Step5: Repeat steps 3 and 4 while increasing the index n and shifting the sequence x (n-m) to the right by one sample.
 Step6: Repetition of step 5 until the products' total equals to zero.

Required Software: Matlab
Required Language: Matlab

Necessary Code:

```
clc;

clear all;

x=[1,2];

h=[1,2,4];

m=length(x);

m1=length(h);

subplot(2,2,1);
```

```
stem(x);

xlabel('n values');

ylabel('Amplitude');

title(' x(n) ');

subplot(2,2,2);

stem(h);

xlabel('n values');

ylabel('Amplitude');

title(' h(n) ');


X=[x,zeros(1,m)];

H=[h,zeros(1,m1)];

for i=1:(m1+m-1)

    y(i)=0;

    for j=1:m

        if(i-j+1)>0

            y(i)=y(i)+X(j)*H(i-j+1);

        end

    end

end

subplot(2,2,3);

stem(y);

xlabel('n values');

ylabel('Amplitude');

title(' y- output ');
```
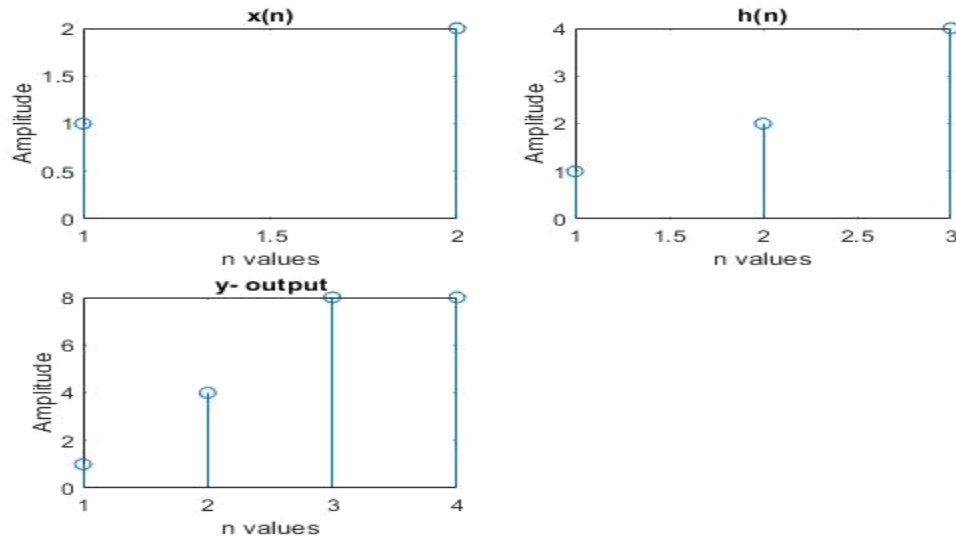
Discussion: Implementing convolution of two discrete signals was the problem at hand. Convolution's built-in function, conv(), was used in the beginning, and then it was implemented using mathematical logic rather than any built-in function. While using the arrays, some issues were found. Since all array indexes in Matlab begin with index 1, rather than zero or a negative value, all indexes whose index started with 0 were increased by one. A method called zeros() was used as padding since the size of each array did not meet the number of iterations and, as a result, was not equal to the total number of iterations.

Conclusion: All the programs ran successfully and we got our desired output.