Heaven's Light is Our Guide

Rajshahi University of Engineering & Technology

Department of Electrical & Computer Engineering

Course No: ECE 4124

Course Title: Digital Signal Processing Sessional

Submitted By:	**Submitted To:**
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Experiment No: 01

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Experiment Name: Study of convolution of two signals using MATLAB.

Theory:

Convolution is a mathematical operation that combines two functions to produce a third function, which represents how one function modifies the shape of the other. In the context of signal processing, convolution is a fundamental tool for analyzing and processing signals, such as audio, images, and time-series data.

The convolution of two signals, f(t) and g(t), is defined as the integral of the product of the two signals as one of the signals is shifted across the other:

$$(f*g)(t) = \int f(\tau)g(t-\tau)d\tau$$

where * denotes convolution, and τ is a dummy variable of integration. In other words, the convolution of f and g at time t is the sum of the products of f and g at all possible time-shifts.

Convolution has several properties that make it a powerful tool for signal processing. For example, convolution is commutative, meaning that fg = gf. Convolution is also associative, which means that (fg)h = f(gh), where h is another signal.

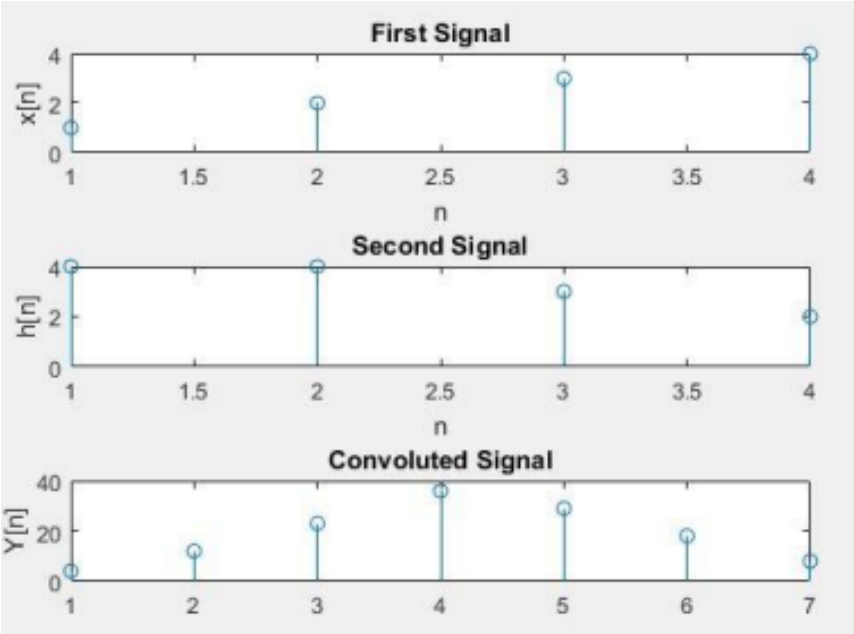
In practice, convolution is used for a variety of signal processing tasks, such as filtering, smoothing, and deconvolution. In this lab report, MATLAB is used to simulate the convolution of two signals and to demonstrate its properties and applications.

Code:

```
x = [ 1 2 3 4];

h = [ 4 4 3 2];

m=length(x);
l=length(h);
X=[x,zeros(1,l)];
H=[h,zeros(1,m)];

z=[];
for i=1:m
 g=h.*x(i);
 z=[z;g];
```

```
end

 [r c] = size(z);
k = r+c;
t =2;
Y =[];
 cd =0;

while(t<=k)
 for i=1:r
 for j=1:c
 if((i+j)==t)
 cd = cd+ z(i,j);  end
 end
 end
 t = t+1;
 Y = [Y cd];
 cd =0;
end


subplot(3,1,1); stem(x); xlabel('n');
ylabel('x[n]'); title('First Signal');

subplot(3,1,2); stem(h); xlabel('n');
ylabel('h[n]'); title('Second Signal');

subplot(3,1,3); stem(Y); xlabel('n'); ylabel('Y[n]');
title('Convoluted Signal');
```

Output:



Discussion:

The experiment was conducted to study the convolution of two signals using MATLAB. The purpose of the experiment was to understand the mathematical principles underlying convolution and its practical applications in signal processing.The results of the experiment demonstrated the fundamental properties of convolution, including its commutative and associative properties. The simulation also showed how convolution can be used for signal filtering and deconvolution, which are essential tasks in signal processing.The experiment also highlighted the importance of MATLAB as a tool for simulating and visualizing signal processing operations. The plot() function in MATLAB was used to visualize the convolved signal and its properties, such as its amplitude and frequency.

Conclusion:

In conclusion, the experiment provided a valuable introduction to the concept of convolution and its applications in signal processing. The simulation using MATLAB demonstrated the fundamental properties of convolution, including its commutative and associative properties. The use of MATLAB also highlighted the importance of computational tools for simulating and visualizing signal processing operations.Overall, the experiment was successful in achieving its goals of providing a better understanding of convolution and its practical applications. The insights gained from this experiment can be useful for future studies in signal processing and related fields.