Department of Electrical Engineering

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Course/Section: BEE-6B **Semester:** 4th Semester

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EE-232Signals and Systems

Lab Report #6 Convolution

Objectives

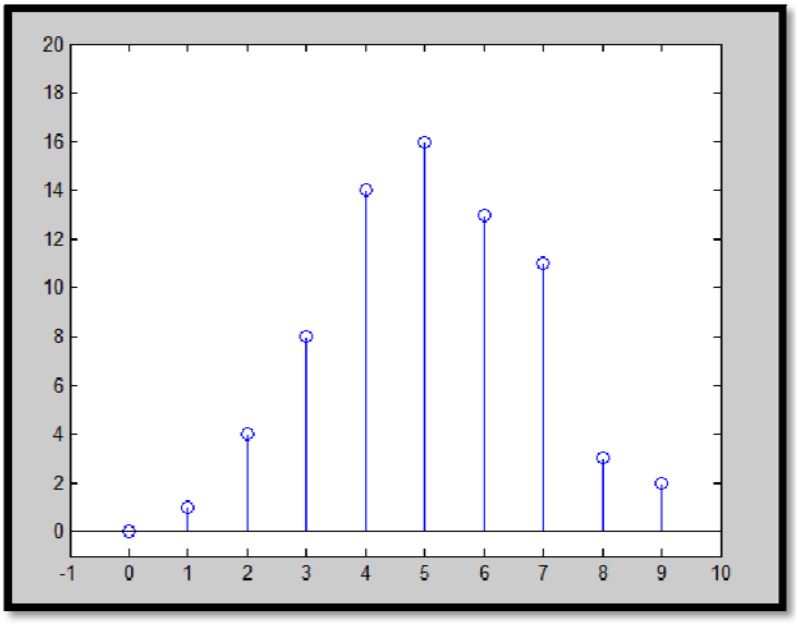
The goal of this exericse is to gain familiarity with the convolution fuction provided in MATLAB and to write a function that would perform the convolution operation. The convolution examples considered in this lab will relate only to the case of discrete time signals.

- How to use the convolution operator in MATLAB
- How to write a function that will perform convolution operation
- Applications of Convolution Operator
- How to use spfirst convolution GUIs

Pre-lab:

After convolving two vectors, starting index is sum of convolving vector's indexes.

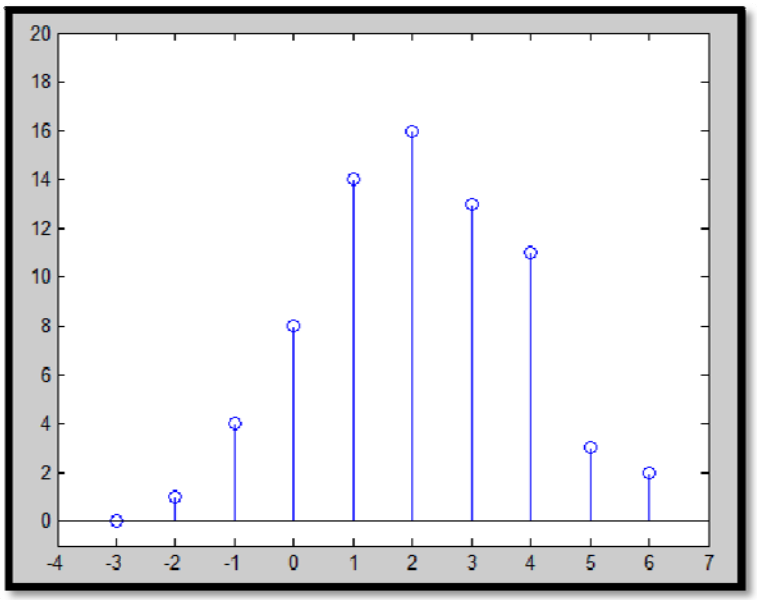
a) Calculate the result of convolving x[n] = {1 2 1 2} with h[n] = {0 1 2 3 4 1 1}.



As,

Xn[1] + Hn[1] = 0 + 0 = 0 starting index

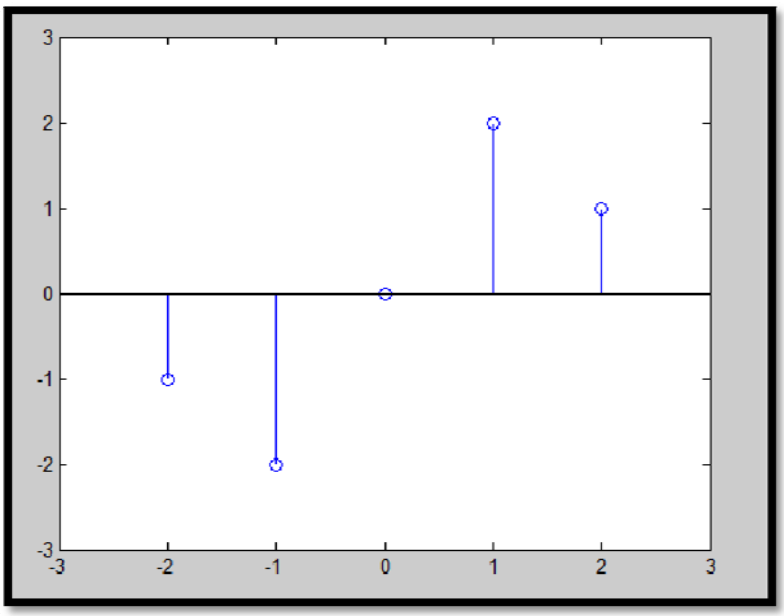
b) Calculate the result of convolving x[n] = {1 2 1 2} with h[n] = {0 1 2 3 4 1 1}.



As,

Xn[1] + Hn[1] = (-1) + (-2) = -3 starting index

c) Calculate the result of convolving x[n] = {-1 0 1} with h[n] = {1 21}.



As,

Xn[1] + Hn[1] = (-1) + (-1) = -2 starting index

Lab Task 1:

Given the following two sequences:
x[n]= {1,2,1,2} h[n]= {0,1,2,3,4,1,1} Where _ indicates the zero position.

I. Write a Matlab function 'my_conv' that will convolve the signal x[n] with the system impulse response h[n] and produce the output y[n]. Plot the output y[n] on a graph with correct axis.

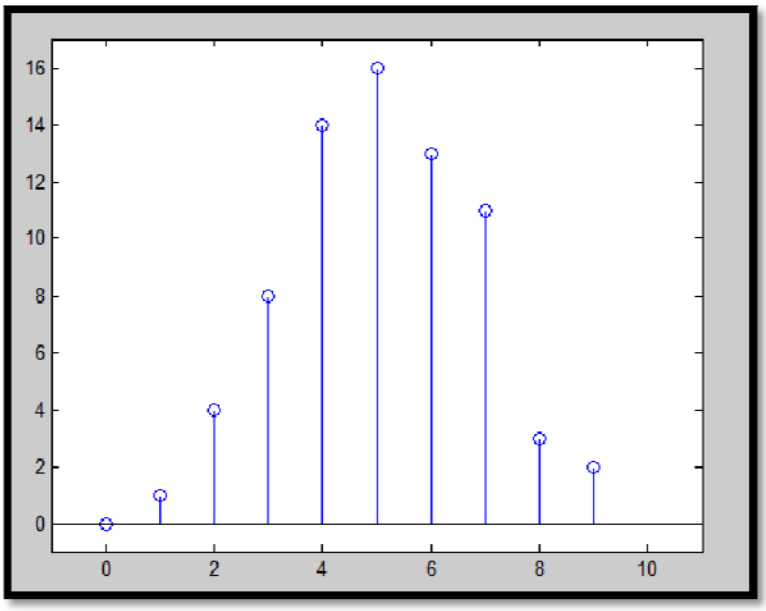
Matlab code:

```
function [Y,N]=convoluter(x,XN,h,HN)
Y=conv(x,h); %Convolution Output
A=(XN(1)+HN(1)); %starting index setup
B=A+length(XN)+length(HN)-2; %end index setup
N=A:B;  %Index vector
stem(N,Y) %plot discrete values
axis([N(1)-1 length(N)+1 min(Y)-1 max(Y)+1]) %Resize axis
```

Matlab Console Input:

```
>> X=[1 2 1 2];
>> Xn=0:3;
>> H=[0 1 2 3 4 1 1];
>> Hn=0:6;
>> convoluter(X,Xn,H,Hn)
```

Matlab plot:



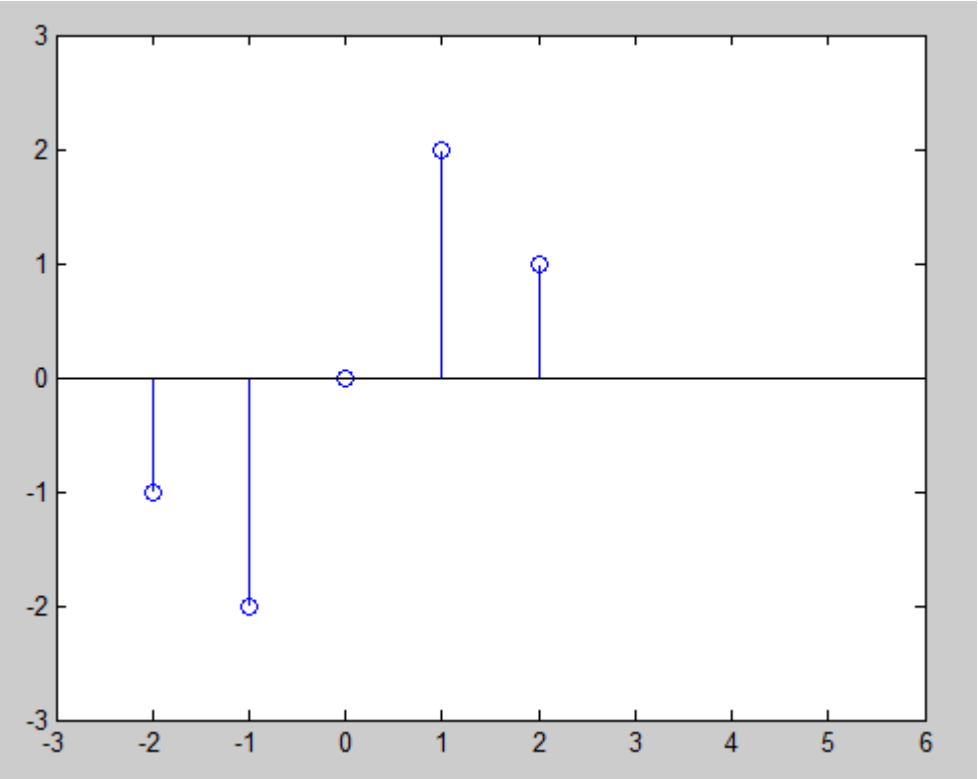
II. Compare your result with built in function of Matlab ‘conv’.

Yes

III. If x[n] starts from -1 and h[n] starts from -2 then what will be the result of convolution using ‘my_conv’ and ‘conv’? Is the result of ‘my_conv’ similar to the result you get on paper? If not, how will you get the correct result with respect to position of signal values. (Note: You have to make time vector to obtain correct plotting on Matlab).

My own function working perfectly, and given problem solution is well described in comments of function.’

IV. Convolution of x[n]={-1 0̲1} with h[n]={1 2̲ 1} results in y[n] ={-1 -2 0̲ 2 1}. Verify this by using the function ‘my_conv’.



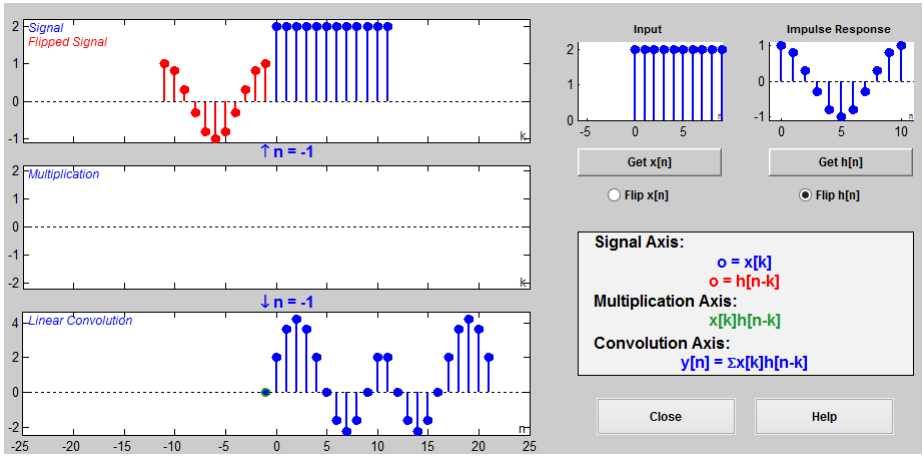
Using Custom Convoluter function

Lab task 2:

Using dconvdemo:

a)

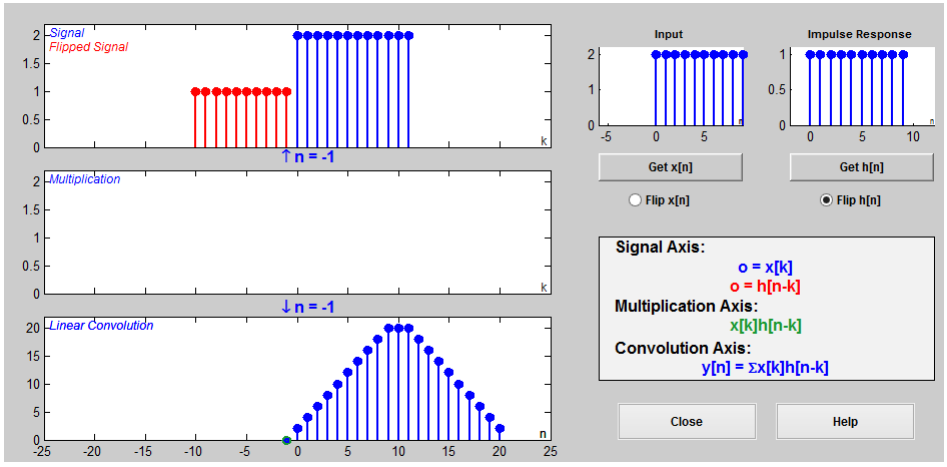
x[n] = 2 {u[n] - u[n - 12]}.
h[n]= cos (0.2*pi*n * w[n]). Where w[n]= u[n]-u[n-11];



Shape: Wave
Length: Sum of length of vector i.e X[n] and Y[n] -1 = 21

b)

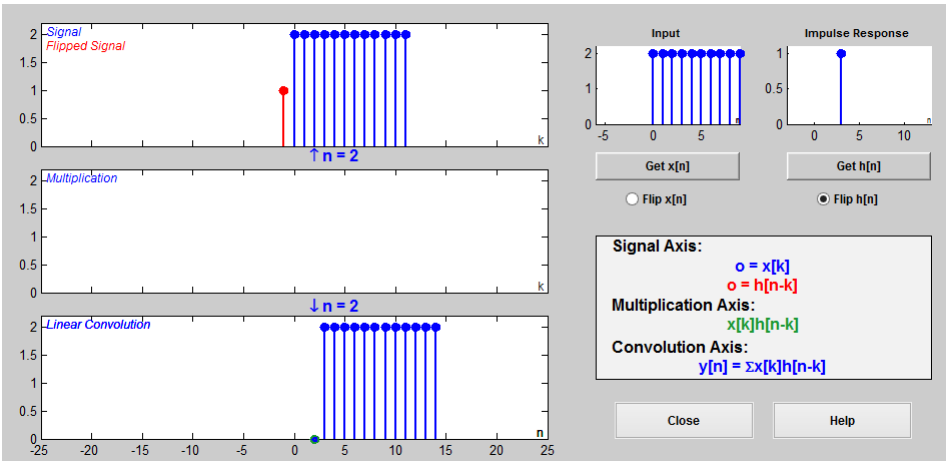
x[n] = 2 {u[n] - u[n - 12]}.
h[n] = 0.1{u[n] - u[n - 10]}



Shape: Triangle
Length: Sum of length of vector i.e X[n] and Y[n] -1 = 21

c)

x[n] = 2 {u[n] - u[n - 12]}.
h[n] = delta[n - 3].

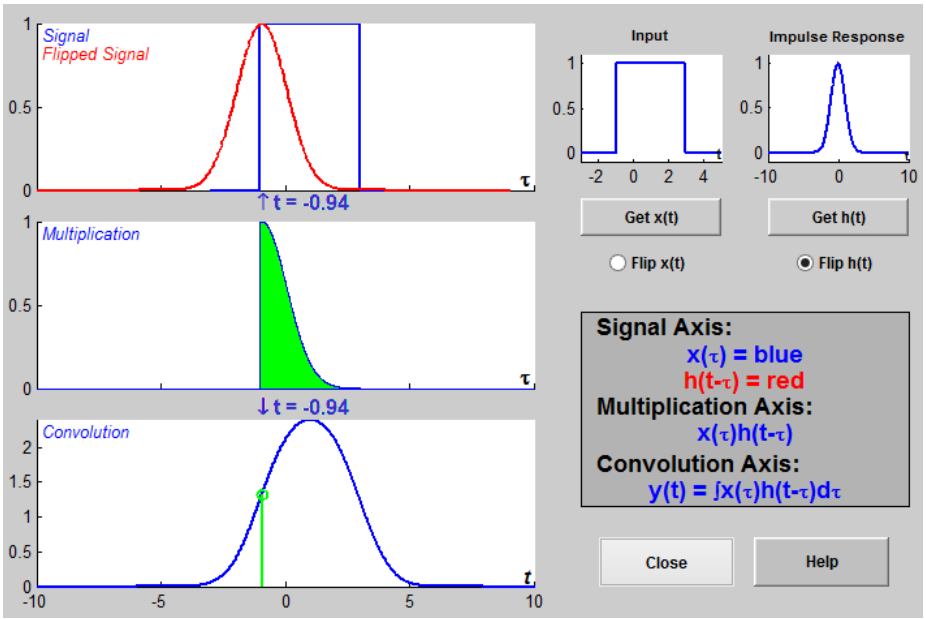


Shape: Rectangle
Length: Sum of length of vector i.e X[n] and Y[n] -1 = 12

Using cconvdemo:

a)

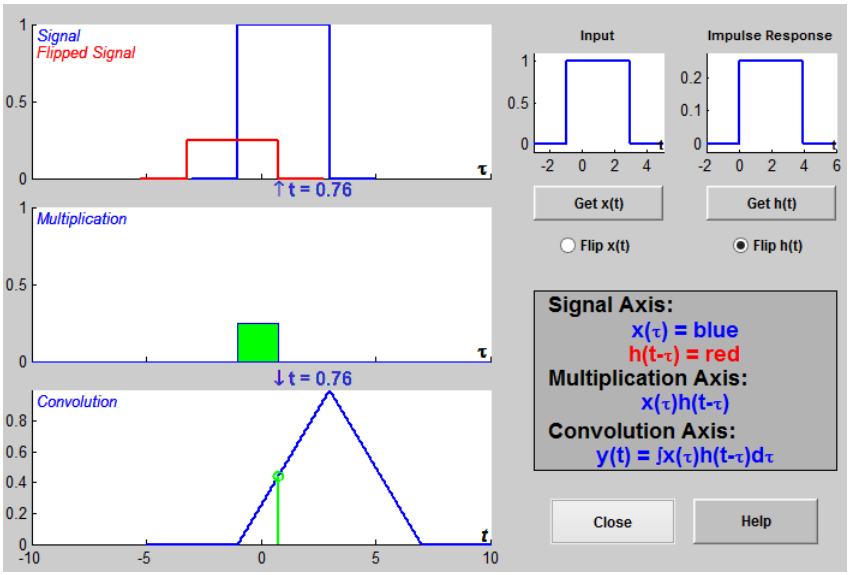
x(t) = u(t+1) - u(t - 3)
$h(t)=e^{-0.5t^{\wedge}2}$ [u(t-5)- u(t-5)]



Shape: Symmetric Mountain
Length: Sum of length of vector i.e X[n] and Y[n] -1

b)

x(t) = u(t+1) - u(t - 3).
h(t) = 0.25{u(t) u(t- 4)}

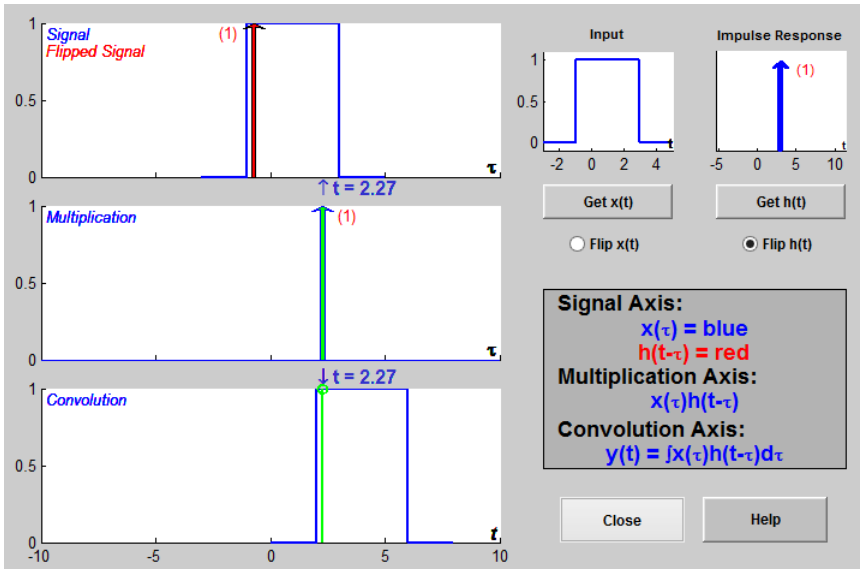


Shape: Cone

Length: Sum of length of vector i.e X[n] and Y[n] -1

c)

x(t) = u(t+1) - u(t - 3).
h(t) = delta(t - 3)



Shape: Rectangle

Length: Sum of length of vector i.e X[n] and Y[n] -1