

Lab#7 – Discrete Convolution Using MATLAB

LAB ASSIGNMENT 1

Suppose that I have two data arrays $X1 = [1 \ 2 \ 3 \ 4]$ and $X2 = [1 \ 2 \ 3]$. If I create a table based on dot multiplication between $X1$ and $X2$, it will look like something as follows:

X2	X1			
	1	2	3	4
1	1	2	3	4
2	2	4	6	8
3	3	6	9	12

Now, I want to add diagonal elements in each diagonal that is formed in this table. For example, in the following table I have 6 diagonals and, in each diagonal, I have few elements. I marked those 6 diagonals with "Red" pointer and used same color for elements in each of those diagonals. So, I want to add diagonal elements for each diagonal and want to store them in another array, let's say Y .

	1	2	3	4
	2	4	6	8
	3	6	9	12

So, the resultant array Y will be, $Y = [1 \ 4 \ 10 \ 16 \ 17 \ 12]$

Now, write a MATLAB code to get this resultant array Y from input array $X1$ and $X2$. Remember write a code in a way so that you can take inputs for $X1$ and $X2$ from outside.

QUESTION 1: How many diagonals form if I have m elements in $X1$ and n elements in $X2$?

LAB ASSIGNMENT 2

Suppose I have to data sets as follows:

$X[n]$	1	2	3	4
Data Position, n	-2	-1	0	1

$h[n]$	1	2	3
Data Position, n	0	1	2

If we convolve them the resultant data set is as follows:

$Y[n]$	1	4	10	16	17	12
Data Position, n	-2	-1	0	1	2	3

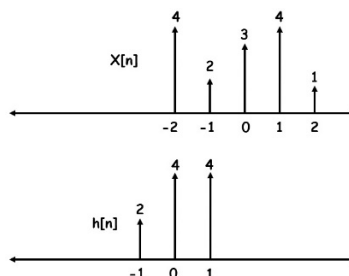
You have to write a MATLAB code to stem plot these data sets in single graph window (using subplot command). In your code, you have to take following inputs from outside:

1. Data input for $X[n]$ and $h[n]$
2. 1st data position for $X[n]$ and $h[n]$

Now, write a MATLAB code based on this information to create the required plots.

LAB ASSIGNMENT 3

Write a MATLAB code to perform convolution operation between given data set and plot $X[n]$, $h[n]$ and $Y[n]$ in a single graph window. Also perform the convolution using general procedure in your lab report and compare two results.



QUESTION 2: Why we can perform convolution operation in LTI (Linear Time Invariant System)?

QUESTION 3: Between two given signals for convolution, which one is better to take for shifting operation and why?

QUESTION 3: Why is convolution of signals important?

Complete the following convolution steps by hand:

	-5	-4	-3	-2	-1	0	1	2	3	4	5	Output
$X[k]$				2	4	6	2	4	6			
$h[k]$				1	2	0	2					
$h[-k]$												

Perform convolution of Lab Assignment of Lab ³ ② using MATLAB function "conv" and compare results.

- QUESTION 1: How many diagonals form if I have m elements in $X1$ and n elements in $X2$?
- QUESTION 2: How data position of convolved output is related to the data position of input signals?
- QUESTION 3: Why flipping is an important operation in convolution?
- QUESTION 4: Why we can perform convolution operation in LTI (Linear Time Invariant System)?
- QUESTION 5: Between two given signals for convolution, which one is better to take for shifting operation and why?