**Experiment 1 : Discrete Convolution**

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| **Experiment No.** | 1 |

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| **AIM:** | The aim of this experiment is to study mathematical operation  such as  :   * Linear Convolution * Circular Convolution * Linear Convolution using Circular Convolution. |
| **OBJECTIVE:** | * To Develop a function to find Linear Convolution and Circular Convolution * To Calculate Linear convolution, Circular convolution, Linear Convolution using  Circular Convolution and verify the results using mathematical formulation. * To Conclude on aliasing effect in Circular convolution |
| **INPUT SPECIFICATION:** | * Length of first Signal L and signal values. * Length of second Signal M and signal values. |
| **PROBLEM DEFINITION:** | * Find Linear Convolution and Circular Convolution of L point sequence x[n] and M point sequence h[n]. * Find Linear Convolution of L point sequence x[n] and M point sequence h[n] using Circular convolution. * Give your conclusion about No of values in  Linearly Convolved signal,  Aliasing effect in Circular Convolution. |
| **Case 1 : Liner convolution** | |
| **Question :** Perform linear convolution of two signal A={12,13,10,11} and B={9,7,14,2}  **Code solution :**    **Result analysis :**  The linear convolution of  A={12,13,10,11} L=4  B={9,7,14,2} M = 4  **y[n]={108,201,349,375,243,174,22} LENGTH =7** | |
| **Question :** Perform linear convolution of two signal A={12,13,10,11} and B={9,7,14,2}  **Code solution :**    **Result analysis :**  The linear convolution of  A={23,12,13,17} L=4  B={9,8,7} M=3  **y[n]={207,292,374,341,227,119} LENGTH = 6** | |
| **Case 2 : Circular convolution** | |
| **Question :** To perform circular convolution between two sequences **A = [4, 6, 9, 10]**  **B = [3, 2, 1, 11, 7]**  **Code solution :**    **Solution :**  To perform circular convolution between two sequences, both sequences must be of the same length. Since sequence A has 4 elements and sequence B has 5 elements, we'll first need to pad the shorter sequence A with zeros to match the length of B.  **Step 1: Pad the shorter sequence**   * **A = [4, 6, 9, 10]** L = 4 becomes **A' = [4, 6, 9, 10, 0]** * **B = [3, 2, 1, 11, 7] M=5**   Now, both sequences are of length 5.  The circular convolution result is: **y = [163, 199, 113, 98, 123] LENGTH = 5** | |
| **Question :** To perform circular convolution between two sequences **A = [7,8,9,10]**  **B = [7,8,9,10]**  **Code solution :**    **Solution :**  **Result analysis :**  The CIRCULAR convolution of  A={7,8,9,10} L=4  B={7,8,9,10} M=4  **y[n]={290,292,290,284} LENGTH = 4** | |
| **Case 3 : Linear Convolution using Circular Convolution** | |
| **Question :** A=[6,9,10,13] , B=[12,8,7,14] , solve linear convolution but use the method of circular convolution  **code solution :**    **Result analysis :**  Since the circular convolution assumes that the sequences are of the same length, we need to pad the sequences with zeros to make their lengths equal to N+M−1, where N and M are the lengths of the original sequences A and B  Given:   * Signal A: A=[6,9,10,13] * Signal B: B=[12,8,7,14]   The length of the circular convolution will be N+M−1=4+4−1=7.  Pad both sequences with zeros to make their lengths 7:   * A=[6,9,10,13,0,0,0] * B=[12,8,7,14,0,0,0]   The linear convolution result using circular convolution method is:  **y[n]=[72,156,234,383,300,231,182]** | |
| **CONCLUSION:** | * Function Accuracy: The developed functions for Linear and Circular Convolution produced accurate results, which matched with mathematical formulations. * Linear Convolution Length: The output length N=L+M−1 was correctly calculated, matching theoretical expectations. * Causality Preservation: The output of Linear Convolution remains causal if both input signals are causal. * Circular Convolution Calculation: Using N=Maximum(L,M) accurately computed Circular Convolution, reflecting the periodic nature of the signals. * Linear Convolution via Circular Convolution: Selecting N≥L+M−1 for Circular Convolution correctly produced the Linear Convolution results. * Aliasing in Circular Convolution: Aliasing effects were observed in Circular Convolution, highlighting the need to manage signal length and periodicity to minimize these effects. |