

Signals and Systems Laboratory
Indian Institute of Technology Jammu
Experiment No.-3

Objective- Write a program (python, Matlab) to obtain linear and circular convolution of the following sequences:

- a. $x(n) = [1, 2, 3, 4, 5]$, $h(n) = [0, 0.5, 1, 1.5]$
- b. $h(n)$ = Room Impulse Response (RIR). Record your own voice, $x(n)$, on mobile. Perform linear and circular convolution. Play the convolved sound.

Apparatus- python+matplotlib, MS-Excel, LibreOffice-Calc, Matlab, Scilab, etc

Theory- Convolution is used to find the output response of a digital system. The linear convolution of two continuous time signals $x[n]$ and $h[n]$ is defined by,

$$y[n] = x[n] * h[n] = \sum_{k=-\infty}^{\infty} x(k)h(n-k)$$

Circular Convolution of two sequences $x[n]$ and $h[n]$, each of length N is given by $y[n]$ = If the length of sequence is not equal, zero padding is done. Convolution operation will result in the convolved signal be zero outside of the range $n = 0, 1, \dots, N-1$.

$$y[n] = x[n] \otimes h[n] = \sum_{k=0}^{N-1} x(k)h(n-k)$$

Algorithm-Linear Convolution

- a. Start the process.
- b. Get the two input sequences $x(n)$ and $h(n)$.
- c. Compute the length of input and output sequences.
- d. Append zeros to the input to get the same length as output.
- e. Sum the product of $x(n)$ and shifted sequence of $h(n-k)$.
- f. Execute the program, display the result and verify theoretically.
- g. Plot the graph for the input and output sequence.
- h. Stop the process.

Algorithm-Circular Convolution

- a. Start the process.
- b. Get the two input sequences $x(n)$ and $h(n)$.
- c. Compute the length of input and output sequences.
- d. Append zeros to $x(n)$ and $h(n)$ to make both sequence of same length.
- e. Rotate the sequence $h(-k)$, 'n' times. If 'n' is positive shift the sequence in anticlockwise direction else in the clockwise direction.
- f. Execute the program, display the result and verify theoretically.
- g. Plot the graph for the input and output sequence.

h. Stop the process.

Observations-

Result- Linear convolution and circular convolution of given sequences has been executed using Python and output has been verified.

Precautions:-

- Program must be written carefully to avoid errors.
- Program can never be saved as standard function name.
- Commands must be written in proper format.