International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Inspection and Analysis of Linear and Circular Convolution of Discrete Time Sequences in Digital Signal Processing

Prof. Amit Kumar Patil

Department of Electronics & Communication Engineering, MIT School of Engineering & Science, MIT ADT University, Pune, India

Abstract-

This paper aims to determine the linear and circular convolution of discrete time sequences. Discrete time signals have amplitude only at specific time intervals. Time is discretized. For any linear and time-invariant system, its output is the linear convolution between the variable input sequence and the constant system impulse response.

I. Introduction

Linear Convolution is a mathematical operation, which takes two signals as input and produces an output signal. Convolution is used to describe the relationship between the input signal, the impulse response, and the output signal. It is the process by which overlapping of two graphs is calculated. Convolution is also interpreted as the area shared by the two graphs over time. If the input and impulse response of a system are x[n] and h[n] respectively, the convolution is given by the expression

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

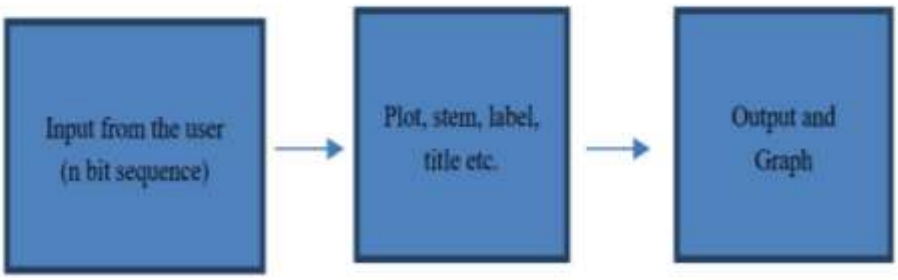
Circular convolution is the convolution of two periodic functions that have the same period. Circular convolution is defined for periodic sequences, whereas linear convolution is defined for aperiodic sequences. The circular convolution of two *N*-point periodic sequences *x1*(*n*) and *x2*(*n*) is given by

$x3[m] = x1[n] * x2[n] = \sum_{n=0}^{N-1} x1[n]\, x2[m-n, (\text{mod } N)]$ m = 0,1,2……N-1

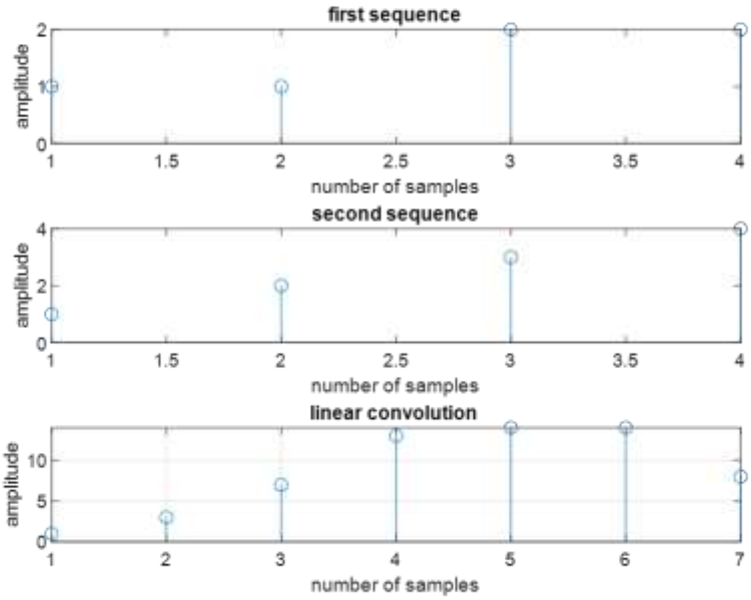
II. Methodology

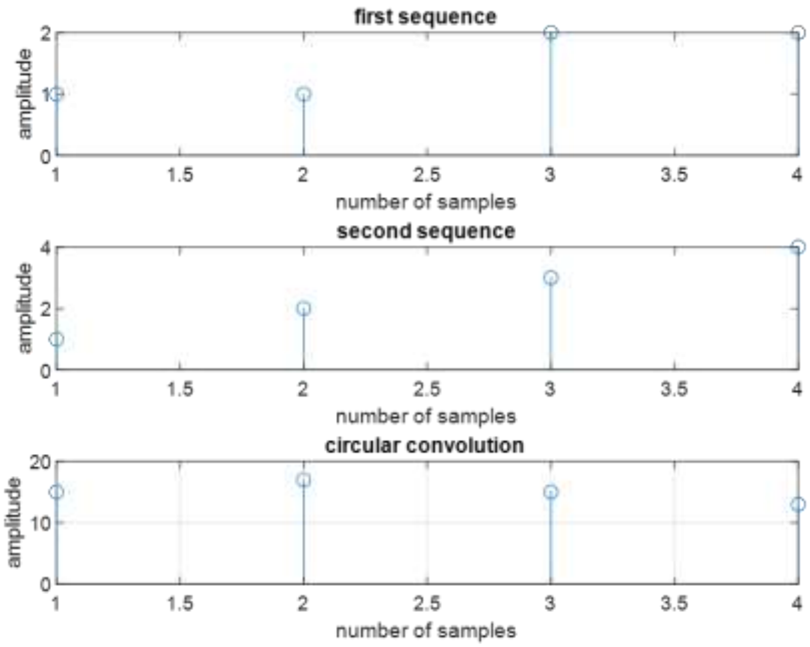
MATLAB tool can be used for the analysis of linear and circular convolution of the discrete time sequences. Graphical convolution can be applied to calculate the resultant graph.

III. Flow Chart:



IV. Results





V. Conclusion

Hence linear and circular convolution can be calculated using graphical method. The resultant signal is z = 1 3 7 13 14 14 8 for linear convolution and the resultant signal is z = 15 17 15 13 for the circular convolution. The two discrete time sequences are [1 1 2 2] and [1 2 3 4]

VI. References

[1] J. Dongarra and F. Sullivan, "Guest editor's introduction to the top 10 algorithms", *Computing in Science & Engineering*, vol. 2, no. 1, pp. 22-23, 2000.

[2] P. S. R. Diniz, Eduardo A. B. da Silva and L. Sergio, Netto: Digital signal processing: system analysis and design, Cambridge University Press, 2010. [3] S. J. Orfanidis, Introduction to signal processing, Prentice Hall, Inc, 1995. [4] S. K. Mitra, Digital signal processing: a computer-based approach, McGraw Hill Higher Education, Inc., 2006.

[5] J. Proakis and D. Manolakis, Digital signal processing: principles algorithms and applications, New Delhi:Prentice Hall, Inc, 2007.

[6] V. K. Ingle and J. G. Proakis, Digital signal processing using Matlab Brooks/Cole, Boston, Mass, USA, 2000.

[7] A. Youssef, P. F. Driessen, F. Gebali and B. Moa, "On time compression overlap-add technique in linear frequency modulation pulse compression radar systems: design and performance evaluation", *IEEE Access*, vol. 5, pp. 27525-27537, 2017.

[8] G. Pand, A. Alvare and P. M. Grant, "A transform domain circular convolution algorithm for adaptive filtering", *IEEE Trans. Acoust. Speech & Signal Process*, vol. 35, no. 8, pp. 1217-1220, 1987.

[9] A. V. Oppenheim and R. Schafer, Digital Signal Processing, NJ, Englewood Cliffs:Prentice-Hall, 1975.

[10] M. Unser, "A family of discrete Fourier transforms with pseudo-cyclic convolution properties", *Proc. ICASSP*, vol. 12, pp. 1815-1818, 1987-Apr.