Digital Signal Processing

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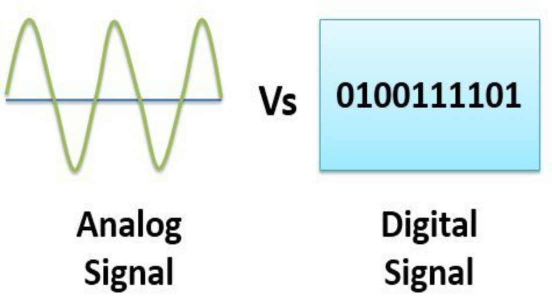
Lecture 6 - Topics

- Introduction
- Unilateral and Bilateral
- Properties of Z transform
- Region of Convergence
- Application of Z transform



Introduction

- In Signal processing, the Z-transform converts a discrete-time signal, which is a sequence of real or complex numbers, into a complex frequency-domain representation.
- It can be considered as a discrete-time equivalent of the Laplace transform.

The z-transform of a sequence $x[n]$ is

$$X(z) = \sum_{n=-\infty}^{\infty} x[n] z^{-n}.$$

Uni and Bilateral Transformations

Two sided or bilateral z-transform

$$X(z) = \sum_{n=-\infty}^{\infty} x[n] z^{-n}$$

Unilateral z-transform

$$X(z) = \sum_{n=0}^{\infty} x[n] z^{-n}$$

Properties of Z transform

1. Linearity :

If $x(n) \overset{\text{Z.T}}{\longleftrightarrow} X(Z)$

and $y(n) \overset{\text{Z.T}}{\longleftrightarrow} Y(Z)$

Then linearity property states that

$$a\,x(n) + b\,y(n) \overset{\text{Z.T}}{\longleftrightarrow} a\,X(Z) + b\,Y(Z)$$

Properties of Z transform

2. Time shifting property:

Time Shifting Property

If $x(n) \xleftrightarrow{\text{Z.T}} X(Z)$

Then Time shifting property states that

$$x(n-m) \xleftrightarrow{\text{Z.T}} z^{-m}X(Z)$$

Properties of Z transform

3. Time Reversal Property:

If $x(n) \xleftrightarrow{\text{Z.T}} X(Z)$

Then time reversal property states that

$$x(-n) \xleftrightarrow{\text{Z.T}} X(1/Z)$$

Region of Convergence (ROC)

The range of variation of z for which z-transform converges is called region of convergence of z-transform.

The region of convergence (ROC) is the set of points in the complex plane for which the Z-transform summation converges.

Applications of Z transform

- Analysis of Discrete signal.
- Voice transmission.
- Use to simulate continous signals.
- Used instead of Fourier transform : it is generalized form of Fourier transform.

Thank you