Heaven's Light is Our Guide

Rajshahi University of Engineering & Technology, Rajshahi

Lab report

Course No: ECE 4124

Course Title: Digital Signal Processing Sessional

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Experiment No: 05

Name of the Experiment: Finding the Z transform of a left sided and right sided signal.

Theory: The Z-transform is a mathematical tool used in digital signal processing to analyze and process discrete-time signals. It's analogous to the Laplace transform used in continuous-time signals. The Z-transform can be used to convert a discrete-time signal into a complex function of a complex variable.In mathematics and 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.

The Z-transform is a very useful tool in the analysis of a linear shift invariant (LSI) system. An LSI discrete time system is represented by difference equations. To solve these difference equations which are in time domain, they are converted first into algebraic equations in z-domain using the Z-transform, then the algebraic equations are manipulated in z-domain and the result obtained is converted back into time domain using the inverse Z-transform.

The Z-transform may be of two types viz. unilateral (or one-sided) and bilateral (or two-sided). When discussing right-sided and left-sided signals in the context of Z-transform, we're talking about the causality of the signal. A right-sided signal is one that is nonzero only for nonnegative time indices, while a left-sided signal is nonzero only for negative time indices.

Mathematically, if x(n) is a discrete-time signal or sequence, then its bilateral or two-sided Z-transform is defined as –

$X(z) = \int_{-\infty}^{+\infty} x(n) Z^{-1}$

Here, x[n] is the discrete-time signal, and z is a complex variable. The Z-transform provides a way to represent a discrete-time signal in a domain where the independent variable is complex, allowing for analysis of frequency content, stability, and other properties of the signal or system. The Z-transform can be used to analyze the behavior of discrete-time systems. By taking the Z-transform of both the input and output signals, you can determine the transfer function of the system, which provides insights into its stability, frequency response, and other properties.The Z-transform has both practical and theoretical significance in the field of digital signal processing. It provides a bridge between the time-domain and frequency-domain representations of discrete-time signals and systems, making it a fundamental tool for designing and analyzing digital systems. The Z-transform is used to design digital filters, which are used for various signal processing tasks like noise reduction and signal enhancement. The convolution operation in the time domain corresponds to multiplication in the Z-domain. This property simplifies convolution calculations and analysis.

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Code:

```
clc;
clear all;
close all;
x=input('Enter sequence from index 0');
b=0;
k=0;
j=0;
n=length(x);
y=sym('z');
for i=1:n
    k=k+x(i)*y^(1-i);
end
display(k);
x=input('Enter sequence from index -1');
n=length(x);
for i=1:n
    j=i+1
    k=k+x(i)*y^(j-1);
end
display(k);
```

output:

```
Enter sequence from index 0[-2 -1 1 2 3 4 5]

k =

1/z^2 - 1/z + 2/z^3 + 3/z^4 + 4/z^5 + 5/z^6 - 2

Enter sequence from index -1[1 2 3 4 5]

k =

z - 1/z + 1/z^2 + 2*z^2 + 2/z^3 + 3*z^3 + 3/z^4 + 4*z^4 + 4/z^5 + 5*z^5 + 5/z^6 - 2
```

Conclusion: Right-sided and left-sided signals in the context of Z-transform, we're talking about the causality of the signal. A right-sided signal is one that is nonzero only for nonnegative time indices, while a left-sided signal is nonzero only for negative time indices. From this experiment we can see that A right-sided signal is one that exists only for nonnegative time indices and a A left-sided signal is one that exists only for negative time indices.