

Rajshahi University of Engineering & Technology

Department of Electrical and Computer Engineering



Course No: ECE 4124

Course Title: Digital Signal Processing Sessional

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Experiment No: 5

Name of the Experiment:

1. Write a code for calculating z-transform of a signal considering left and right sided by using MATLAB.
2. Write a code for calculating z-transform for a non-causal signal using MATLAB.

Theory:

Discrete-time difference equations can be transformed mathematically into algebraic equations in the Z-domain using the Z-transform. When an infinite series converges, it is relevant because it shows that the sum of the values adds up to a finite outcome.

When discussing systems, causality refers to whether a system's output depends just on current and previous input values or also on future input values. As demonstrated by the example $y(n) = x(n)$, a causal system generates output that is only dependent on the input's most recent and prior values.

A non-causal system, on the other hand, is one in which the outcome depends on future input values. This is demonstrated by the equation $y(n-1) = x(n)$, where the input value in the following step determines the output at a certain point.

Code:

Code for z-transform of a signal considering left and right sided:

```
clc;
clear all;
close all;

x = [1 5 3 7 3 8 5];
l = length(x);
y = sym('z');
zt_l = 0;
zt_r = 0;

for i = 1:l
    zt_l = zt_l + x(i) * y^(-i);
end

for i = 1:l
    zt_r = zt_r + x(i) * y^(i);
end

disp('Left = ');
disp(zt_l);

disp('Right = ');
disp(zt_r);
```

Output for z-transform of a signal considering left and right sided:

```
Command Window
Enter the index: 5
Output =
7*z + 8/z + 5/z^2 + 3*z^2 + 5*z^3 + z^4 + 3
fx >>
```

Code for z-transform for non-causal signal:

```
clc;
clear all;
close all;

x = [1 5 3 7 3 8 5];
inp = input('Enter the index: ');
l = length(x);
y = sym('z');
zt_l = 0;
zt_r = 0;

for i = 1:l
    if i >= inp
        zt_r = zt_r + x(i) * y^(inp - i);
    else
        zt_l = zt_l + x(i) * y^((-1) * (i - inp));
    end
end

output = zt_l + zt_r;
disp('Output = ');
disp(output);
```

Output for z-transform for non-causal signal:

```
Command Window
Enter the index: 5
Output =
7*z + 8/z + 5/z^2 + 3*z^2 + 5*z^3 + z^4 + 3
fx >>
```

Discussion:

The Z-transform computations were performed using a predefined signal and the MATLAB code, taking into account both left and right-sided cases. The length function was used to calculate the signal's length. The signal's components were then repeatedly processed using a for loop. A standard was developed inside this loop for handling the left-sided situation. The right-sided condition was also taken into account by adding another for loop. The output that was produced once the loop was finished was displayed. Similar to this, a signal was picked in order to create the Z-transform for a non-causal signal. An index number has to be entered by the user. The length function was used to determine the signal's length. The components of the signal were then iterated through using a for loop. An if-else structure was used inside the loop. Conditions were included in this framework to cover both left- and right-sided occurrences. The calculated values from the right- and left-sided calculations were then added. Displaying the computed result ultimately demonstrated the Z-transform's result.

Conclusion: The program ran successfully without any error and we got our desired output.