Rajshahi University of Engineering and Technology

Department of Computer Science and Engineering

Lab Report

z-Transform of a Signal

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Problem: Implement and analyze the z-transform of various real world signals.

Input:

- Take an input signal

Output:

- Convert the input signal to z-domain
- Display the input signal
- Display the transformed function

Solution:

```
n = [-10:10];
x = randi(100, [1, 21]); % input signal

disp('Input signal');
disp(x);

% plot the input signal
subplot(2,1,1);
plot(n, x);
title('Input Signal')
grid on;

% z-transformation of x
k = length(n);
X=0;
z = sym('z');

for i=0:k-1
    X = X + x(i+1)*z^(-i);
end

disp('Output Signal (manually)');
pretty(X);

a = sym('a');
xa = x*a;
xz = ztrans(xa);
disp('Output signal (using built-in function')
pretty(xz);

subplot(2,1,2);
title('Transformed Signal')
grid on;
zplane(x, n);
```

```
Input signal
    70    90    96    55    14    15    26    85   |26    82    25    93    35    20    26    62    48    36    84    59    55

Output Signal (manually)
90   96   55   14   15   26   85   26   82    25    93    35    20    26    62    48    36    84    59    55
-- + -- + -- + -- + -- + -- + -- + -- + -- + --- + --- + --- + --- + --- + --- + --- + --- + --- + --- + --- + --- + 70
 z    2    3    4    5    6    7    8    9    10    11    12    13    14    15    16    17    18    19    20
     z    z    z    z    z    z    z    z    z     z     z     z     z     z     z     z     z     z     z
```

Figure 1: Input signal and Output signal (manual transformation)

```
Output signal (using built-in function

-- --   70 z      90 z      96 z          14 z      15 z          85 z          82 z      25 z      93 z      35 z      20 z
|  |  --------, --------, --------, #2, --------, --------, #1, --------, #1, --------, --------, --------, --------, --------, #1,
|  |         2         2         2             2         2             2             2         2         2         2         2
-- -- (z - 1)   (z - 1)   (z - 1)       (z - 1)   (z - 1)       (z - 1)       (z - 1)   (z - 1)   (z - 1)   (z - 1)   (z - 1)

    62 z      48 z      36 z      84 z      59 z       -- --
  --------, --------, --------, --------, --------, #2  |  |
         2         2         2         2         2      |  |
  (z - 1)   (z - 1)   (z - 1)   (z - 1)   (z - 1)      -- --

where

          26 z
   #1 == --------
                2
         (z - 1)

          55 z
   #2 == --------
                2
         (z - 1)
```

Figure 2: Output signal (using built-in `ztrans()` function of Matlab)

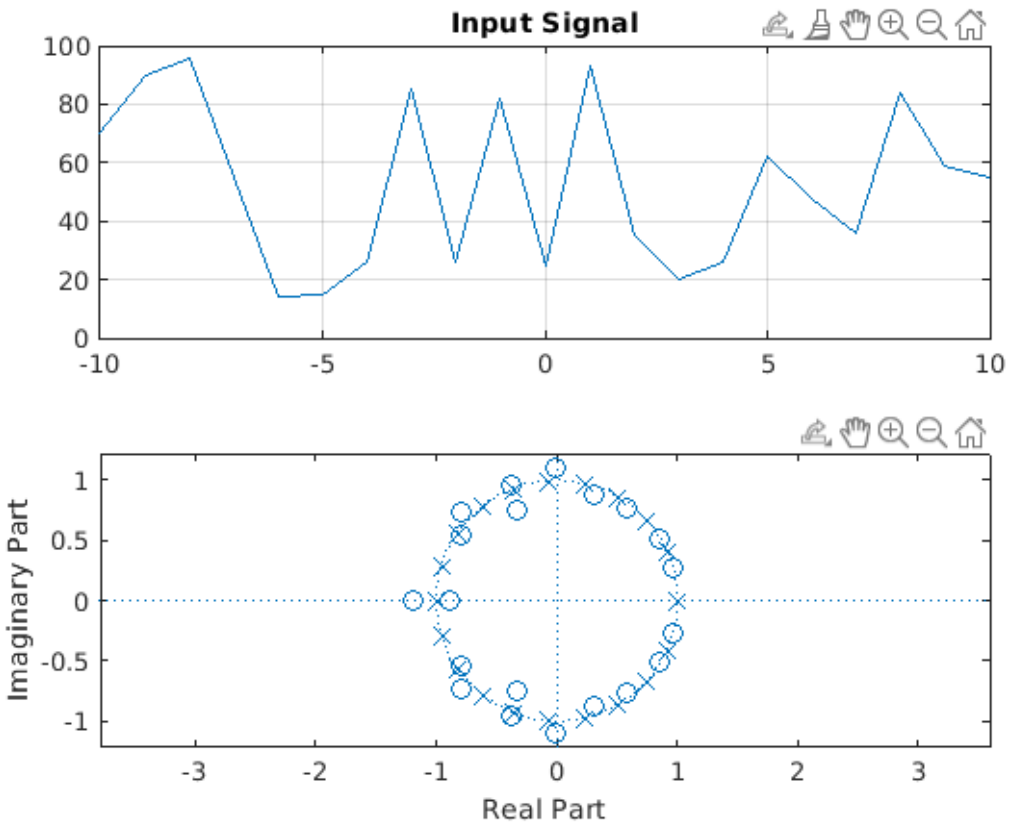

Figure 3: Plot of Input signal and Output signal