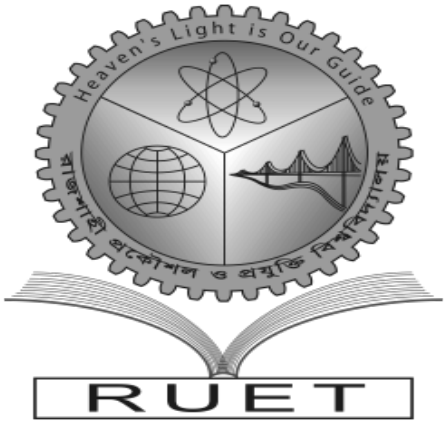

Rajshahi University of Engineering and Technology

Department of Electrical and Computer Engineering(ECE)

Course Title: Digital Signal Processing Sessional

Course No: ECE 4124

Submitted By:

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Experiment Date: 14 May, 2023

Experiment No: 04

Name of the Experiment:

i) Take a continuous square wave signal, make a delay of that signal and do the auto correlation of the two signal. Write a code for that signal using MATLAB.
ii) Take a discrete square wave signal, make a delay of that signal and do the auto correlation of the two signal. Write a code for that signal using MATLAB.
iii) Write a code for calculating z-transform of a signal using MATLAB.

Theory: The correlation of two functions or signals or waveforms is defined as the measure of similarity between those signals. There are two types of correlations. They are

1. Autocorrelation
2. Cross-correlation

The autocorrelation function is defined as the measure of similarity or coherence between a signal and its time delayed version. Therefore, the autocorrelation is the correlation of a signal with itself. Autocorrelation is useful for finding repeating patterns in a signal, such as determining the presence of a periodic signal which has been buried under noise or identifying the missing fundamental frequency in a signal implied by its harmonic frequencies.

The cross-correlation between two different signals or functions or waveforms is defined as the measure of similarity or coherence between one signal and the time-delayed version of another signal. The cross-correlation between two different signals indicates the degree of relatedness between one signal and the time-delayed version of another signal. This is also known as a sliding dot product or sliding inner-product. It is commonly used for searching a long signal for a shorter, known feature.

Code:

Code for autocorrelation of continuous signal:

```
clc
close all
clear all
t = 0:0.001:4;
a1 = t>=0 & t<=1;
a2 = t>=1.5 & t<=2.5;
a = a1-a2;
subplot(3, 1, 1);
plot(a);
    title('The Square wave signal');
    s1 = t>=1 & t<=2;
    s2 = t>=2.5 & t<=3.5;
    s = s1-s2;
    subplot(3, 1, 2);
    plot(s);
    title('Delay signal');
```

```
17.      N = -(length(t)-1):(length(t)-1);
18.      corr = xcorr(d,a);
19.      subplot(3, 1, 3);
20.      plot(N,corr);
21.      title('Auto correlation signal');
22.      % max value calculation
23.      maxx = max(corr);
24.      F = find(corr == maxx);
25.      maximum_value = F-length(t)
```

Code for autocorrelation of discrete signal:

```
1. clc
2. clear all
3. close all
4. t = 0:0.1:4;
5. a1 = t>=0 & t<=1;
6. a2 = t>=1.5 & t<=2.5;
7. a = a1-a2;
8. subplot(3, 1, 1);
9. stem(a);
10.      title('Square wave signal');
11.      d1 = t>=1 & t<=2;
12.      d2 = t>=2.5 & t<=3.5;
13.      d = d1-d2;
14.      subplot(3, 1, 2);
15.      stem(d);
16.      title('Delay signal');
17.      N = -(length(t)-1):(length(t)-1);
18.      corr = xcorr(d,a);
19.      subplot(3, 1, 3);
20.      stem(N,corr);
21.      title('Auto correlation signal');
22.      % max value calculation
23.      maxx = max(corr);
24.      F = find(corr == maxx);
25.      maximum_value = F-length(t)
```

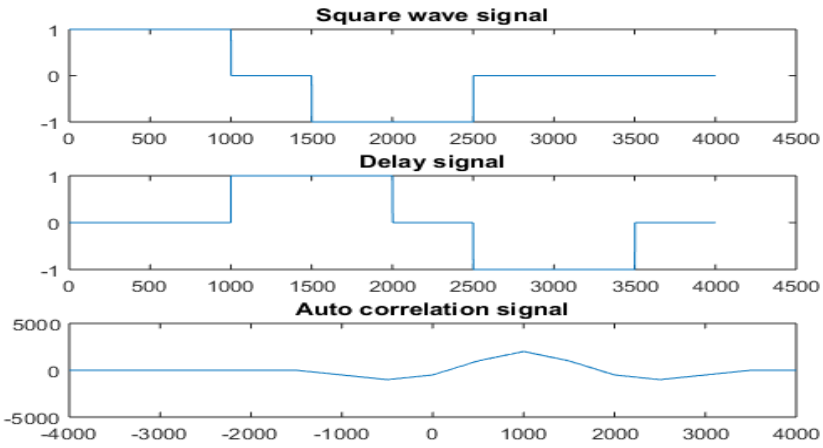
Code for z-transform of a signal:

```
1. clc
2. clear all
3. close all
4. syms n z
5. x = 2^n
6. z_transform = ztrans(x)
```

Output:

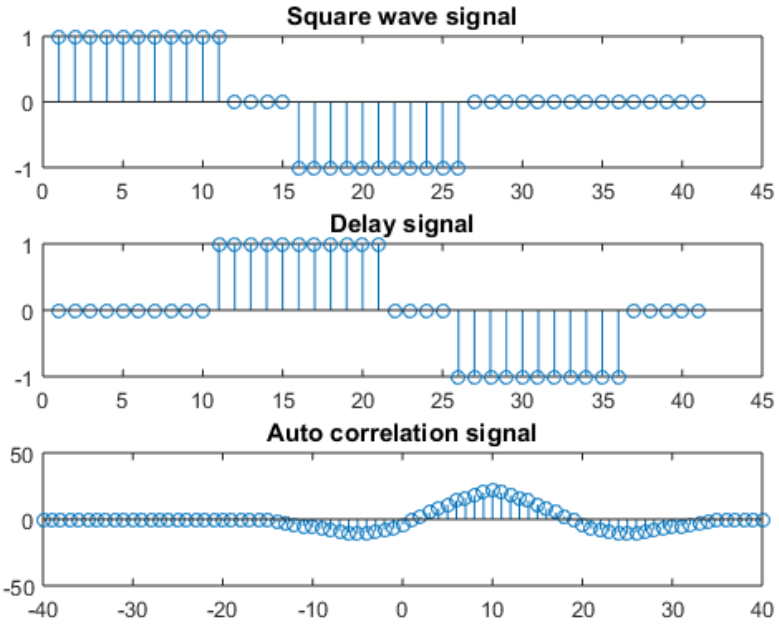
Output for autocorrelation of continuous signal:

```
maximum_value =

        1000
```



Output for autocorrelation of discrete signal:

```
maximum_value =

    10
```



Output for z-transform of a signal:

```
z_transform =

z/(z - 2)
```

Discussion: MATLAB was used to implement the z-transform and autocorrelation codes. The first time t was stated was for the implementation of continuous signal coding autocorrelation. The continuous square wave signal was then plotted after writing some conditions for making a signal. The signal was then plotted after some conditions for making the delay signal were written. Then the two signals were auto-correlated, and the signal was plotted. Xcorr function was used to perform auto correlation. The length of the autocorrelation signal was declared. Then the maximum delay value was determined. The discrete signal code's implementation of auto correlation was comparable to that of the continuous signal code. Instead of the plot function in this case, stem function was used.

Conclusion: The code was successfully run, and no mistakes were discovered. We learnt about autocorrelation, the z-transform, and how to use MATALB to plot the signal from this experiment.

References:

[1]"Correlation – tutorialspoint", tutorialspoint, 2023. [Online].
Available: https://www.tutorialspoint.com/what-is-correlation-in-signals-and-systems
[Accessed: 17 - May - 2023]

[2]"Continuous signal – tutorialspoint", tutorialspoint, 2023. [Online].
Available: https://www.tutorialspoint.com/digital_signal_processing/dsp_signals_definition.htm#
[Accessed: 17 - May - 2023]