Heaven's Light is Our Guide

Rajshahi University of Engineering& Technology

Department of Electrical & Computer Engineering

Course No: ECE 4124
Course Name: Digital Signal Processing Sessional

Submitted by:
Name: Sabbir Ahmad
Roll: 1810034

Submitted to:
Hafsa Binte Kibria
Lecturer,
Dept. of ECE
RUET

Experiment No: 04

Experiment Date: 14.05.2023

Experiment Name: Experiment on finding delay of a function and plotting poles and zeros of the z transform of a function.

Theory: The shifted version of any signal can be used to describe the delay of a function. When a signal is shifted to the right by two units, the delayed function is denoted by (t-2). Using the autocorrelation of the signal and a delayed version of that signal, we can use MATLAB to determine the delay of a function. The delay of the function will be at the index where the value of the associated array is greatest. For both continuous and discrete signals, it is the same.

A transfer function's poles and zeros are the frequencies at which its denominator and numerator values, respectively, become infinite and zero. Whether a system is stable depends on the values of its poles and zeros.

And the system's effectiveness. In its most basic form, control systems can be created by giving the system's poles and zeros particular values.

X(n)=u(n) is the equation for a unit step signal.

This will be the ztransform: z[x(n)=z/(z-1)

The poles in this case are where z=1 and the zeros are.

Software used: MATLAB

Code:

Delay of discrete signal:

```
clc;
clear all;
close all;

x = [0 0 1 2 3 4];
x1 = [1 2 3 4];

[autocorr, lags] = xcorr(x, x1);
subplot(3,1,1);
stem(x);
title('Signal');

subplot(3,1,2);
stem(x1);
title('Delayed signal');

subplot(3,1,3);
stem(lags, autocorr);
title('Lags vs autocorrelation-value');

[~, index] = max(autocorr);

delay_sample = abs(lags(index));
Fs = 1;
delay_seconds = delay_sample / Fs;
```

Delay of continuous signal:

```
clc;
clear all;
close all;
t = 0:1:10;
f = 10;
x = 10 * sin(2 * f * pi * (t - 4));
x1 = 10 * sin(2 * f * pi * t);
plot(xcorr(x, x1));
z = xcorr(x, x1);
[autocorr, lags] = xcorr(x, x1);
subplot(3,1,1);
plot(x);
title('Signal');

subplot(3,1,2);
plot(x1);
title('Delayed signal');
subplot(3,1,3);
plot(lags, autocorr);

title('Lags vs autocorrelation-value');
[~, index] = max(autocorr);

delay_sample = abs(lags(index));
Fs = 1;
delay_seconds = delay_sample / Fs;
```

Plotting poles and zeros:

```
clc;
clear all;
close all;

a = [1];
b = [1 -1];

zplane(a, b);
grid;
```

Output:

Delay of discrete signal:

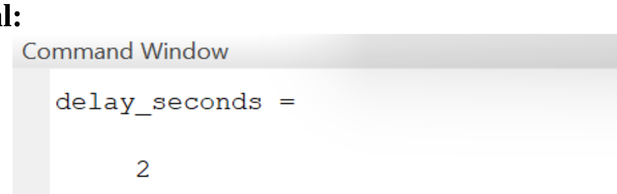

Fig. 1 Delay of the discrete function.

Figure plot:

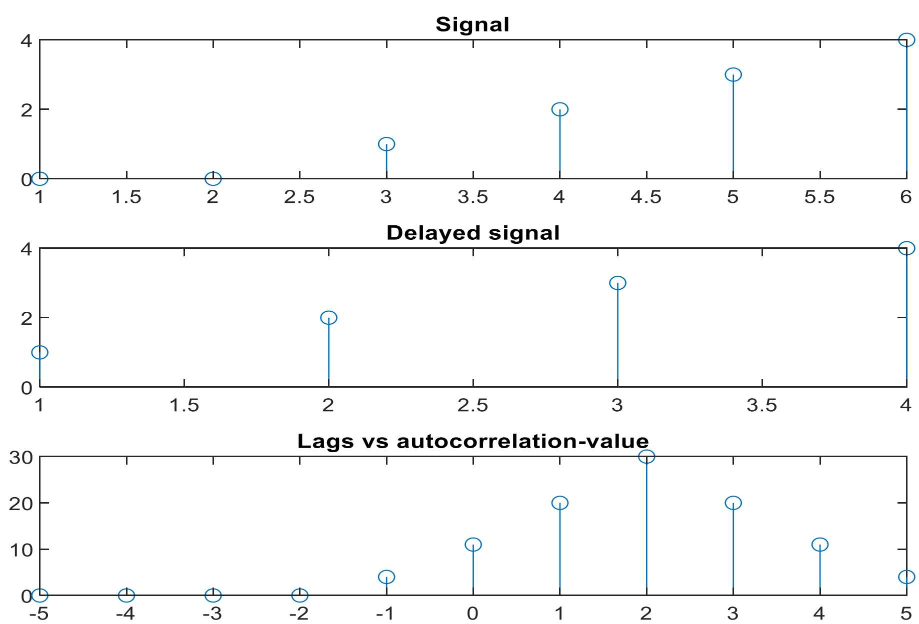

Fig. 2 Delay of the discrete function (2 seconds).

Delay of continuous signal:

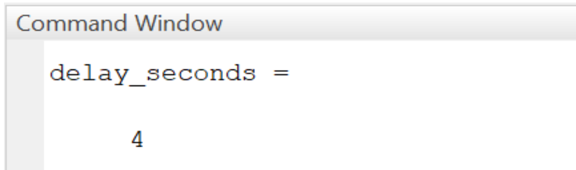

Fig. 3 Delay of the continuous function (4 seconds).

Plotting poles and zeros:

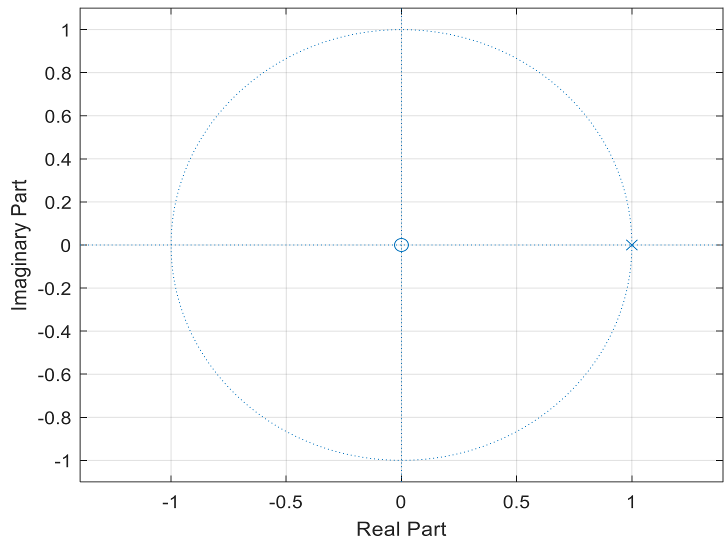

Fig. 5 Poles and zeros of the transfer function.

Discussion: In the experiment, we dealt with signal delay. Here, autocorrelation is used to determine the delay. The delay of the signal is represented by the highest value in this plot of lags vs. autocorr_value. Both the discrete and continuous signals' delays are determined. Then, we dealt with a signal's ztransform's poles and zeros. Here, O stands for zeros, and X for the step function's poles that we have been working with.

Conclusion: In the experiment, all of the code and visualizations function without any errors or complications.