Department of
Robotics and Mechatronics Engineering

Lab report

DIGITAL SIGNAL PROCESSING (CSE-401)

Submitted By:
Md. Tahmeed Abdullah
Roll: SH-092-002
4^{th} year 1^{st} semester

Submitted To:
Mr. Sujan Sarker
Lecturer
Dept. of RME

Date of submission: 3 February, 2019

Name of the experiment

Time shifting of digital signals.

Objectives

- To learn about sampling a continuous time signal and basics of digital singals.
- Learn time delay and time advance of signals.
- Learn to implements signal processing in MATLAB

Theory

A digital signal is obtained by sampling and quantizing a continuous time signal. Let $x[n]$ be a digital signal where n indicate the sample number. Let the shifted signal is represented by $y[n] = x[n-k]$. If $k > 0$, the output signal $y[n]$ is delayed by samples k and if $k < 0$, the output signal $y[n]$ is time advanced by samples k. If $k = 0$, the output signal is the same as input signal.

For example:

$$x[n] = \{-x_3, -x_2, -x_1, x_0, x_1, x_2, x_3\}$$

Here $x[n]$ is a finite digital signal and for $n = 0, x[n] = x_0$. If time advance is applied to the signal, where the signal advances by 3 samples i.e. $k = -3$. Then the output signal is as follows.

$$y[n] = \{x_0, x_1, x_2, x_3, 0, 0, 0\}$$

So, $y[n] = x[n-k]$, where $k = -3$ for this example. putting $n = 0$, we get $y[0] = x[3]$. So, the signal advances by 3 samples.

Again, if time delay is applied to the signal, where the signal is delayed by 3 samples i.e. $k = 3$. Then the output signal is as follows.

$$y[n] = \{0, 0, 0, -x_3, -x_2, -x_1, x_0\}$$

So, $y[n] = x[n-k]$, where $k = 3$ for this example. putting $n = 0$, we get $y[0] = x[-3]$. So, the signal delays by 3 samples.

In both the processes, some signal values get removed from the finite window and the empty spaces are filled with zero value.

Implementation Code

main.m

```
clc; clear; close all;
origin = 6;
sample = [-1,0,1,2,3,4,4,4,4,4];
k=3;
sampleDelayed = delay(sample,origin,k);
sampleAdvanced = advance(sample,origin,k);
subplot(3,1,1); stem([-5:4],sample);
ylim([0,10]); title('Original Sequence');

subplot(3,1,2); stem([-5:4],sampleDelayed);
ylim([0,10]); title('Delayed Sequence');

subplot(3,1,3); stem([-5:4],sampleAdvanced);
ylim([0,10]); title('Advanced Sequence');
```

Functions Used:

delay.m

```
function out = delay(sample,origin,k)
out = zeros(size(sample));
for i=1:size(out,2)
    if i>k
        out(i)=sample(i-k);
    end
end
end
```

advance.m

```
function out = advance(sample,origin,k)
out = zeros(size(sample));
for i=1:size(out,2)
    if i<=size(out,2)-k
        out(i)=sample(i+k);
    end
end
end
```