Heaven's Light is Our Guide

RAJSHAHI UNIVERSITY OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

LAB REPORT

Course No: EEE 4108

Course Name: Digital signal processing Sessional

Experiment No: 01

Experiment Name: Study of sampling error vs frequency graph and quantization error vs ADC graph using MATLAB code

Date of experiment: 04/03/2023

Date of Submission: 06/05/2023

Submitted By:	**Submitted To:**
Name: Md Maruf Hassan Roll: 1801105 Section: B Registration No: 285 Session: 2018-2019	Dr. Mohammod Abdul Motin Assistant Professor, Department of Electrical & Electronic Engineering Rajshahi University of Engineering & Technology

Experiment No: 01

1.1 Experiment Name:

Study of sampling error vs frequency graph and quantization error vs ADC graph using Matlab code

1.2 Objectives:

1.To get introduced to sampling, quantizing, sampling error and quantization error

2. To know about sampling and quantizing by using Matlab code

1.3 Theory:

To create a digital image, we need to convert the continuous sensed data into digital form. This process includes 2 processes:

1. Sampling: Digitizing the co-ordinate value is called sampling.

2. Quantization: Digitizing the amplitude value is called quantization.

To convert a continuous image f (x, y) into digital form, we have to sample the function in both co-ordinates and amplitude.

Difference between Image Sampling and Quantization:

Sampling	**Quantization**
Digitization of co-ordinate values.	Digitization of amplitude values.
x-axis(time) – discretized.	x-axis(time) – continuous.
y-axis(amplitude) – continuous.	y-axis(amplitude) – discretized.
Sampling is done prior to the quantization process.	Quantization is done after the sampling process.
It determines the spatial resolution of the digitized images.	It determines the number of grey levels in the digitized images.
It reduces c.c. to a series of tent poles over a time.	It reduces c.c. to a continuous series of stair steps.
A single amplitude value is selected from different values of the time interval to represent it.	Values representing the time intervals are rounded off to create a defined set of possible amplitude values.

1.4 Code for sampling of different frequencies:

```
clc
clear all
close all
fs=100:150:1000;
er=zeros(size(fs));
for i=1:length(fs)
    Fs=fs(i);
    t1=0:1/Fs:.8;
    t2=0:1/Fs:.8;
    f=2;
    s1=10*sin(2*pi*f*t1);
    s2=5*sin(2*pi*f*t2);
    yr=interp1(t1,s1,t2);
    er(i)=mean(abs(s2-yr));
    subplot(length(fs),1,i)
```

```
    hold on
    stem(t1,s1);
    plot(t1,s1);
    plot(t2,s2);
    title(sprintf('sampling frequency in dhz',fs(i)))
end
figure;
plot(fs,er)
```

1.5 Output waveform for sampling of different frequency:

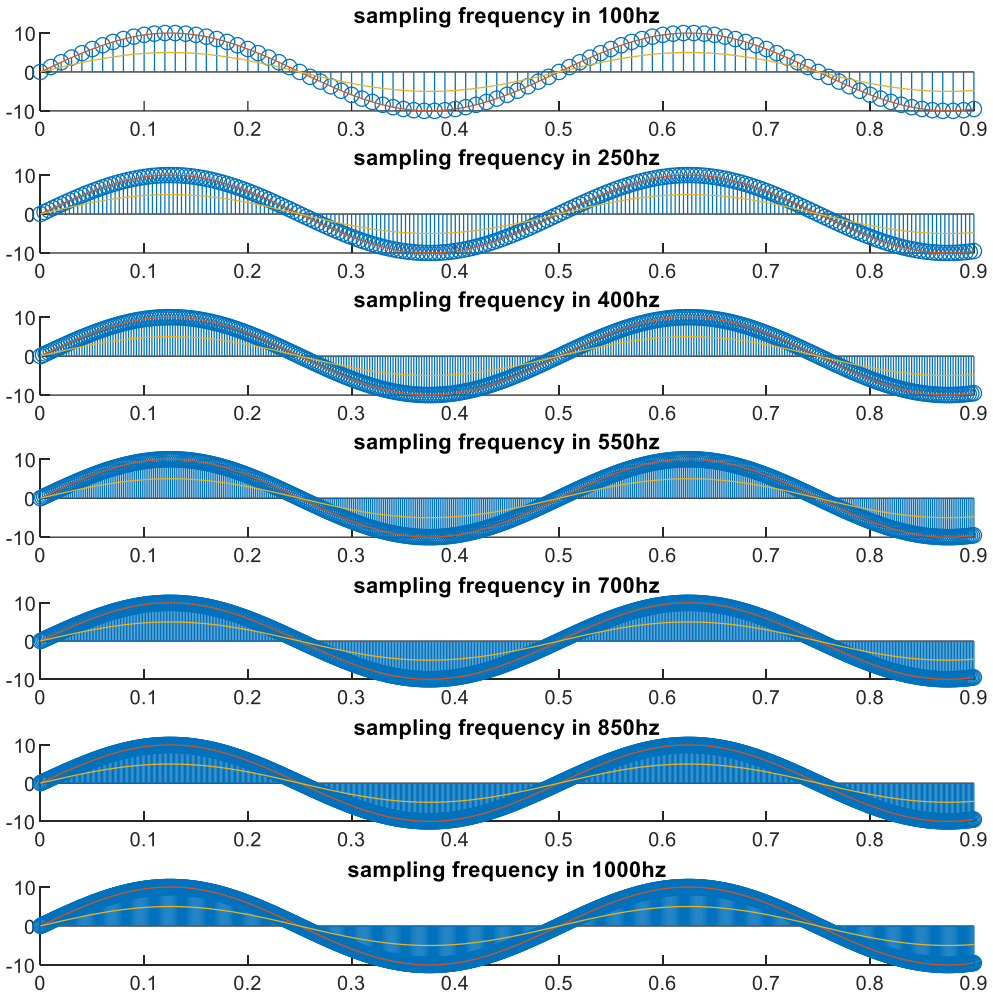

Fig.1.1. Main and sampled signal for different frequency

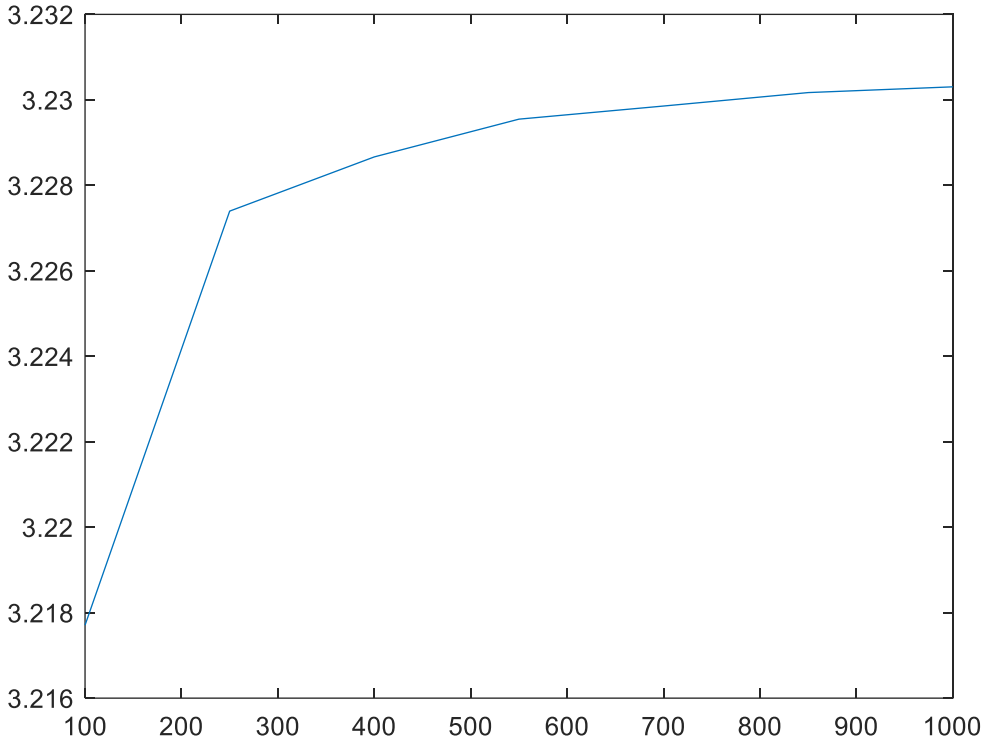

Fig.1.2. sampling error vs frequency

1.6 Code for quantizing of different bit levels:

```
clc
clear all
t=0:0.0001:.3;
s=10*sin(2*pi*10*t);
plot(t,s);
AB=[1 2 3 8]; %AB=bits
for i=1:4
    bit=AB(i);
    Q_L=2^bit;
    tmax=max(s);
    tmin=min(s);
    step_size=(tmax-tmin)/Q_L;
    sq=round(s/step_size)*step_size;
    error(i)=mean((s-sq).^2);% quantization error
    subplot(length(AB),1,i);
    hold on
    plot(t,s);
    plot(t,sq);
    title(sprintf('bit number is %d',AB(i)));
    xlabel('Time(s)');
    ylabel('Amplitude');
end
figure;
plot(AB,10*log10(error));% plotting quantization error
```

1.7 Output waveform for quantizing of different bit levels:

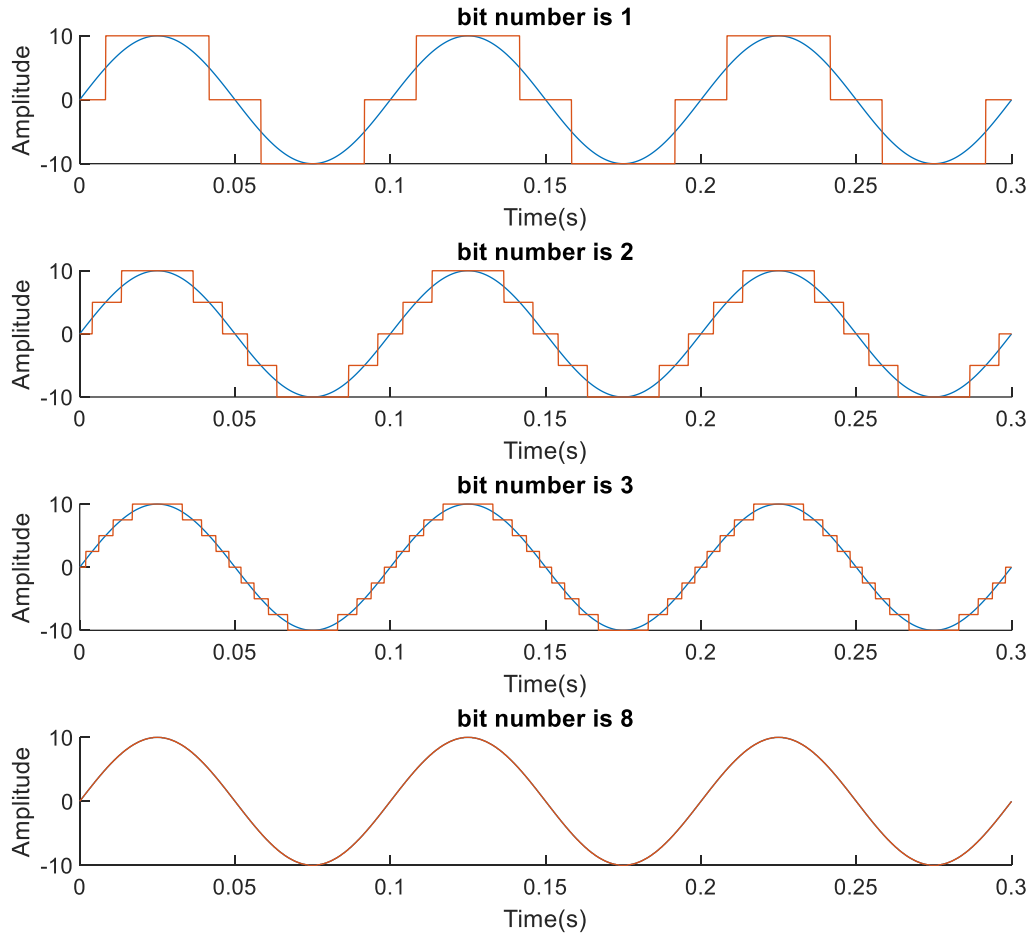

Fig.1.3. Main and sampled signal for different bits

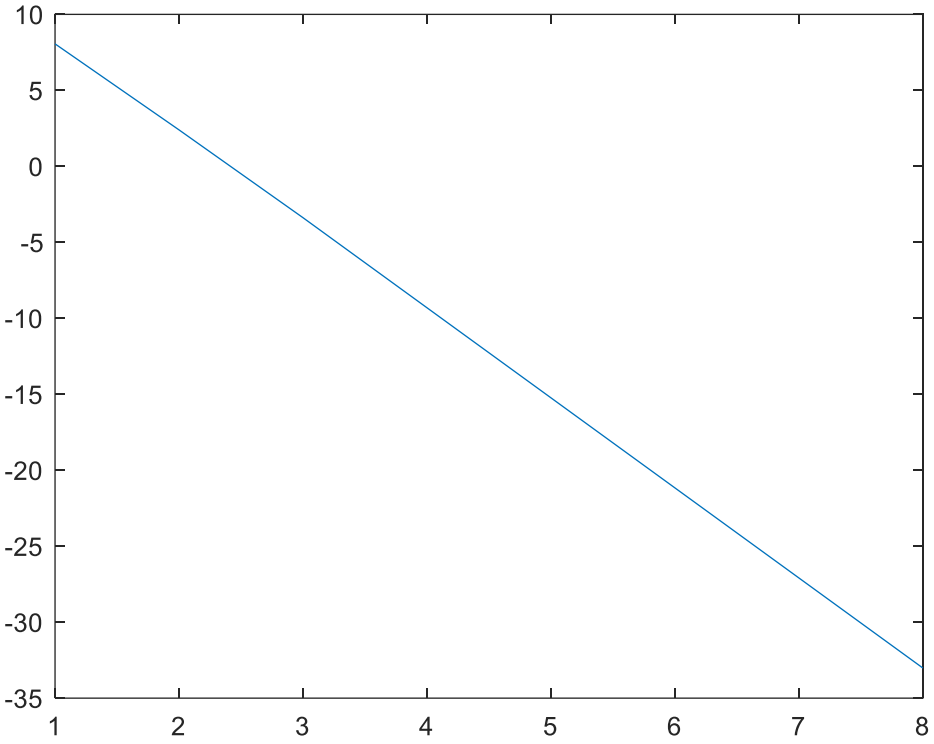

Fig.1.4. Quantization vs bit numbers

1.8 Discussion and Conclusion:

Firstly, the signal was sampled at different frequency. The sampled frequencies are 25Hz,50Hz, 100 Hz. There showed that the signal is distorted when the sample frequency is lower than twice frequency of message frequency. When sample frequency is higher than twice of message frequency then the signal remains same as message signal. And finally quantized the signal at different quantizing level. Signal was distorted by decreasing the quantizing level. Therefore, the experiment was successfully done.