A blue circle with text and symbols

Description automatically generated

**AMERICAN INTERNATIONAL UNIVERSITY–BANGLADESH (AIUB)**

FACULTY OF ENGINEERING

Course name: Data Communication

Course code: COE 3201

Section: H

Semester: Spring 2023-24

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ID: 22-47019-1

Instructor name: Dr. Muhammad Morshed Alam

Experiment no: 03

Experiment name: Analog Signal quantization using MATLAB

Submission date: Feb 28th, 2024

**Performance Task for Lab Report: ( ID = AB-CDEFG-H)**

ID: AB-CDEFG-H

Write a MATLAB code that can generate an approximated quantized signal for the following analog function:

1. Define the amplitude , sampling frequency, define the time domain for function that gives at least 3 complete cycles.
2. Define the number of quantization levels, step size or resolution, then find the quantized signal .
3. Obtain the absolute quantization error, )

Finally, use 2x2 subplot to plot analog signal , sampling signal of , quantized signal , and quantized error signal .

**ANSWER:**

1. Define the amplitude , sampling frequency, define the time domain for function that gives at least 3 complete cycles.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| A | B | - | C | D | E | F | G | - | H |
| 2 | 2 | - | 4 | 7 | 0 | 1 | 9 | - | 1 |

My id:

ID = 22-47019-1

A1 = GD = 97; //Amplitude

F = CDE = 470; // Frequency

So,

//MATLAB code where all the parameters are defined

A1 = 97; % Amplitude of the analog signal,

Sampling\_Frequency = 60e3; % Sampling frequency

CDE = 470; %Frequency of the analog signal

Num\_Quantization\_Levels = 8; % Number of quantization levels

Duration = 3; % Duration of the signal in seconds

Resolution = (2 \* A1) / (2^Num\_Quantization\_Levels); % Step size

t=0:1/Sampling\_Frequency:0.001;

% Defining the analog signal

x1 = A1 \* cos(2 \* pi \* (CDE \* 100) \* t);

L=(2^Num\_Quantization\_Levels)-1;

delta=(max(x1)-min(x1))/L;

% Quantization

Quantized\_Signal = min(x1)+(round((x1-min(x1))/delta)).\*delta; %xq

% Plotting

stem(t, Quantized\_Signal, 'r')

title('Quantized Signal')

xlabel('Time (s)')

ylabel('Amplitude')

1. Define the number of quantization levels, step size or resolution, then find the quantized signal .

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| --- | --- |
| MATLAB Code | Output Figure |
| %{  ID: 22-47019-1 (AB-CDEFG-H);  A1 = GD = 97;  F = CDE = 470;      %}  A1 = 97; % Amplitude of the analog signal,  Sampling\_Frequency = 60e3; % Sampling frequency  CDE = 470; %Frequency of the analog signal  Num\_Quantization\_Levels = 8; % Number of quantization levels  Duration = 3; % Duration of the signal in seconds  Resolution = (2 \* A1) / (2^Num\_Quantization\_Levels); % Step size  t=0:1/Sampling\_Frequency:0.001;    % Defining the analog signal  x1 = A1 \* cos(2 \* pi \* (CDE \* 100) \* t);    L=(2^Num\_Quantization\_Levels)-1;    delta=(max(x1)-min(x1))/L;    % Quantization  Quantized\_Signal = min(x1)+(round((x1-min(x1))/delta)).\*delta; %xq      % Plotting  stem(t, Quantized\_Signal, 'r')  title('Quantized Signal')  xlabel('Time (s)')  ylabel('Amplitude') | A diagram of a signal  Description automatically generated |

(C) Obtain the absolute quantization error, )

|  |  |
| --- | --- |
| MATLAB Code | Output Figure |
| %{  ID: 22-47019-1 (AB-CDEFG-H);  A1 = GD = 97;  F = CDE = 470;      %}  A1 = 97; % Amplitude of the analog signal,  Sampling\_Frequency = 60e3; % Sampling frequency  CDE = 470; %Frequency of the analog signal  Num\_Quantization\_Levels = 8; % Number of quantization levels  Duration = 3; % Duration of the signal in seconds  Resolution = (2 \* A1) / (2^Num\_Quantization\_Levels); % Step size  t=0:1/Sampling\_Frequency:0.001;%    % Defining the analog signal  x1 = A1 \* cos(2 \* pi \* (CDE \* 100) \* t);      L=(2^Num\_Quantization\_Levels)-1;    delta=(max(x1)-min(x1))/L;    % Quantization  Quantized\_Signal = min(x1)+(round((x1-min(x1))/delta)).\*delta; %xq    % Calculating quantization error  err = abs(x1 - Quantized\_Signal);    stem(t, err)  title('Quantization Error')  xlabel('Time (s)')  ylabel('Absolute Error') | A graph of a number of blue dots  Description automatically generated |

1. Finally, use 2x2 subplot to plot analog signal , sampling signal of , quantized signal , and quantized error signal .

|  |  |
| --- | --- |
| MATLAB Code | Output Figure |
| %{  ID: 22-47019-1 (AB-CDEFG-H);  A1 = GD = 79;  F = CDE = 470;      %}  A1 = 97; % Amplitude of the analog signal,  Sampling\_Frequency = 40e3; % Sampling frequency  CDE = 470; %Frequency of the analog signal  Num\_Quantization\_Levels = 8; % Number of quantization levels  Duration = 3; % Duration of the signal in seconds  Resolution = (2 \* A1) / (2^Num\_Quantization\_Levels); % Step size  t=0:1/Sampling\_Frequency:0.001;%    % Defining the analog signal  x1 = A1 \* cos(2 \* pi \* (CDE \* 100) \* t);    L=(2^Num\_Quantization\_Levels)-1;    delta=(max(x1)-min(x1))/L;    % Quantization  Quantized\_Signal = min(x1)+(round((x1-min(x1))/delta)).\*delta;      subplot(2,2,1)  plot(t, x1)  title('Analog Signal')  xlabel('Time (s)')  ylabel('Amplitude')    subplot(2,2,2)  stem(t, x1)  title('Sampled Signal')  xlabel('Time (s)')  ylabel('Amplitude')    subplot(2,2,3)  stem(t, Quantized\_Signal)  title('Quantized Signal')  xlabel('Time (s)')  ylabel('Amplitude')    subplot(2,2,4)  stem(t, Quantization\_Error)  title('Quantization Error')  xlabel('Time (s)')  ylabel('Absolute Error') | A diagram of a signal  Description automatically generated with medium confidence |