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

FACULTY OF ENGINEERING

Course name: Data Communication

Course code: COE 3201

Section: H

Semester: Spring 2023-24

Name: MD. ABU TOWSIF

ID: 22-47019-1

Instructor name: Dr. Muhammad Morshed Alam

Experiment no: 02

Experiment name: **Study of signal frequency, spectrum, bandwidth, bit rate, quantization using MATLAB**

Submission date: Feb 17th, 2024

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

\*\*Generate a composite signal using two simple signals as,

x1(t) = A1 cos(2π(C\*100)t ) x2(t) = A2 cos(2π(F\*100)t)

x3(t) = x1(t) + x2(t)

(a) Select the value of the amplitudes as follows: let A1 = GD and A2 = AF.

(b) Make a plot of x3 over a range of t that will exhibit approximately 2 cycles. Make sure the

plot starts at a negative time so that it will include t = 0, and make sure that you have at least 20

samples per period of the wave.

(c) Plot x3 in frequency domain and calculate its bandwidth.

(d) Quantize x3 in 6 equally distributed levels and provide image for one cycle of the original

signal and quantized signal.

**ANSWER:**

(a) Select the value of the amplitudes as follows: let A1 = GD and A2 = AF

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

My id:

ID = 22-47019-1

C = 4, F = 1

f1 = C \* 100 = 4 \* 100 = 400

f2 = F \* 100 = 1 \* 100 = 100

A1 = GD = 97

A2 = AF = 21

t = linspace(-2, + 2, 80); % 80 samples

So,

x1 = A1 \* cos(2 \* pi \* f1 \* t); % First Signal

x2 = A2 \* cos(2 \* pi \* f2 \* t); % Second Signal

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| MATLAB Code | Output Figure |
| %{  ID = 22-47019-1  C = 4, F = 1  SO, F1 = C \* 100 = 4 \* 100 = 400  F2 = F \* 100 = 1 \* 100 = 100  A1 = GD = 97  A2 = AF = 21  %}    t = linspace(-2, + 2, 80); % 80 samples  f1 = 400; % Frequency of first signal  f2 = 100; % Frequency of second signal  A1 = 97; % Amplitude of first signal  A2 = 21; % Amplitude of second signal  x1 = A1\*cos(2\*pi\*f1\*t); % First Signal  x2 = A2\*cos(2\*pi\*f2\*t); % Second Signal    x3 = x1 + x2; %this composite signal x3  plot(t,x3,'LineWidth',1.5)  xlabel('time in seconds')  ylabel('Amplitude')  title('composite signla x3') | A graph of a graph  Description automatically generated |

(b) Make a plot of x3 over a range of t that will exhibit approximately 2 cycles. Make sure the plot starts at a negative time so that it will include t = 0, and make sure that you have at least 20 samples per period of the wave.

(c) Plot x3 in frequency domain and calculate its bandwidth

|  |  |
| --- | --- |
| MATLAB Code | Output Figure |
| %{  ID = 22-47019-1  C = 4, F = 1  SO, F1 = C \* 100 = 4 \* 100 = 400  F2 = F \* 100 = 1 \* 100 = 100  A1 = GD = 97  A2 = AF = 21  %}  fs = 1000; % Sampling frequency  t = linspace(-2, 2, 1000); % 20 samples  f1 = 400; % Frequency of first signal  f2 = 100; % Frequency of second signal  A1 = 97; % Amplitude of first signal  A2 = 21; % Amplitude of second signal  x1 = A1 \* cos(2 \* pi \* f1 \* t); % First Signal  x2 = A2 \* cos(2 \* pi \* f2 \* t); % Second Signal    x3 = x1 + x2; % Composite signal x3    fx3 = fft(x3);    % Normalize the FFT  fx3 = fftshift(fx3) / length(x3);    % Define frequency vector based on the sampling frequency  f = fs/2 \* linspace(-1, 1, length(x3));    plot(f, abs(fx3), 'LineWidth', 1.5)  title('Magnitude FFT of x3')  xlabel('Frequency (Hz)')  ylabel('Magnitude');    bandwidth = obw(x3,fs) %calculating the bandwith | A graph of a frequency  Description automatically generated  Bandwidth calculation  Plot in frequency domain |

(d) Quantize x3 in 6 equally distributed levels and provide image for one cycle of the original signal and quantized signal.

|  |  |
| --- | --- |
| MATLAB Code | Output Figure |
| %{  ID = 22-47019-1  C = 4, F = 1  SO, F1 = C \* 100 = 4 \* 100 = 400  F2 = F \* 100 = 1 \* 100 = 100  A1 = GD = 97  A2 = AF = 21  %}    fs = 1000; % Sampling frequency  t = [0:1/fs:0.1];  fs = 1000; % Sampling frequency  t = linspace(-3, +3, 400);  f1 = 400; % Frequency of first signal  f2 = 100; % Frequency of second signal  A1 = 97; % Amplitude of first signal  A2 = 21; % Amplitude of second signal  x1 = A1 \* cos(2 \* pi \* f1 \* t); % First Signal  x2 = A2 \* cos(2 \* pi \* f2 \* t); % Second Signal    x3 = x1 + x2; % Composite signal x3    partition = [-2.5, -1.5, 0.0, 0.5, 1.5];    codebook = [-3:2];  [index, quants] = quantiz(x3, partition, codebook); % Quantize.  figure  plot(t, x3, 'x', t, quants, '.')  legend('Original signal', 'Quantized signal') | A graph of a signal  Description automatically generated |