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,

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

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

(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
```

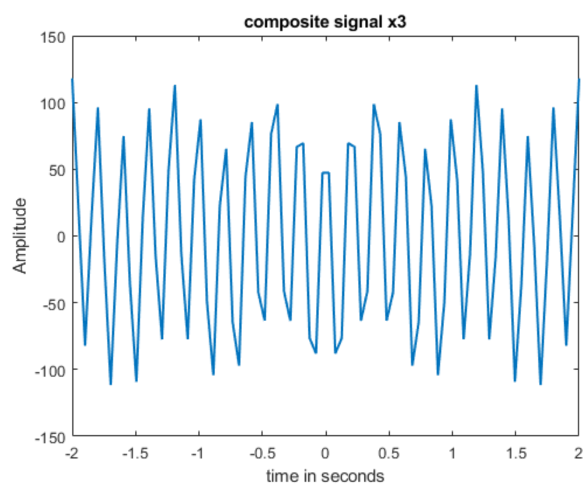
(b) Make a plot of x3 over a range of t that will exhibit approximately 2 cycles. Make sure the plot starts at a negative time so that it will include t = 0, and make sure that you have at least 20 samples per period of the wave.

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')
```



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

<table>
<tr><th>MATLAB Code</th><th>Output Figure</th></tr>
<tr><td>

```
%{
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
```

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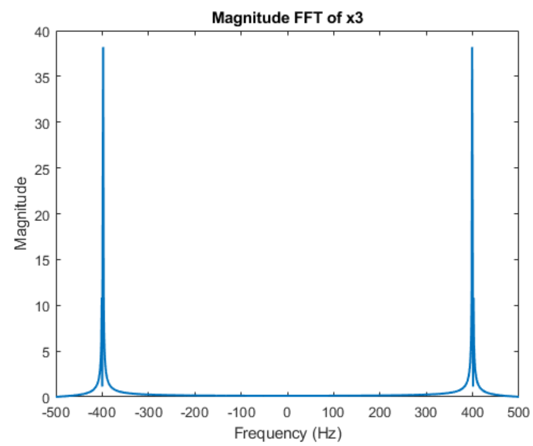
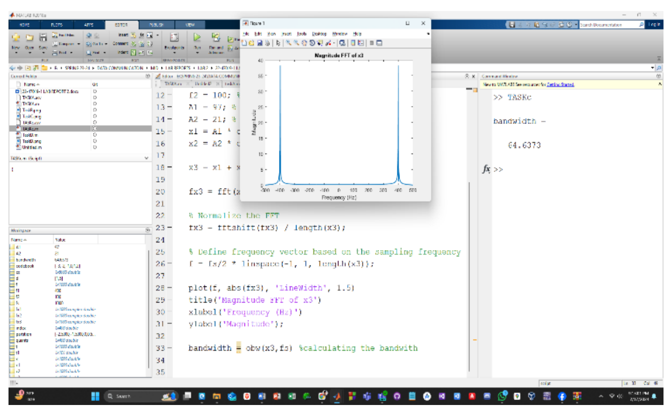


Plot in frequency domain



Bandwidth calculation

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

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```
%{
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')
```

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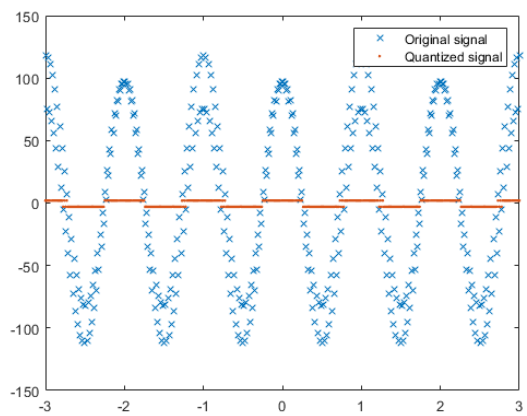

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