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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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

ID:

22-47018-1
So, the parameters will be

C = 4, F = 1 , f1 = C * 100 = 4 * 100 = 400 , f2 = F * 100 = 1 * 100 = 100
A1 = 87 , A2 = 21

So, the signals will be

```
x1 = A1 * cos(2 * pi * f1 * t);
x2 = A2 * cos(2 * pi * f2 * t);
```

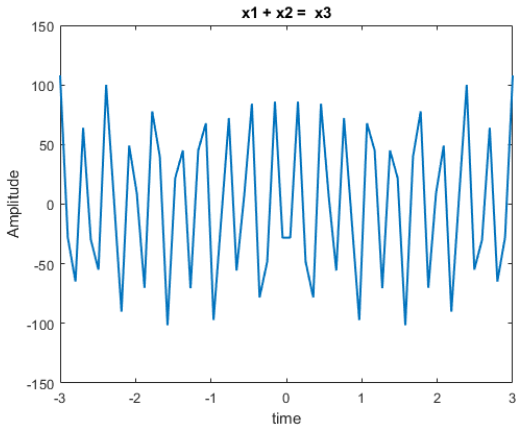
(b) Make a plot of x3 over a range of t that will exhibit approximately 2 cycles. Make sure the plot starts at a negative time so that it will include t = 0, and make sure that you have at least 20 samples per period of the wave.

Code	Output

```
%{
ID = 22-47018-1 , C = 4, F = 1
SO, F1 = C * 100 = 4 * 100 = 400
F2 = F * 100 = 1 * 100 = 100
A1 = GD = 87, A2 = AF = 21
%}

t = linspace(-3, + 3, 60);
f1 = 400;
f2 = 100;
A1 = 87;
A2 = 21;
x1 = A1*cos(2*pi*f1*t);
x2 = A2*cos(2*pi*f2*t);

x3  = x1 + x2;
plot(t,x3,'LineWidth',1.5)
xlabel('time')
ylabel('Amplitude')
title('x1 + x2 =  x3')
```



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

Code	Output

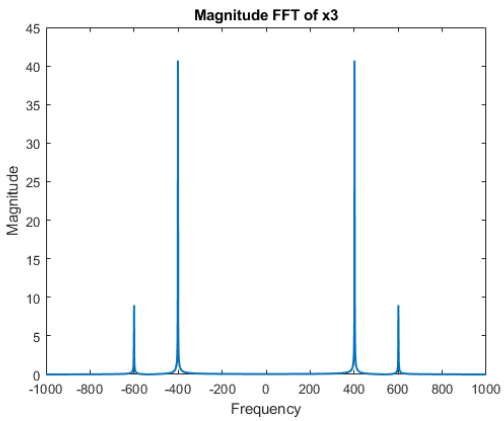
```
%{
ID = 22-47018-1 , C = 4, F = 1
SO, F1 = C * 100 = 4 * 100 = 400
F2 = F * 100 = 1 * 100 = 100
A1 = GD = 87, A2 = AF = 21
%}
fs = 2000;
t = linspace(-3, 3, 2000);
f1 = 400;
f2 = 100;
A1 = 87;
A2 = 21;
x1 = A1 * cos(2 * pi * f1 * t);
x2 = A2 * cos(2 * pi * f2 * t);

x3 = x1 + x2;

fx3 = fft(x3);


fx3 = fftshift(fx3) / length(x3);


f = fs/2 * linspace(-1, 1, length(x3));
```



```
bandwidth = obw(x3,fs)

plot(f, abs(fx3), 'LineWidth', 1.5)
title('Magnitude FFT of x3')
xlabel('Frequency')
ylabel('Magnitude');
```

```
bandwidth =

  208.4247

fx >>
```

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

Code	Output

```
%{
ID = 22-47018-1 , C = 4, F = 1
SO, F1 = C * 100 = 4 * 100 = 400
F2 = F * 100 = 1 * 100 = 100
A1 = GD = 87, A2 = AF = 21
%}

fs = 2000;
t = [0:1/fs:0.1];
fs = 2000;
t = linspace(-1, +1, 400);
f1 = 400;
f2 = 100;
A1 = 87;
A2 = 21;
x1 = A1 * cos(2 * pi * f1 * t);
x2 = A2 * cos(2 * pi * f2 * t);

x3  = x1 + x2;

partition = [-2.5, -1.5, 0.0, 0.5,
1.5];

codebook = [-3:2];
[index, quants] = quantiz(x3,
partition, codebook);
figure
plot(t, x3, 'x', t, quants, '.')
legend('Original signal', 'Quantized
signal')
```