ANALYSIS OF AMPLITUDE MODULATED AND DEMODULATED SIGNAL USING MATLAB

LAB # 08

Fall 2023

CSE-402L

Digital Signal Processing Lab

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Class Section: **A**

"On my honor, as student of University of Engineering and Technology, I have neither given nor received unauthorized assistance on this academic work."

Student Signature: 

Submitted to:

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Tuesday, December 26, 2023

Department of Computer Systems Engineering

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CSE 402L: Digital Signal Processing

Demonstration of Concepts	**Poor (Does not meet expectation (1))** The student failed to demonstrate a clear understanding of the assignment concepts	**Fair (Meet Expectation (2-3))** The student demonstrated a clear understanding of some of the assignment concepts	**Good (Exceeds Expectation (4-5)** The student demonstrated a clear understanding of the assignment concepts	**Score** **30%**
Accuracy	The student completed (<50%) tasks and provided MATLAB code and/or Simulink models with errors. Outputs shown are not correct in form of graphs (no labels) and/or tables along with incorrect analysis or remarks.	The student completed partial tasks (50% - <90%) with accurate MATLAB code and/or Simulink models. Correct outputs are shown in form of graphs (without labels) and/or tables along with correct analysis or remarks.	The student completed all required tasks (90%-100%) with accurate MATLAB code and/or Simulink models. Correct outputs are shown in form of labeled graphs and/or tables along with correct analysis or remarks.	**30%**
Following Directions	The student clearly failed to follow the verbal and written instructions to successfully complete the lab	The student failed to follow the some of the verbal and written instructions to successfully complete all requirements of the lab	The student followed the verbal and written instructions to successfully complete requirements of the lab	**20%**
Time Utilization	The student failed to complete even part of the lab in the allotted amount of time	The student failed to complete the entire lab in the allotted amount of time	The student completed the lab in its entirety in the allotted amount of time	**20%**

Dr. Yasir Saleem Afridi

Analysis of Amplitude Modulated and Demodulated Signal using MATLAB

Objectives:

- Amplitude Modulate a baseband signal using carrier signal.
- Demodulate an amplitude modulated signal using carrier signal.

Tasks:

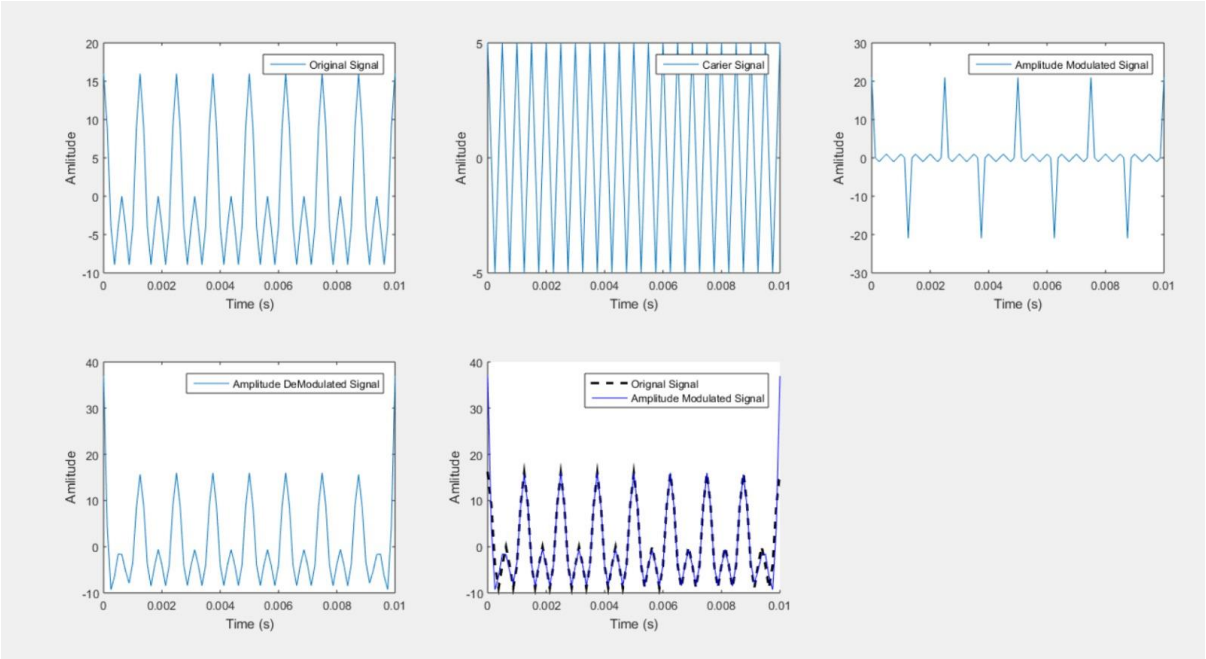
Task 1: Provide .m file with detailed comments

Code for time domain signals:

```
clc;
clear;
close all;

m = 0.5;
fc = 2000;
fs = 8000;
t = (0:1/fs:0.01)';
s = 8*cos(2*pi*800*t)+8*cos(2*pi*1600*t);
c = (10*m)*cos(2*pi*fc*t);

modulated_signal = ammod(s, fc, fs, 0, 10*m);
demodulated_signal = amdemod(modulated_signal, fc, fs, 0, 10*m);
figure(1)
subplot(2,3,1);

plot(t, s);
xlabel('Time (s)');
ylabel('Amlitude');
legend('Original Signal');

subplot(2,3,2);
plot(t, c);
legend('Carier Signal');
xlabel('Time (s)');
ylabel('Amlitude');

subplot(2,3,3);
plot(t, modulated_signal);
legend('Amplitude Modulated Signal');
xlabel('Time (s)');
ylabel('Amlitude');
```

```
subplot(2,3,4);
plot(t, demodulated_signal);
legend('Amplitude DeModulated Signal');
xlabel('Time (s)');
ylabel('Amlitude');

subplot(2, 3, 5);
hold on;
plot(t, s, 'k--', 'LineWidth', 2);
plot(t, demodulated_signal, 'b');
hold off;
legend('Orignal Signal', 'Amplitude Modulated Signal');
xlabel('Time (s)');
ylabel('Amlitude');


N = length(t);
fca = (-N/2:N/2-1/N);
length(t)
length(fca)
figure(2)
title('Frequency Domain')
subplot(2,2,1);
plot(fca, abs(fft(s)), 'LineWidth', 2);
xlabel('Frequency (Hz)');
ylabel('Amlitude');
legend('Original sognal');

subplot(2,2, 2);
plot(fca, abs(fft(c)), 'LineWidth', 2);
xlabel('Frequency (Hz)');
ylabel('Amlitude');
legend('Carier signal');

subplot(2,2,3);
plot(fca, abs(fft(modulated_signal)), 'LineWidth', 2);
xlabel('Frequency (Hz)');
ylabel('Amlitude');
legend('Modulated signal');

title('Frequency Domain')
subplot(2,2,4);
plot(fca, abs(fft(demodulated_signal)), 'LineWidth', 2);
xlabel('Frequency (Hz)');
ylabel('Amlitude');
legend('Demodulated sognal');
```

Output:

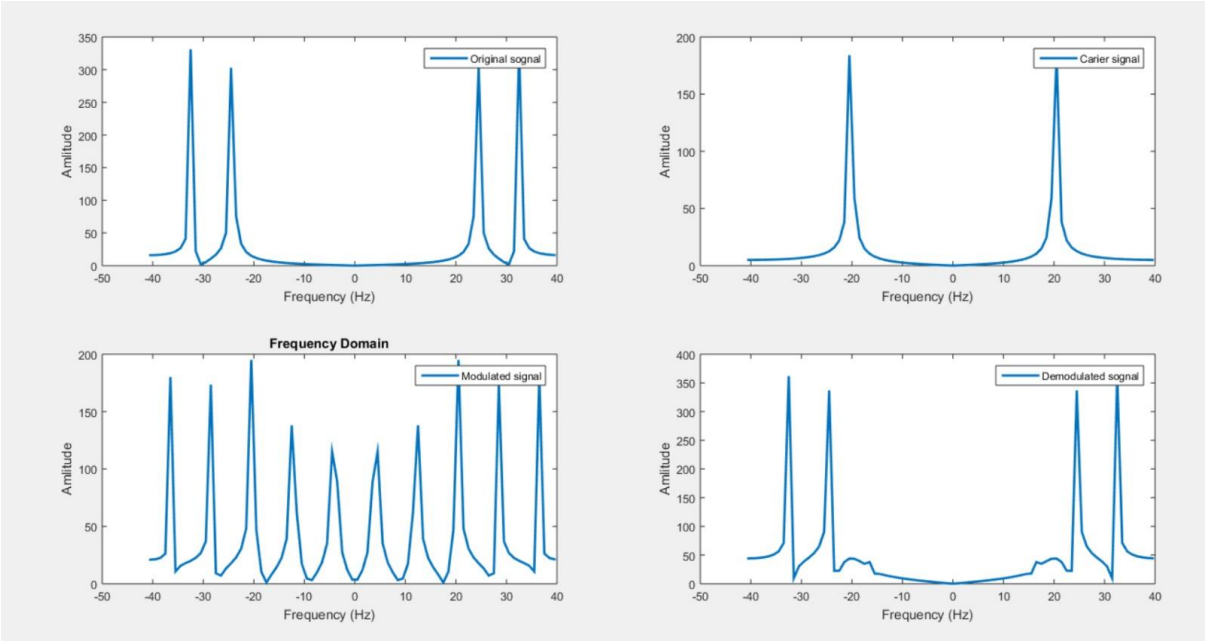


Code for frequency domain signals:

```
clc;
clear;
close all;

% Two-tone message signal
t = 0:1/8000:0.1;
s = 10*sin(2*pi*300*t)+10*sin(2*pi*600*t);
figure;
subplot(2,2,1);
plot(t,s);
title('Two-Tone Message Signal');
xlabel('Time (s)');
ylabel('Amplitude (V)');

% Carrier signal
m = 0.5;
fc = 10000;
fs = 80000;
t = (0:1/fs:0.01)';
c = 10/m*sin(2*pi*fc*t);
subplot(2,2,2);
plot(t,c);
title('Carrier Signal');
xlabel('Time (s)');
ylabel('Amplitude (V)');

% Modulated signal
```

```
y = ammod(s, fc, fs, 0, 10/m);
subplot(2,2,3);
plot(t,y);
title('Modulated Signal');
xlabel('Time (s)');
ylabel('Amplitude (V)');

% Demodulated signal
z = amdemod(y, fc, fs, 0, 10/m);
subplot(2,2,4);
plot(t,z);
title('Demodulated Signal');
xlabel('Time (s)');
ylabel('Amplitude (V)');

% Frequency domain plots
figure;
subplot(2,2,1);
plot(abs(fft(s)));
title('Frequency Domain Plot of Two-Tone Message Signal');
xlabel('Frequency (Hz)');
ylabel('Magnitude');

subplot(2,2,2);
plot(abs(fft(c)));
title('Frequency Domain Plot of Carrier Signal');
xlabel('Frequency (Hz)');
ylabel('Magnitude');

subplot(2,2,3);
plot(abs(fft(y)));
title('Frequency Domain Plot of Modulated Signal');
xlabel('Frequency (Hz)');
ylabel('Magnitude');

subplot(2,2,4);
plot(abs(fft(z)));
title('Frequency Domain Plot of Demodulated Signal');
xlabel('Frequency (Hz)');
ylabel('Magnitude');
```

Output:



Task 2: Define Amplitude Modulation?

Ans: Amplitude modulation is a modulation technique used in electronic communication, most commonly for transmitting messages with a radio wave. In amplitude modulation, the amplitude of the wave is varied in proportion to that of the message signal, such as an audio signal

Task 3: Define Amplitude Demodulation?

Ans: Demodulation is the process of recovering the original data-carrying signal from a carrier wave. A demodulator is an electronic circuit (or software program in the case of software-defined radio) that recovers the information content from a modulated carrier wave

Task 4: List three reasons, why we implement Amplitude Modulation in Communication Systems?

- Amplitude modulation is used to transmit the signal over a long distance.
- It is also used for radio transmission.
- It is also applied in two-way communication for air traffic control.
- Amplitude modulation (AM) communication systems arose from the need to send an acoustic signal, a “message”, over the airwaves using a reasonably sized antenna to radiate it. The size of the antenna depends inversely on the highest

frequency present in the message, and voice and music have relatively low frequencies.

Task 5: Define Modulation Index?

Ans: Modulation index is a measure of extent of modulation done on a carrier signal. In Amplitude modulation, it is defined as the ratio of the amplitude of modulating signal to that of the carrier signal.

Reference:

To view my codes, please refer to my GitHub account.

Conclusion:

In conclusion, I have learned why the AM is need and how to perform the AM on a signal using a carrier signal. I also learned how to perform demodulation of AM signals. I saw how modulated signal and demodulated signals both in frequency and time domains.

The End.