**Implementation of complete Communication system**

**LAB # 08**

****

**FALL 2021**

**CSE402L-Digital Signal Processing**

Submitted by: **Ashfaq Ahmad**

Registration No: **19PWCSE1795**

Class Section: **B**

“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:

**Prof. Ihsan Ul Haq**

February 23, 2021

**Department of Computer Systems Engineering**

**University of Engineering and Technology, Peshawar**

**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%** |

**STEP 1:** the signals are reproduced as they arrive.

**Code:**

[y1,fs1]=audioread('sound1.wav');

sound(y1,fs1);

pause(6);

[t,fs]=audioread('beep.wav');

sound(t,fs);

[y2,fs2]=audioread('sound2.wav');

sound(y2,fs2);

pause(6)

[t,fs]=audioread('beep.wav');

sound(t,fs);

[y3,fs3]=audioread('sound3.wav');

sound(y3,fs3);

**STEP 2:** plot the spectra of the signals as they arrive.

**Code:**

spectrum1=fft(y1);

n1=length(y1);

ts1=1/fs1;

f1=(0:n1-1)\*(ts1/n1);

subplot(2,2,1)

plot(f1,abs(spectrum1));

xlabel('Frequency (Hz)')

ylabel('Magnitude')

title('Spectrum graph of voice 1');

spectrum2=fft(y2);

n2=length(y2);

ts2=1/fs2;

f2=(0:n2-1)\*(ts2/n2);

subplot(2,2,2)

plot(f2,abs(spectrum2));

xlabel('Frequency (Hz)')

ylabel('Magnitude')

title('Spectrum graph of voice 2');

spectrum3=fft(y3);

n3=length(y3);

ts3=1/fs3;

f3=(0:n3-1)\*(ts3/n3);

subplot(2,2,3)

plot(f3,abs(spectrum3));

xlabel('Frequency (Hz)')

ylabel('Magnitude')

title('Spectrum graph of voice 3');

spectrum4=fft(t);

n=length(t);

ts=1/fs;

f4=(0:n-1)\*(ts/n);

subplot(2,2,4)

plot(f4,abs(spectrum4));

xlabel('Frequency (Hz)')

ylabel('Magnitude')

title('Spectrum graph of tune signal');

**Output:**

**STEP 3**: The signals are passed through a low pass filter and played.

**STEP 4:** reproduce the signals after passing them through the filter.

**Code:**

lpf1=lowpass(y1,1000,fs1);

lpf2=lowpass(y2,1000,fs2);

lpf3=lowpass(y3,1000,fs3);

lpf4=lowpass(t,1000,fs)

sound(lpf1,fs1);

pause(6);

sound(lpf4,fs);

sound(lpf2,fs2);

pause(6)

sound(lpf4,fs);

sound(lpf3,fs3);

**STEP 5:** The signals are modulated to different carriers.

**Code:**

%c1 c2 c3 are different carrier frequencies.

c1=8000;

c2=14000;

c3=18000;

mod1=fmmod(y1,c1,fs1,1000); %signal1 modulated

mod2=fmmod(y2,c2,fs2,1000); %signal2 modulated

mod3=fmmod(y3,c3,fs3,1000); %signal3 modulated

**STEP 6:** The modulated signals are filtered in the defined bands and added.

**Code:**

bp1=bandpass(mod1,[300 1000],fs1);

bp2=bandpass(mod2,[300 1000],fs2);

bp3=bandpass(mod3,[300 1000],fs3);

bp1=bp1(1:220097);

bp3=bp3(1:220097);

multiplexer=bp1+bp2+bp3;

fmultiplexer=abs(fft(multiplexer));

**STEP 7:** some noise is added to the transmitted signal.

**Code:**

noise=awgn(multiplexer,10);

**STEP 8**: upon arrival each band is filtered.

**Code:**

signal1=mod3+mod2;

demux\_signal1=multiplexer-signal1;

signal2=mod3+mod1;

demux\_signal2=multiplexer-signal2;

signal3=mod1+mod2;

demux\_signal3=multiplexer-signal3;

**STEP 9**: each recovered band is demodulated to return the signal to the baseband frequency.

**Code:**

demod1=ssbdemod(demux\_signal1,c1,fs1);

demod2=ssbdemod(demux\_signal2,c2,fs2);

demod3=ssbdemod(demux\_signal3,c3,fs3);

**STEP 10:** the recovered signal is passed through a low pass filter.

**Code:**

nose\_remove1=lowpass(demod1,1000,fs1);

noise\_remove2=lowpass(demod2,1000,fs2);

noise\_remove3=lowpass(demod3,1000,fs3);

**STEP 11:** play the reproduced signal after transmission.

**Code:**

sound(noise\_remove1,fs1);

pause(6)

sound(noise\_remove2,fs2);

pause(6)

sound(noise\_remove2,fs3);

**Complete Code:**

clc

clear

close all

[y1,fs1]=audioread('sound1.wav');

sound(y1,fs1);

pause(6);

[t,fs]=audioread('beep.wav');

sound(t,fs);

[y2,fs2]=audioread('sound2.wav');

sound(y2,fs2);

pause(6)

[t,fs]=audioread('beep.wav');

sound(t,fs);

[y3,fs3]=audioread('sound3.wav');

sound(y3,fs3);

spectrum1=fft(y1);

n1=length(y1);

ts1=1/fs1;

f1=(0:n1-1)\*(ts1/n1);

subplot(2,2,1)

plot(f1,abs(spectrum1));

xlabel('Frequency (Hz)')

ylabel('Magnitude')

title('Spectrum graph of voice 1');

spectrum2=fft(y2);

n2=length(y2);

ts2=1/fs2;

f2=(0:n2-1)\*(ts2/n2);

subplot(2,2,2)

plot(f2,abs(spectrum2));

xlabel('Frequency (Hz)')

ylabel('Magnitude')

title('Spectrum graph of voice 2');

spectrum3=fft(y3);

n3=length(y3);

ts3=1/fs3;

f3=(0:n3-1)\*(ts3/n3);

subplot(2,2,3)

plot(f3,abs(spectrum3));

xlabel('Frequency (Hz)')

ylabel('Magnitude')

title('Spectrum graph of voice 3');

spectrum4=fft(t);

n=length(t);

ts=1/fs;

f4=(0:n-1)\*(ts/n);

subplot(2,2,4)

plot(f4,abs(spectrum4));

xlabel('Frequency (Hz)')

ylabel('Magnitude')

title('Spectrum graph of tune signal');

lpf1=lowpass(y1,1000,fs1);

lpf2=lowpass(y2,1000,fs2);

lpf3=lowpass(y3,1000,fs3);

lpf4=lowpass(t,1000,fs);

sound(lpf1,fs1);

pause(6);

sound(lpf4,fs);

sound(lpf2,fs2);

pause(6)

sound(lpf4,fs);

sound(lpf3,fs3);

%c1 c2 c3 are different carrier frequencies.

c1=8000;

c2=14000;

c3=18000;

mod1=fmmod(y1,c1,fs1,1000); %signal1 modulated

mod2=fmmod(y2,c2,fs2,1000); %signal2 modulated

mod3=fmmod(y3,c3,fs3,1000); %signal3 modulated

bp1=bandpass(mod1,[300 1000],fs1);

bp2=bandpass(mod2,[300 1000],fs2);

bp3=bandpass(mod3,[300 1000],fs3);

bp1=bp1(1:220097);

bp3=bp3(1:220097);

multiplexer=bp1+bp2+bp3;

fmultiplexer=abs(fft(multiplexer));

noise=awgn(multiplexer,10);

signal1=mod3+mod2;

demux\_signal1=multiplexer-signal1;

signal2=mod3+mod1;

demux\_signal2=multiplexer-signal2;

signal3=mod1+mod2;

demux\_signal3=multiplexer-signal3;

demod1=ssbdemod(demux\_signal1,c1,fs1);

demod2=ssbdemod(demux\_signal2,c2,fs2);

demod3=ssbdemod(demux\_signal3,c3,fs3);

nose\_remove1=lowpass(demod1,1000,fs1);

noise\_remove2=lowpass(demod2,1000,fs2);

noise\_remove3=lowpass(demod3,1000,fs3);

sound(noise\_remove1,fs1);

pause(6)

sound(noise\_remove2,fs2);

pause(6)

sound(noise\_remove2,fs3);