**Open-Lab labsheet 2**

**Working on audio file**

Q1. Use the uploaded speech file in AUMS,

(1)Read the audio file using Matlab, (2)find its sampling freq, (3)plot it with respect to time in sec, (4)play back the signal using Matlab, (5) Plot the spectrogram with the help of Hanning window.

load handel.mat

file='speech.wav';

[x,fs] = audioread(file);

ts=1/fs;

N=length(x)-1;

t=0:N;% time matrix to store the number of samples

subplot(2,1,1);%ploting waveform

plot(t.\*ts,x);

title("waveform");

xlabel("time");

ylabel("amplitude");

sound(y,Fs);%playback the audio file

subplot(2,1,2);

len=256;% lenght of window

window=hann(len);

overlap=len/2;% overlap percentage

nfft=256;%number of fft samples

spectrogram(x,window,overlap,nfft);

title("Spectrograph");



Q2. Obtain the spectrograph on a stationary wave

clc

clear

fs=1000;

t=0:1/fs:1;

f1=10;

f2=50;

f3=100;

x1=sin(2\*pi\*f1\*t);

x2=sin(2\*pi\*f2\*t);

x3=sin(2\*pi\*f3\*t);

x4=x1+x2+x3;

subplot(2,1,1);

plot(t,x4);

title("Multitone Sine wave (10Hz+50Hz+100Hz)");

xlabel("time");

ylabel("amplitude");

subplot(2,1,2);

len=256;% length of window

window=hann(len);

overlap=len/2;% overlap percentage

nfft=256;%number of fft samples

spectrogram(x4,window,overlap,nfft);

title("Spectrograph");



Q3. Spectrograph of non-stationary signal

clc

clear

fs=1000; %sampling frequency

t1=0:1/fs:0.250;

t2=0.251:1/fs:0.500;

t3=0.501:1/fs:0.750;

t4=0.751:1/fs:1;

t=[t1 t2 t3 t4];

%various frequencies

f1=10;

f2=50;

f3=100;

%generating the signals

x1=sin(2\*pi\*f1\*t1);

x2=sin(2\*pi\*f1\*t2)+sin(2\*pi\*f2\*t2);

x3=sin(2\*pi\*f1\*t3)+sin(2\*pi\*f2\*t3)+sin(2\*pi\*f3\*t3);

x4=sin(2\*pi\*f1\*t4);

%concatination

x5=[x1 x2 x3 x4];

subplot(2,1,1);

plot(t,x5);

title("non-stationary Sine wave");

xlabel("time");

ylabel("amplitude");

subplot(2,1,2);

len=256;% length of window

window=hann(len);

overlap=round(len\*.75);% overlap percentage

nfft=512;%number of fft samples

spectrogram(x5,window,overlap,nfft);

title("Spectrograph");



From the above graphs we can see that, when we take the spectrograph it shows clearly where the frequencies are actually present. By this we are able to understand the difference between stationary and non-stationary waves. If we take the take the Fourier transform of a signal and plot it, we won’t be able to understand the difference between stationary and non-stationary waves from it. But in the spectrograph the yellow bar shows where the frequencies are more present. Thus spectrographs are more preferred to analyse waveforms as it provides more data.