Ahsanullah University of Science & Technology

Department of Electrical and Electronic Engineering

Project Report

Course No : EEE 3218

Course Title : Digital Signal Processing Lab

Project Name : Design of a simple FDM system for DSB AM voice signal using MATLAB

Submission Date : 23-02-2023

Submitted by

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ID 190205184

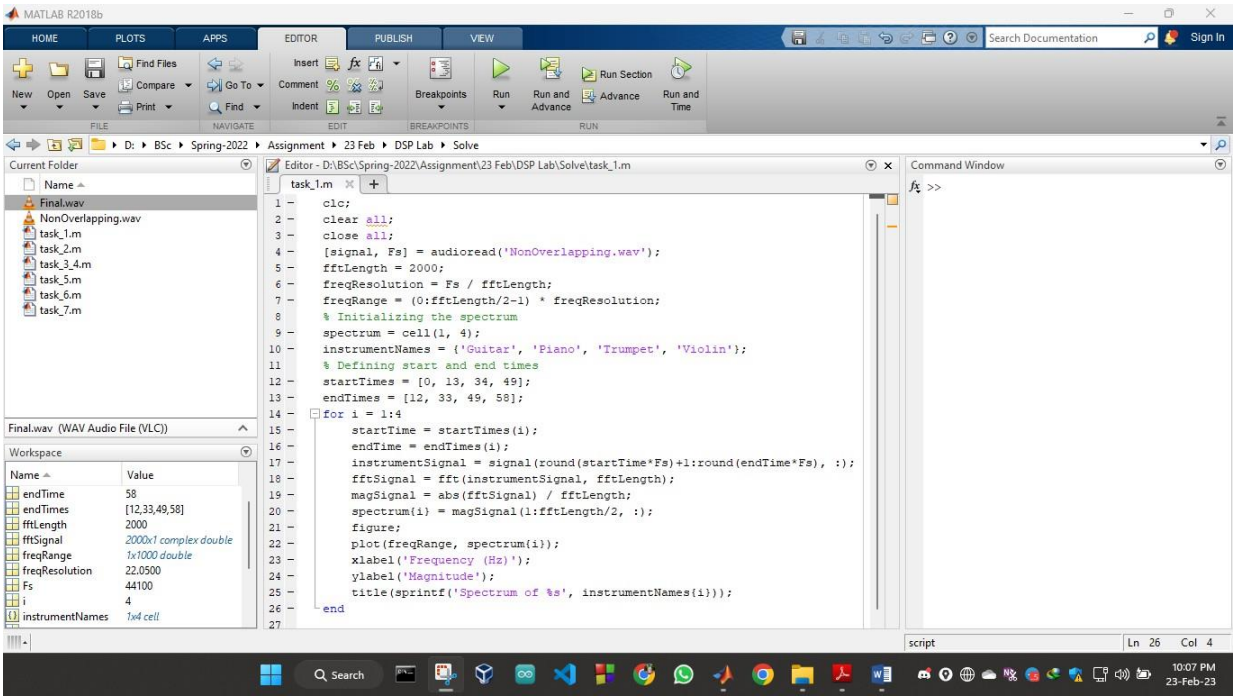
Section : C2

Year : 3rd

Semester : 2nd

Task 1:

Code:


MATLAB R2018b
HOME
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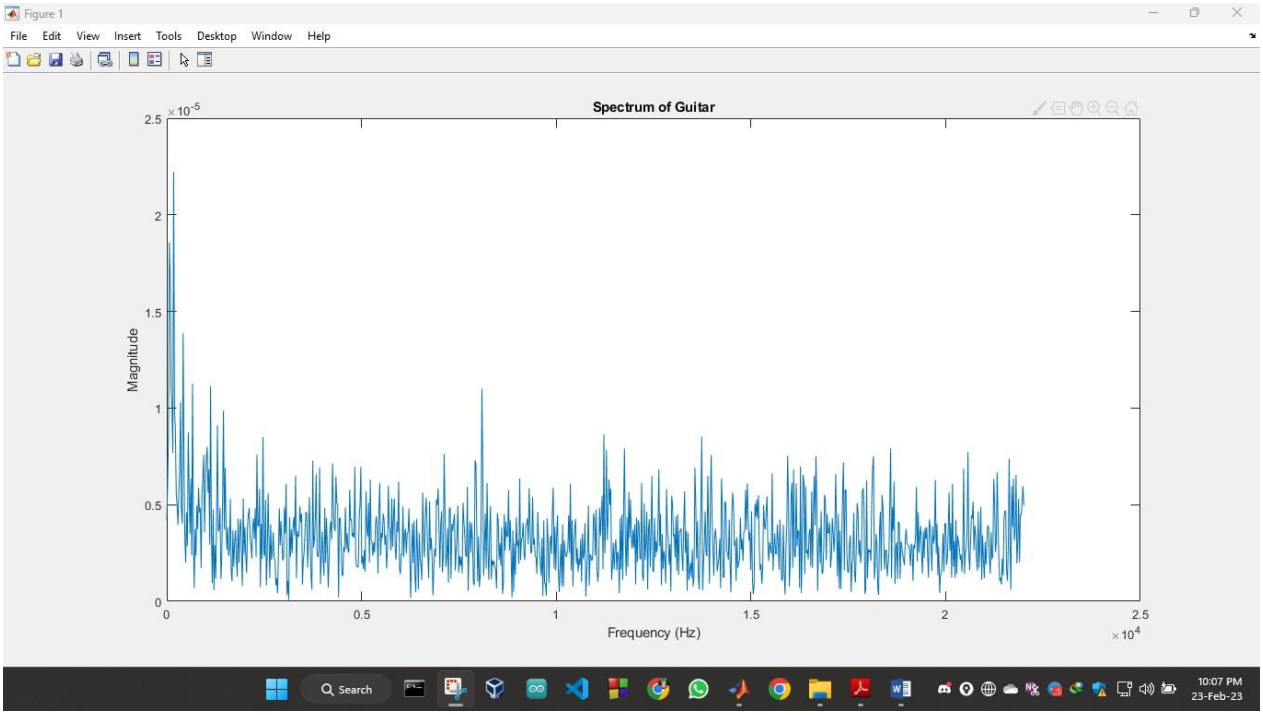
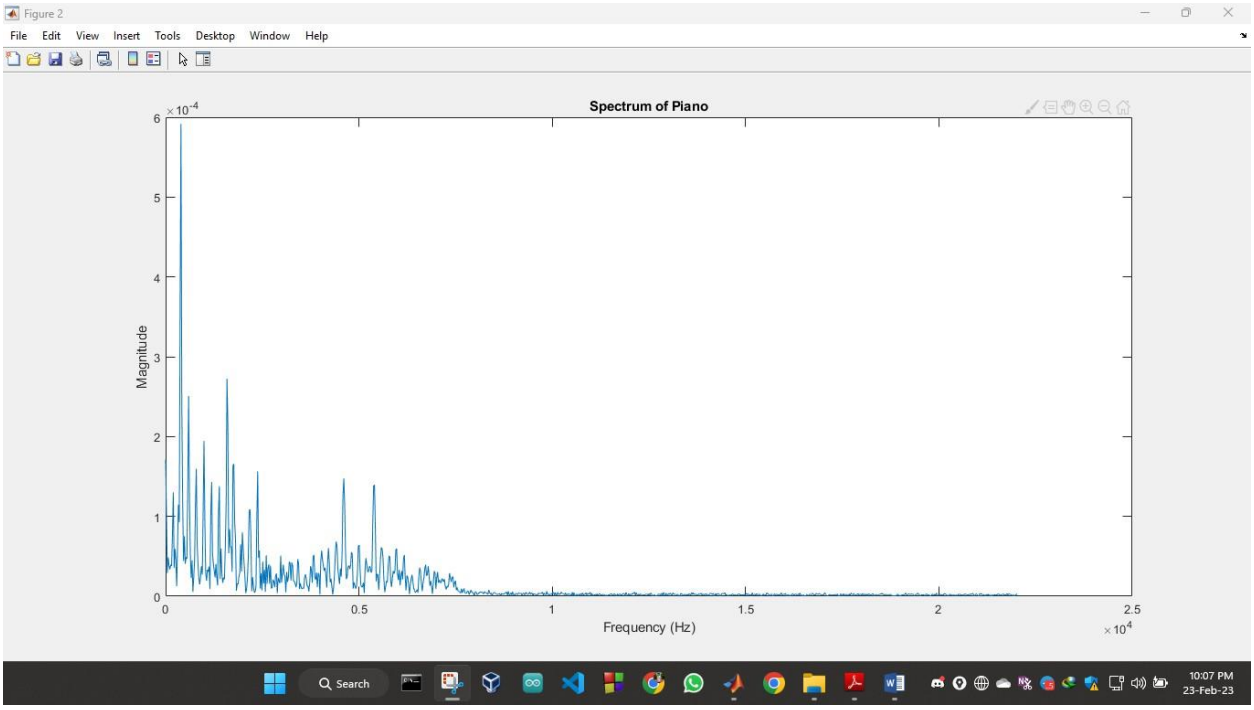
Breakpoints
Run
Run and Advance
Run Section
Advance
Run and Time
FILE
NAVIGATE
EDIT
BREAKPOINTS
RUN
D: ▸ BSc ▸ Spring-2022 ▸ Assignment ▸ 23 Feb ▸ DSP Lab ▸ Solve
Current Folder
Name
Final.wav
NonOverlapping.wav
task_1.m
task_2.m
task_3_4.m
task_5.m
task_6.m
task_7.m
Final.wav (WAV Audio File (VLC))
Workspace
Name
Value
endTime 58
endTimes [12,33,49,58]
fftLength 2000
fftSignal 2000x1 complex double
freqRange 1x1000 double
freqResolution 22.0500
Fs 44100
i 4
instrumentNames 1x4 cell
Editor - D:\BSc\Spring-2022\Assignment\23 Feb\DSP Lab\Solve\task_1.m
task_1.m
clc;
clear all;
close all;
[signal, Fs] = audioread('NonOverlapping.wav');
fftLength = 2000;
freqResolution = Fs / fftLength;
freqRange = (0:fftLength/2-1) * freqResolution;
% Initializing the spectrum
spectrum = cell(1, 4);
instrumentNames = {'Guitar', 'Piano', 'Trumpet', 'Violin'};
% Defining start and end times
startTimes = [0, 13, 34, 49];
endTimes = [12, 33, 49, 58];
for i = 1:4
startTime = startTimes(i);
endTime = endTimes(i);
instrumentSignal = signal(round(startTime*Fs)+1:round(endTime*Fs), :);
fftSignal = fft(instrumentSignal, fftLength);
magSignal = abs(fftSignal) / fftLength;
spectrum{i} = magSignal(1:fftLength/2, :);
figure;
plot(freqRange, spectrum{i});
xlabel('Frequency (Hz)');
ylabel('Magnitude');
title(sprintf('Spectrum of %s', instrumentNames{i}));
end
Command Window
>>
script
Ln 26 Col 4
Search
10:07 PM
23-Feb-23

Guitar:



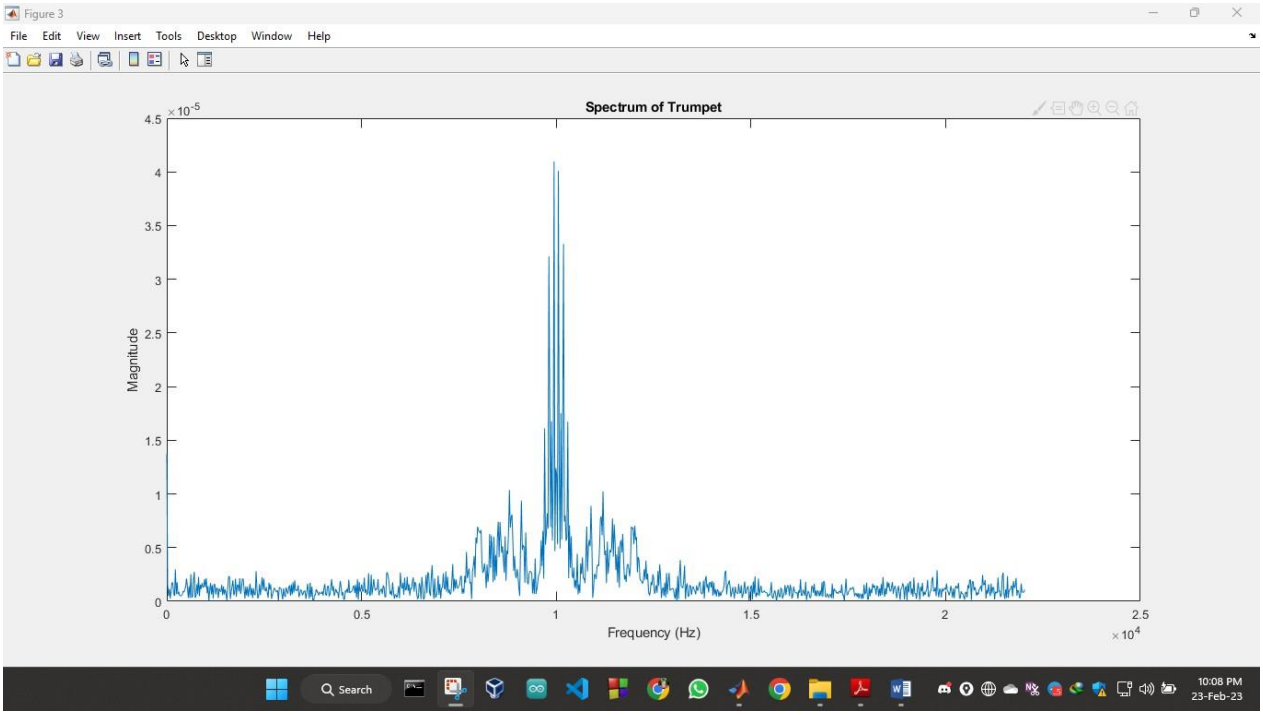
It has a frequency range between 0 Hz to 22010 Hz.

Piano:



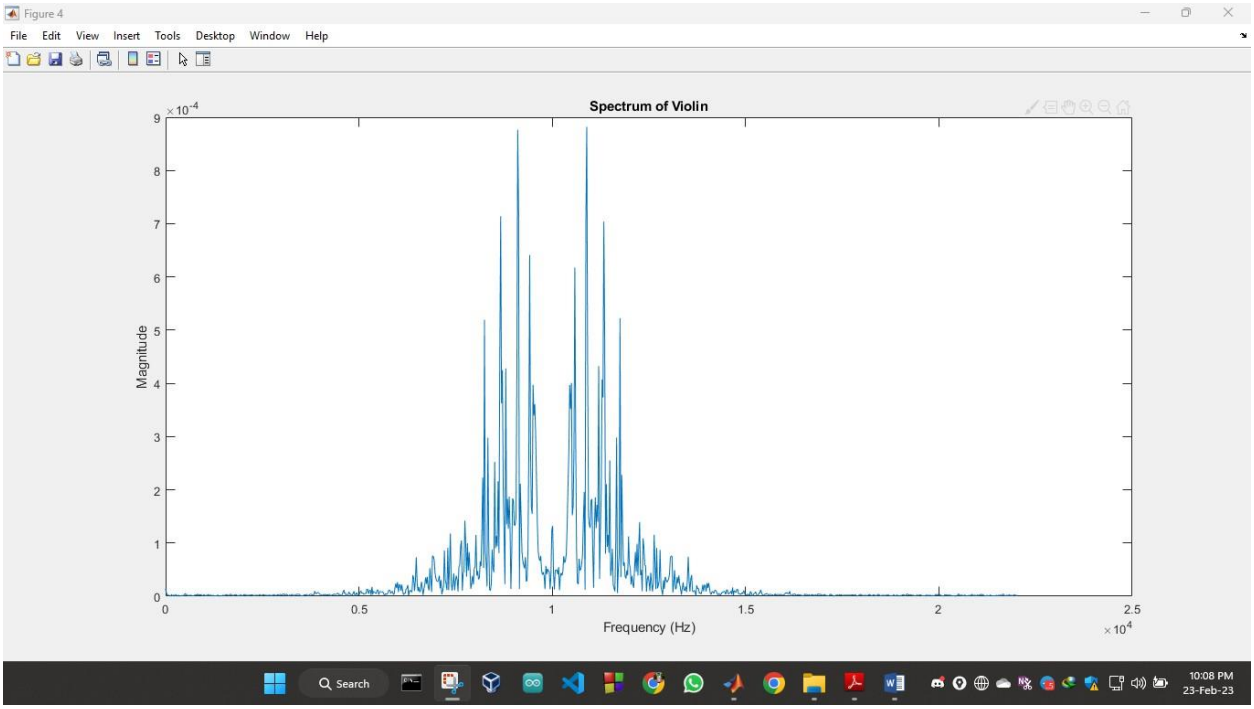
It has a frequency range between 0 Hz to 7629 Hz.

Trumpet:



It has a frequency range between 0 Hz to 22030 Hz.

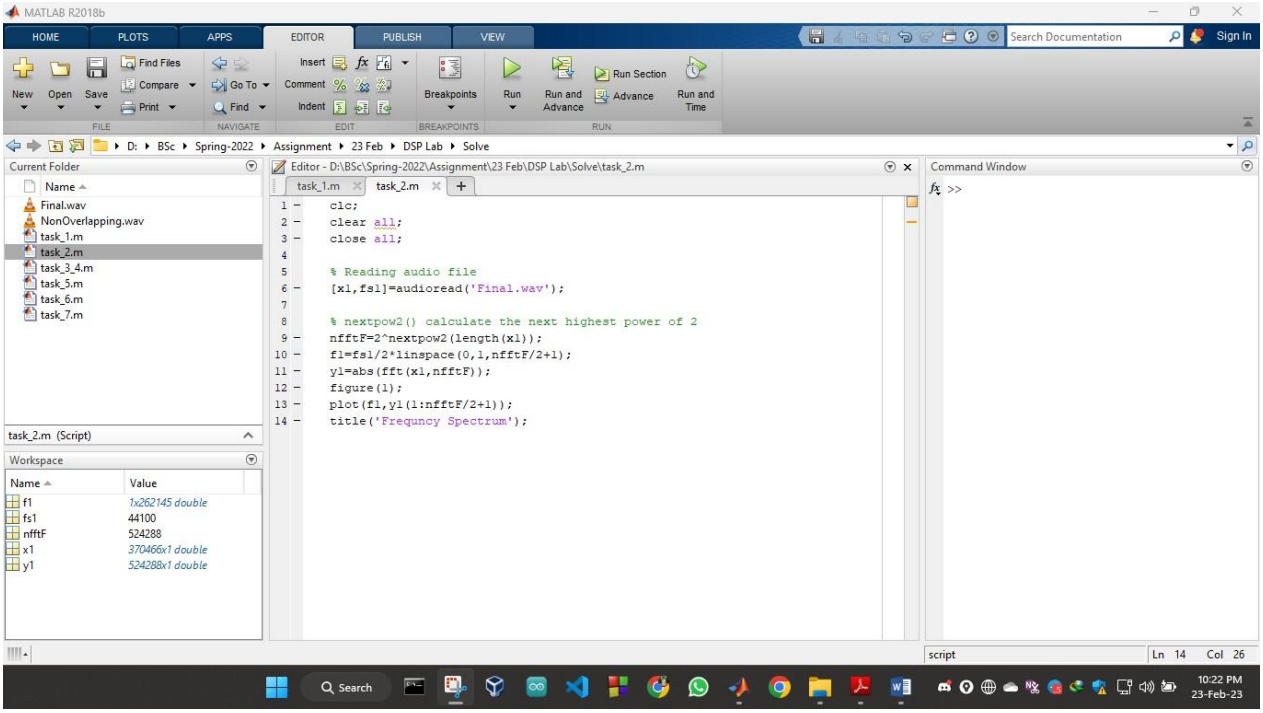
Violin:



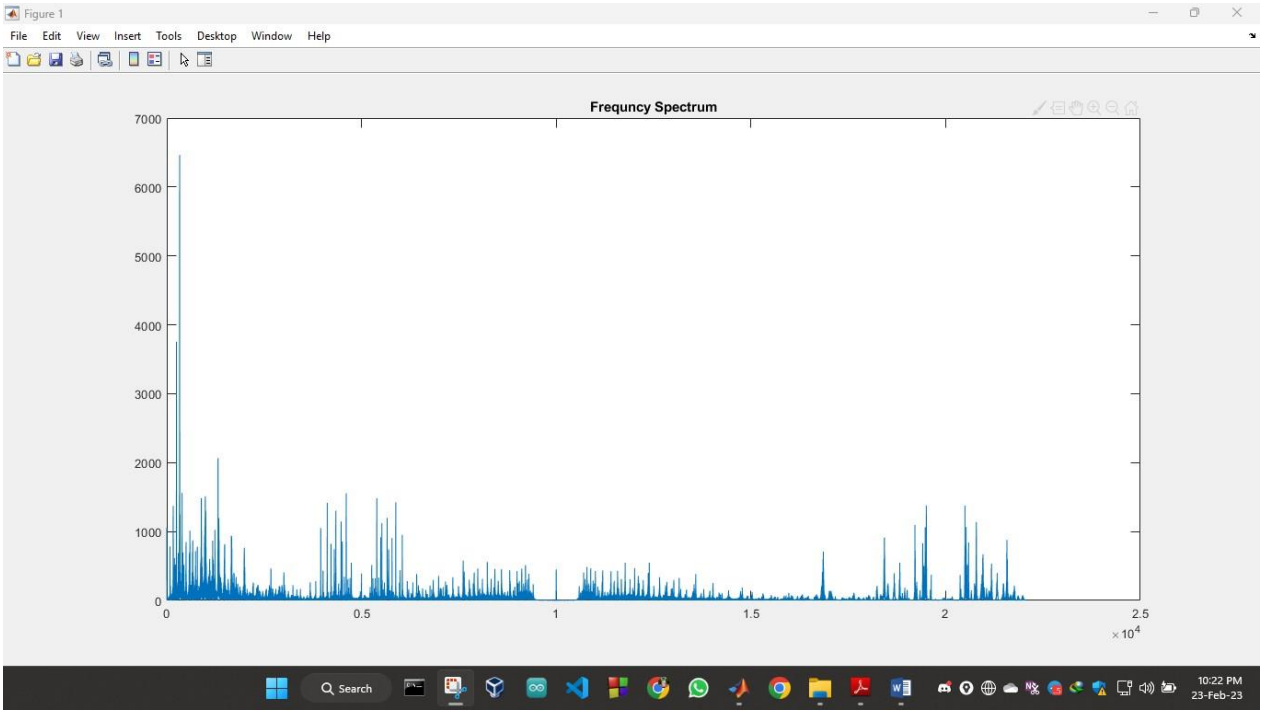
It has a frequency range between 5005 Hz to 16140 Hz.

Task 2:

Code:



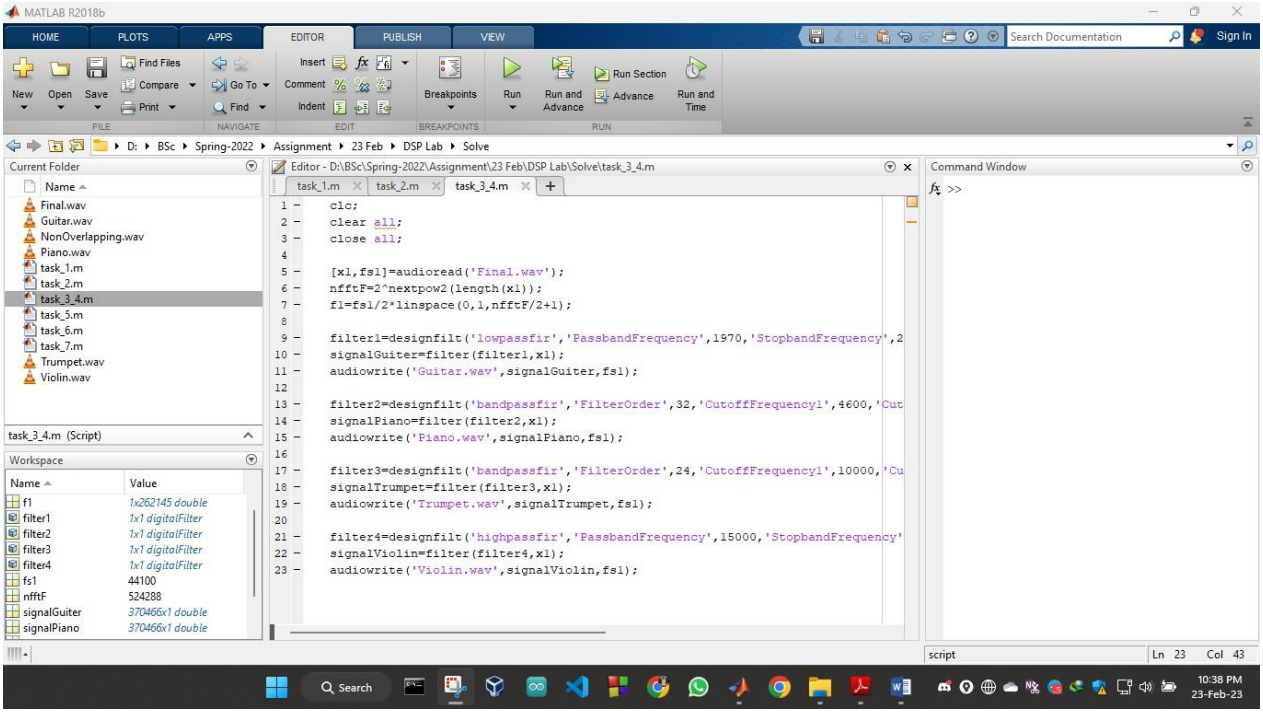
Spectrum:



The frequency range is between 0 Hz to 22050 Hz.

Task 3 & 4:

Code:



Guitar: Guitar uses low pass filter with pass band frequency of 1970 Hz, stopband frequency of 2290 Hz, pass band ripple 1, stopband attenuation of 94.

Piano: Piano uses band pass filter with order 32, cutoff frequency 4600Hz and 6100 Hz.

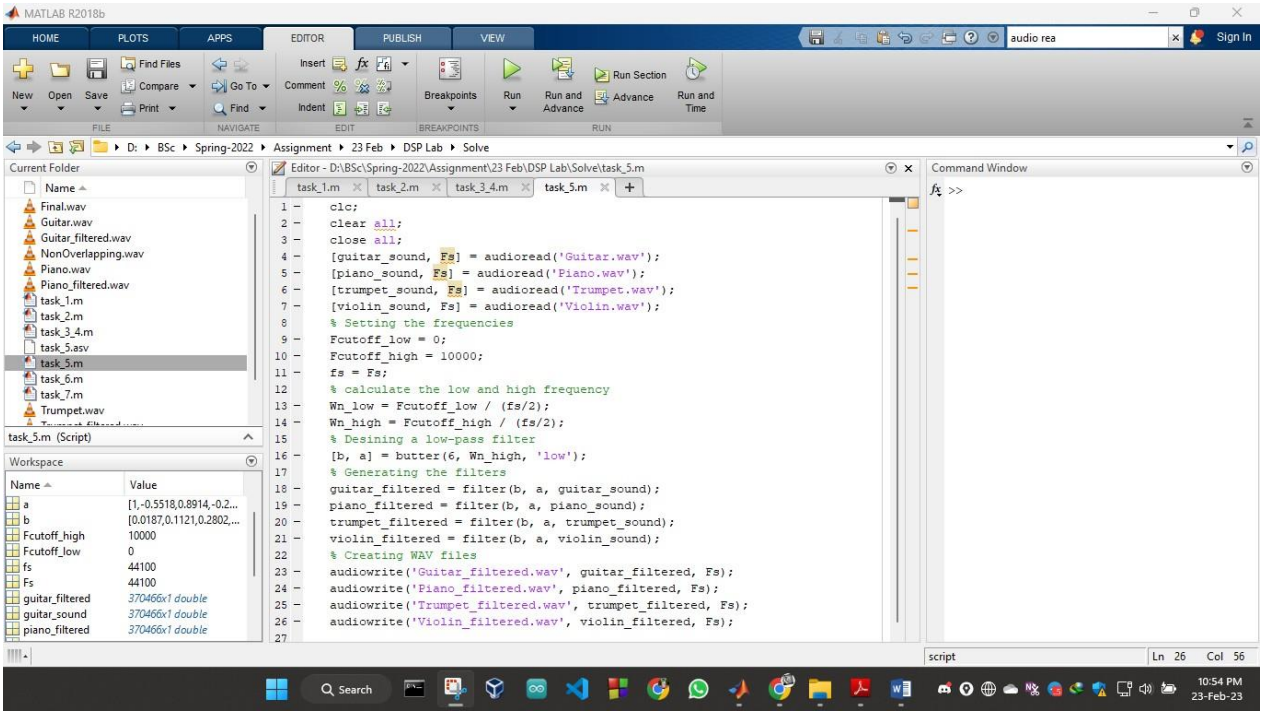
Trumpet: Trumpet uses band pass filter with filter order 24, cutoff frequency 10000Hz and 11000 Hz.

Violin: Violin uses high pass filter with pass band frequency of 15000 Hz, stopband frequency of 14900 Hz, pass band ripple 1, stopband attenuation of 77.

Extracted files are Guitar.wav, Piano.wav, Trumpet.wav and Violin.wav.

Task 5:

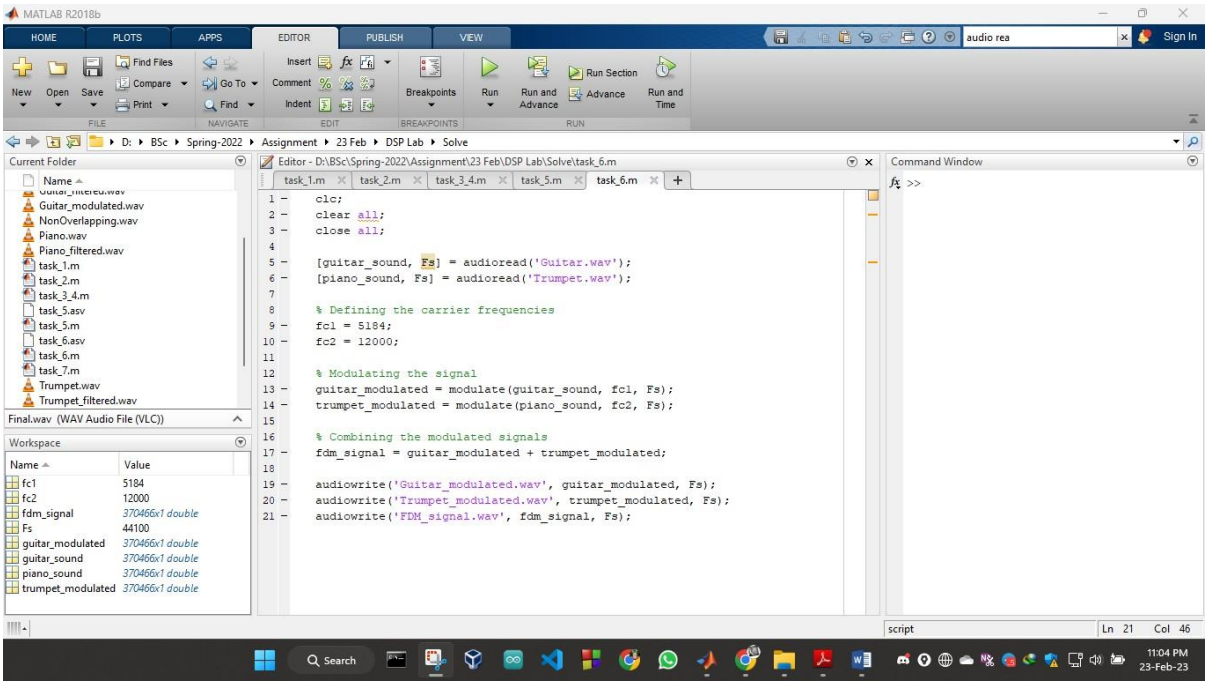
I can pass the individual wav files separately through a channel of bandwidth 0 to 10 kHz by setting the lower frequency to 0 Hz and higher frequency to 10000 Hz and using the low pass filter with butter function with filter order 6.



Task 6:

Sending guitar and trumpet signals through a 2-channel FDM link using carrier frequency of 5184 Hz and 12000 Hz.

Code:


MATLAB R2018b
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Run and Advance
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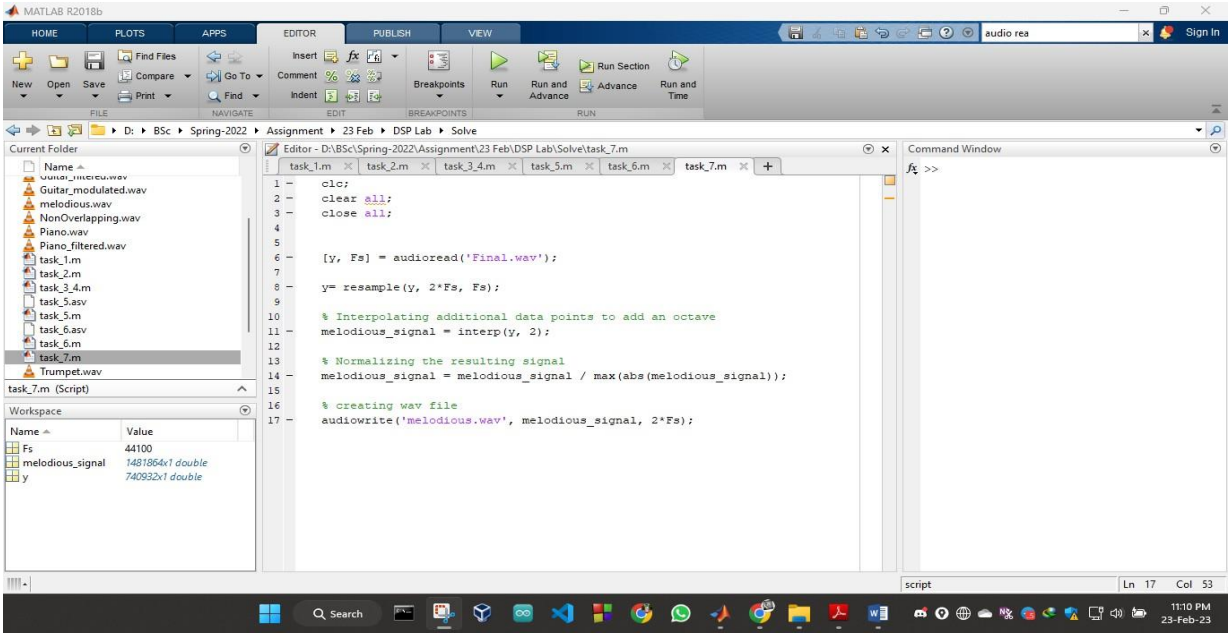
Advance
Run and Time
FILE
NAVIGATE
EDIT
BREAKPOINTS
RUN
D: ▸ BSc ▸ Spring-2022 ▸ Assignment ▸ 23 Feb ▸ DSP Lab ▸ Solve
Current Folder
Name
Guitar_modulated.wav
NonOverlapping.wav
Piano.wav
Piano_filtered.wav
task_1.m
task_2.m
task_3_4.m
task_5.asv
task_5.m
task_6.asv
task_6.m
task_7.m
Trumpet.wav
Trumpet_filtered.wav
Final.wav (WAV Audio File (VLC))
Workspace
Name
Value
fc1 5184
fc2 12000
fdm_signal 370466x1 double
Fs 44100
guitar_modulated 370466x1 double
guitar_sound 370466x1 double
piano_sound 370466x1 double
trumpet_modulated 370466x1 double
Editor - D:\BSc\Spring-2022\Assignment\23 Feb\DSP Lab\Solve\task_6.m
task_1.m
task_2.m
task_3_4.m
task_5.m
task_6.m
clc;
clear all;
close all;
[guitar_sound, Fs] = audioread('Guitar.wav');
[piano_sound, Fs] = audioread('Trumpet.wav');
% Defining the carrier frequencies
fc1 = 5184;
fc2 = 12000;
% Modulating the signal
guitar_modulated = modulate(guitar_sound, fc1, Fs);
trumpet_modulated = modulate(piano_sound, fc2, Fs);
% Combining the modulated signals
fdm_signal = guitar_modulated + trumpet_modulated;
audiowrite('Guitar_modulated.wav', guitar_modulated, Fs);
audiowrite('Trumpet_modulated.wav', trumpet_modulated, Fs);
audiowrite('FDM_signal.wav', fdm_signal, Fs);
Command Window
>>
script
Ln 21 Col 46
Search
11:04 PM
23-Feb-23

Task 7:

Code:


MATLAB R2018b
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Advance
Run and Time
FILE
NAVIGATE
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BREAKPOINTS
RUN
D: ▸ BSc ▸ Spring-2022 ▸ Assignment ▸ 23 Feb ▸ DSP Lab ▸ Solve
Current Folder
Name
Guitar_modulated.wav
melodious.wav
NonOverlapping.wav
Piano.wav
Piano_filtered.wav
task_1.m
task_2.m
task_3_4.m
task_5.asv
task_5.m
task_6.asv
task_6.m
task_7.m
Trumpet.wav
task_7.m (Script)
Workspace
Name
Value
Fs 44100
melodious_signal 1481864x1 double
y 740932x1 double
Editor - D:\BSc\Spring-2022\Assignment\23 Feb\DSP Lab\Solve\task_7.m
task_1.m
task_2.m
task_3_4.m
task_5.m
task_6.m
task_7.m
clc;
clear all;
close all;
[y, Fs] = audioread('Final.wav');
y= resample(y, 2*Fs, Fs);
% Interpolating additional data points to add an octave
melodious_signal = interp(y, 2);
% Normalizing the resulting signal
melodious_signal = melodious_signal / max(abs(melodious_signal));
% creating wav file
audiowrite('melodious.wav', melodious_signal, 2*Fs);
Command Window
>>
script
Ln 17 Col 53
Search
11:10 PM
23-Feb-23