VIT®

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

DIGITAL HEARING AID

Submitted To:

Lokanath M.

Assistant Professor , Sense

Submitted By:

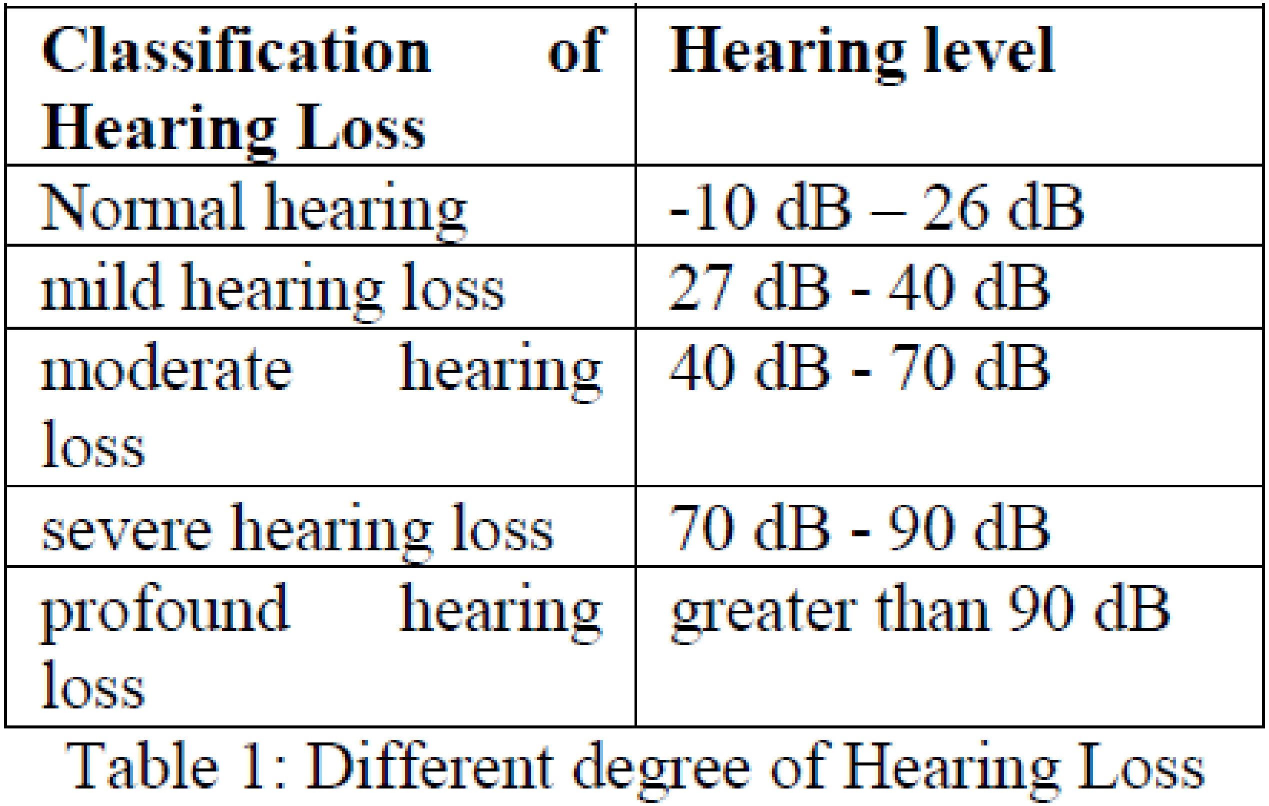
18BEC0898- VAIBHAV JAIN
18BEC0883- A.RAAHUL
18BEC0853- SHANTANU NIKAM
18BEC0841- NIDHI PATEL
18BEC0339- JASPREET SINGH
18BEC0274- ABHIMANYU REDDY
18BEC0268- ANIKET AGARWAL

ECE1004-Signals and System
Slot-C1
Fall Semester 2019-20
Project Report

Contents

1. Need of Hearing Aid
2. Block Diagram of System
3. Algorithm
4. GUI & Program Flow
5. Output Graphs

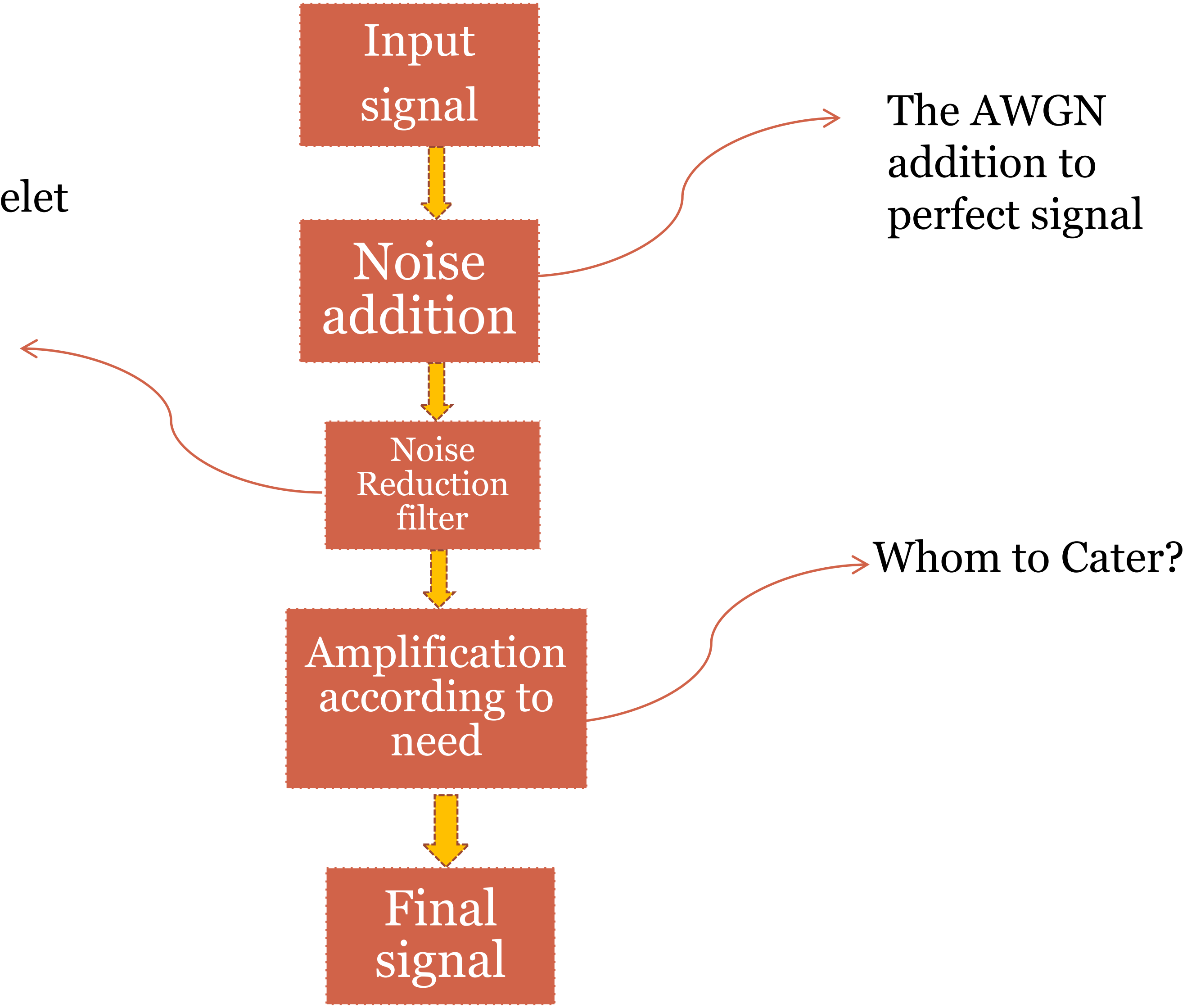
Need of Hearing Aid



Classification of Hearing Loss	**Hearing level**
Normal hearing	-10 dB – 26 dB
mild hearing loss	27 dB - 40 dB
moderate hearing loss	40 dB - 70 dB
severe hearing loss	70 dB - 90 dB
profound hearing loss	greater than 90 dB

Table 1: Different degree of Hearing Loss

BLOCK DIAGRAM



Input signal

Noise addition

Noise Reduction filter

Amplification according to need

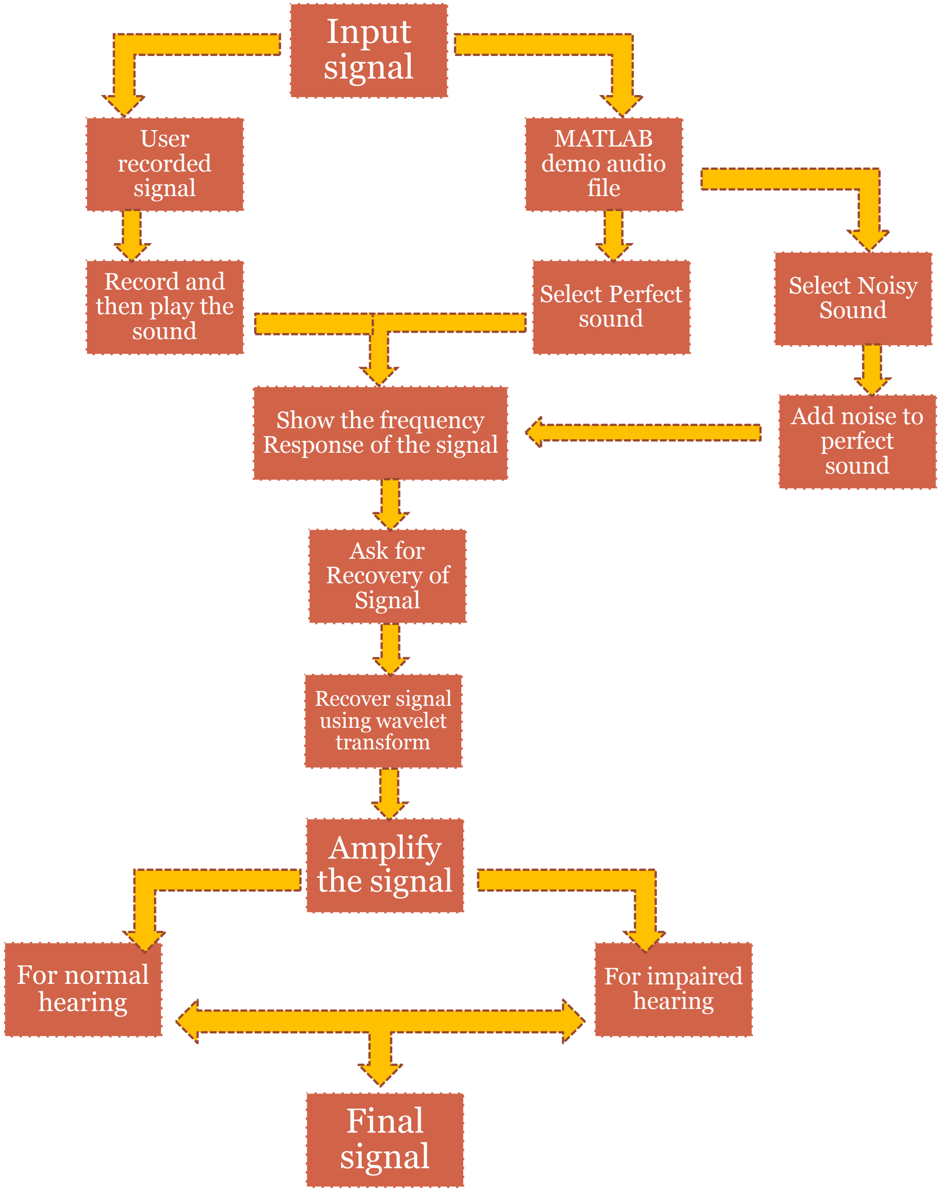
Final signal

The AWGN addition to perfect signal

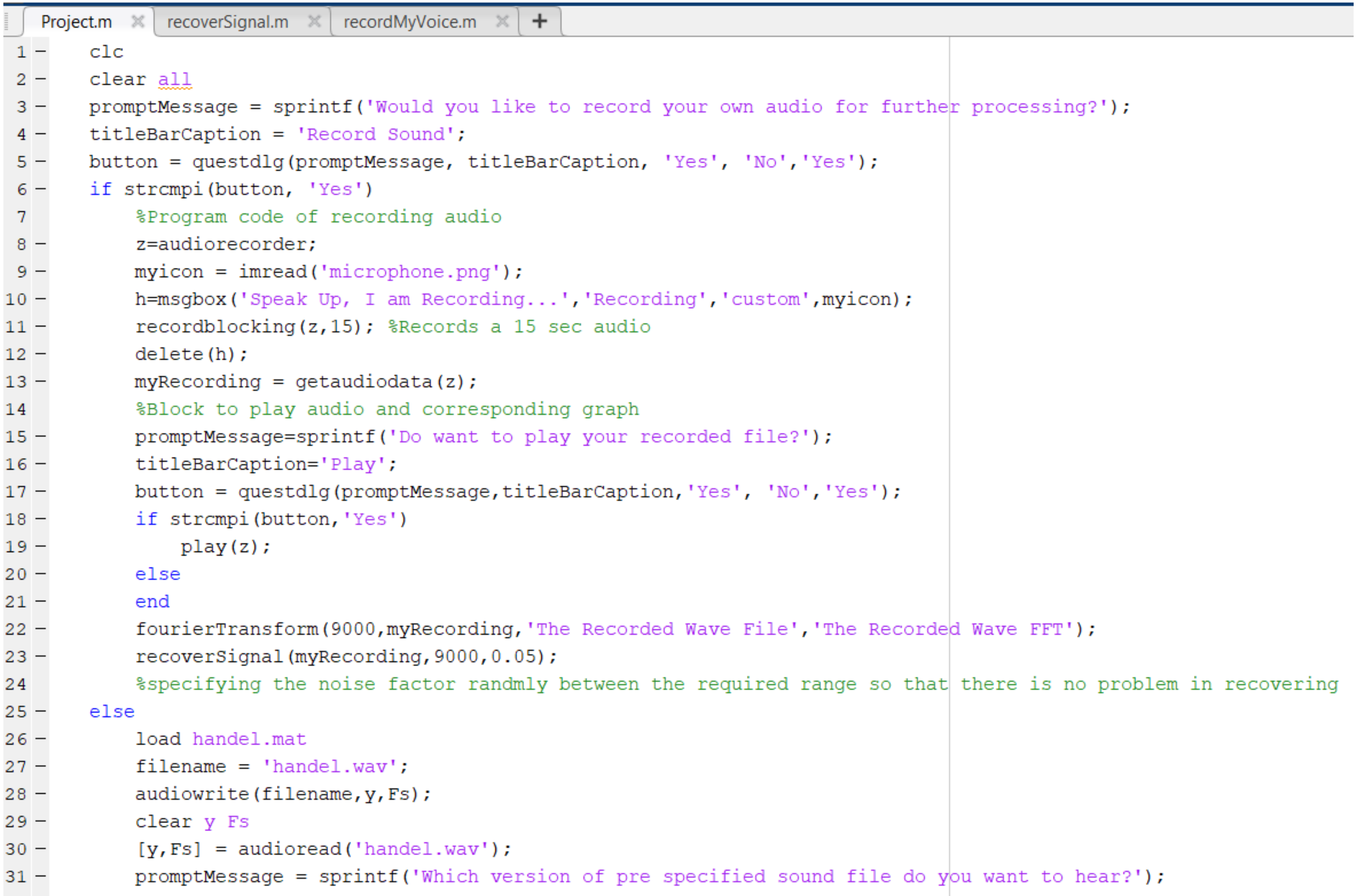
Using Wavelet Tranform

Whom to Cater?

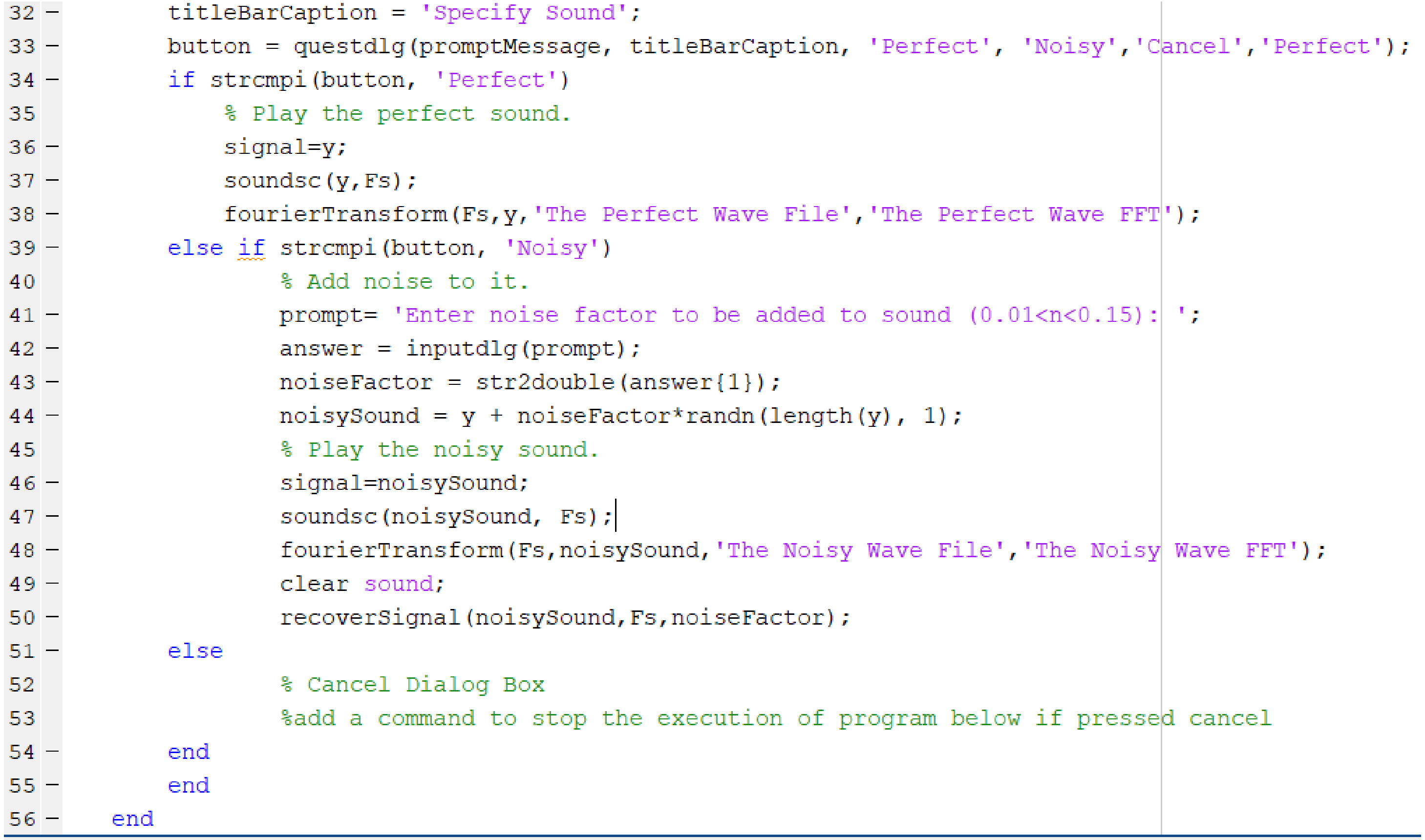
ALGORITHM


Input signal
User recorded signal
MATLAB demo audio file
Record and then play the sound
Select Perfect sound
Select Noisy Sound
Add noise to perfect sound
Show the frequency Response of the signal
Ask for Recovery of Signal
Recover signal using wavelet transform
Amplify the signal
For normal hearing
For impaired hearing
Final signal

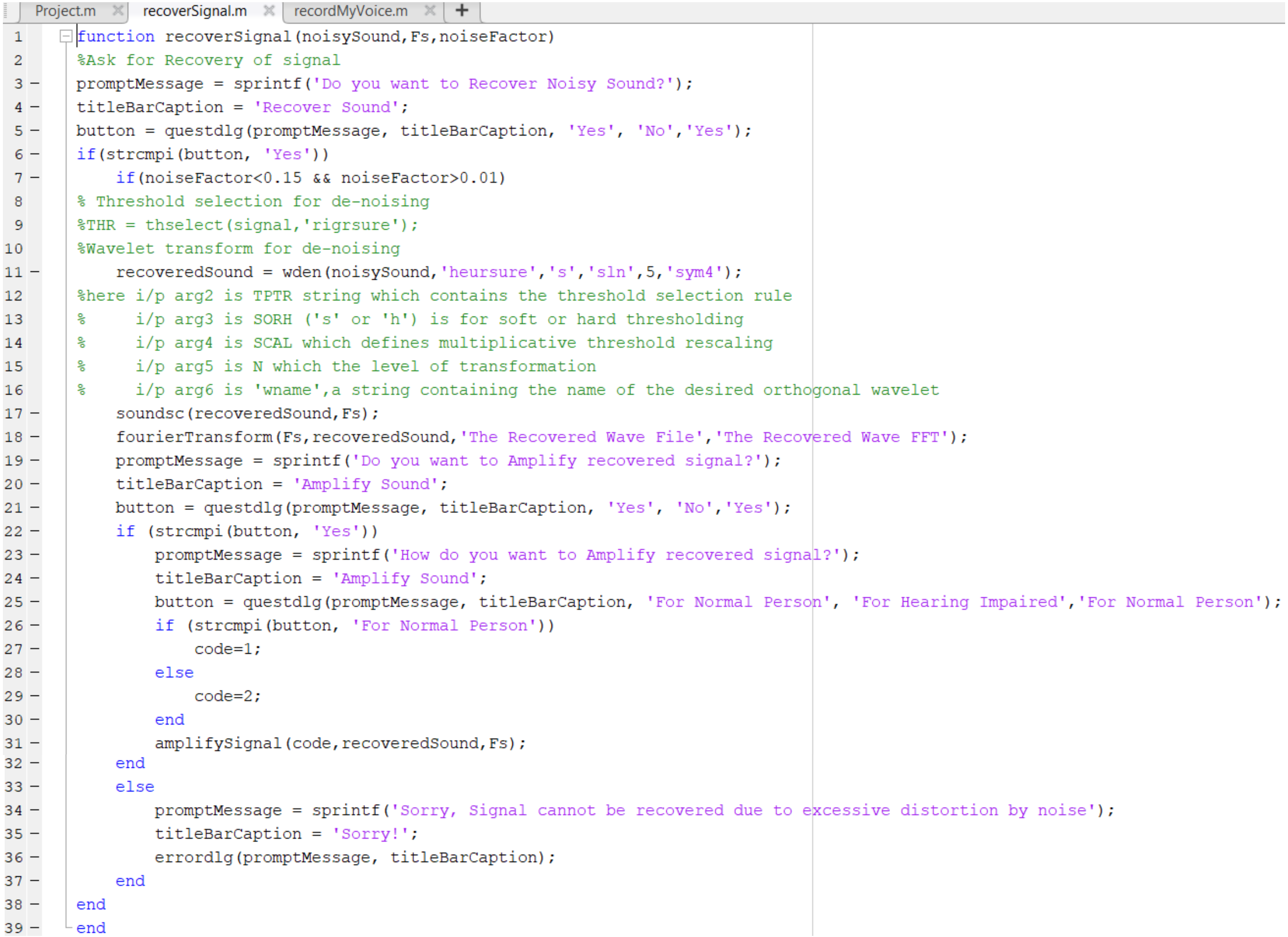
Matlab Code:



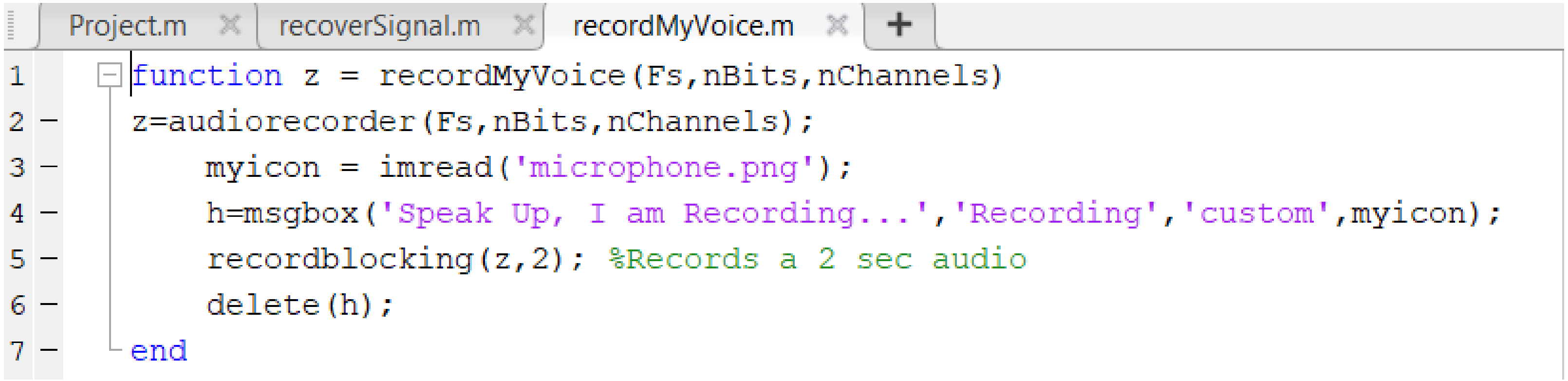
```matlab
clc
clear all
promptMessage = sprintf('Would you like to record your own audio for further processing?');
titleBarCaption = 'Record Sound';
button = questdlg(promptMessage, titleBarCaption, 'Yes', 'No','Yes');
if strcmpi(button, 'Yes')
    %Program code of recording audio
    z=audiorecorder;
    myicon = imread('microphone.png');
    h=msgbox('Speak Up, I am Recording...','Recording','custom',myicon);
    recordblocking(z,15); %Records a 15 sec audio
    delete(h);
    myRecording = getaudiodata(z);
    %Block to play audio and corresponding graph
    promptMessage=sprintf('Do want to play your recorded file?');
    titleBarCaption='Play';
    button = questdlg(promptMessage,titleBarCaption,'Yes', 'No','Yes');
    if strcmpi(button,'Yes')
        play(z);
    else
    end
    fourierTransform(9000,myRecording,'The Recorded Wave File','The Recorded Wave FFT');
    recoverSignal(myRecording,9000,0.05);
    %specifying the noise factor randmly between the required range so that there is no problem in recovering
else
    load handel.mat
    filename = 'handel.wav';
    audiowrite(filename,y,Fs);
    clear y Fs
    [y,Fs] = audioread('handel.wav');
    promptMessage = sprintf('Which version of pre specified sound file do you want to hear?');
```



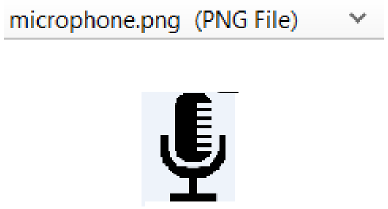
```
        titleBarCaption = 'Specify Sound';
        button = questdlg(promptMessage, titleBarCaption, 'Perfect', 'Noisy','Cancel','Perfect');
        if strcmpi(button, 'Perfect')
            % Play the perfect sound.
            signal=y;
            soundsc(y,Fs);
            fourierTransform(Fs,y,'The Perfect Wave File','The Perfect Wave FFT');
        else if strcmpi(button, 'Noisy')
                % Add noise to it.
                prompt= 'Enter noise factor to be added to sound (0.01<n<0.15): ';
                answer = inputdlg(prompt);
                noiseFactor = str2double(answer{1});
                noisySound = y + noiseFactor*randn(length(y), 1);
                % Play the noisy sound.
                signal=noisySound;
                soundsc(noisySound, Fs);
                fourierTransform(Fs,noisySound,'The Noisy Wave File','The Noisy Wave FFT');
                clear sound;
                recoverSignal(noisySound,Fs,noiseFactor);
        else
                % Cancel Dialog Box
                %add a command to stop the execution of program below if pressed cancel
        end
        end
    end
```



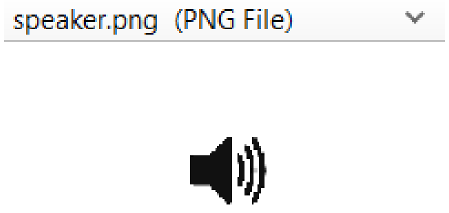
```matlab
function recoverSignal(noisySound,Fs,noiseFactor)
%Ask for Recovery of signal
promptMessage = sprintf('Do you want to Recover Noisy Sound?');
titleBarCaption = 'Recover Sound';
button = questdlg(promptMessage, titleBarCaption, 'Yes', 'No','Yes');
if(strcmpi(button, 'Yes'))
    if(noiseFactor<0.15 && noiseFactor>0.01)
% Threshold selection for de-noising
%THR = thselect(signal,'rigrsure');
%Wavelet transform for de-noising
    recoveredSound = wden(noisySound,'heursure','s','sln',5,'sym4');
%here i/p arg2 is TPTR string which contains the threshold selection rule
%     i/p arg3 is SORH ('s' or 'h') is for soft or hard thresholding
%     i/p arg4 is SCAL which defines multiplicative threshold rescaling
%     i/p arg5 is N which the level of transformation
%     i/p arg6 is 'wname',a string containing the name of the desired orthogonal wavelet
    soundsc(recoveredSound,Fs);
    fourierTransform(Fs,recoveredSound,'The Recovered Wave File','The Recovered Wave FFT');
    promptMessage = sprintf('Do you want to Amplify recovered signal?');
    titleBarCaption = 'Amplify Sound';
    button = questdlg(promptMessage, titleBarCaption, 'Yes', 'No','Yes');
    if (strcmpi(button, 'Yes'))
        promptMessage = sprintf('How do you want to Amplify recovered signal?');
        titleBarCaption = 'Amplify Sound';
        button = questdlg(promptMessage, titleBarCaption, 'For Normal Person', 'For Hearing Impaired','For Normal Person');
        if (strcmpi(button, 'For Normal Person'))
            code=1;
        else
            code=2;
        end
        amplifySignal(code,recoveredSound,Fs);
    end
    else
        promptMessage = sprintf('Sorry, Signal cannot be recovered due to excessive distortion by noise');
        titleBarCaption = 'Sorry!';
        errordlg(promptMessage, titleBarCaption);
    end
end
end
```



```
function z = recordMyVoice(Fs,nBits,nChannels)
z=audiorecorder(Fs,nBits,nChannels);
    myicon = imread('microphone.png');
    h=msgbox('Speak Up, I am Recording...','Recording','custom',myicon);
    recordblocking(z,2); %Records a 2 sec audio
    delete(h);
end
```

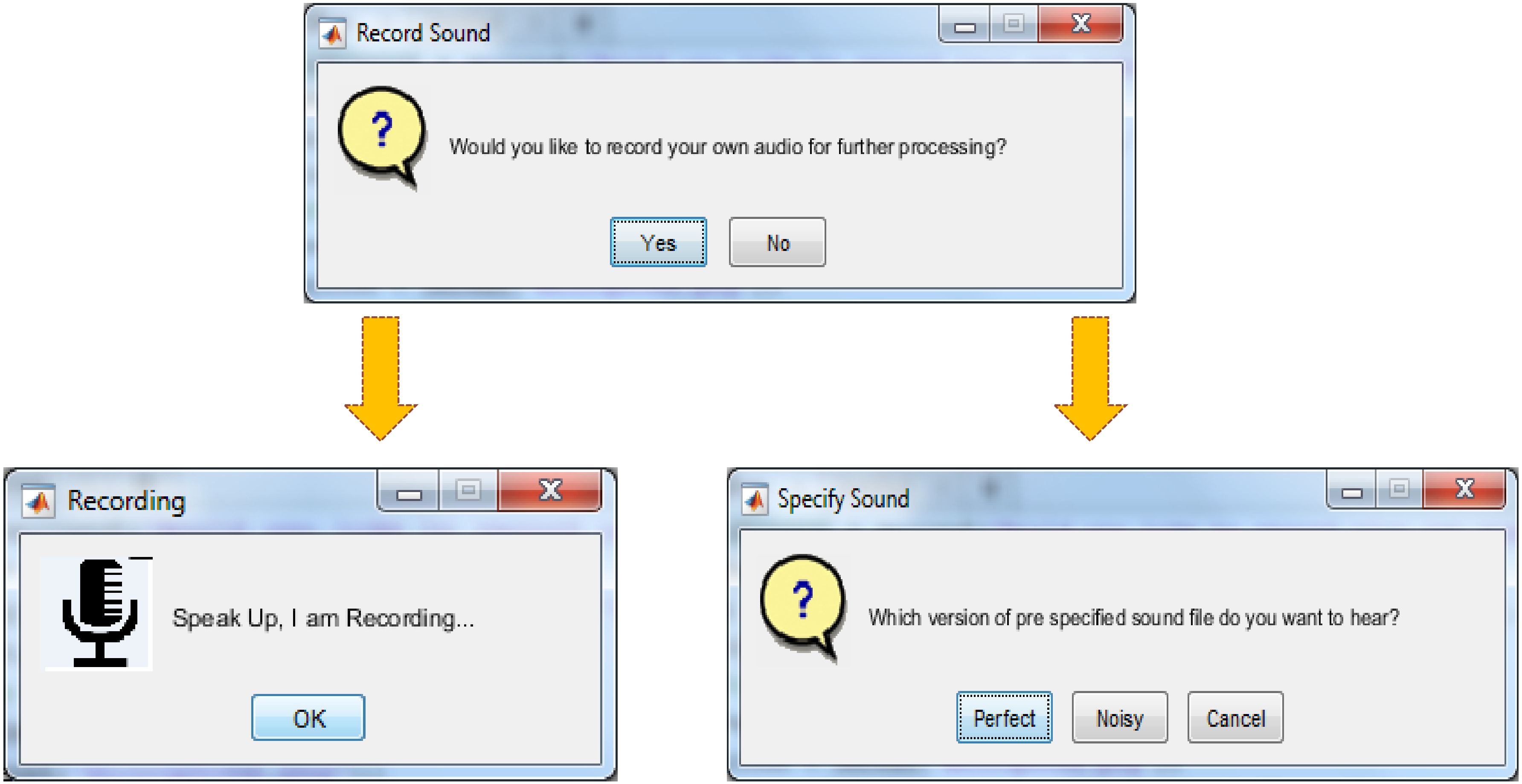


Width: 61 Height: 72



Width: 56 Height: 49

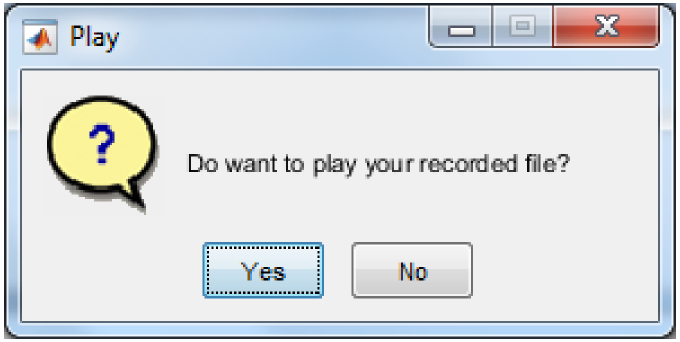
GUI and program flow



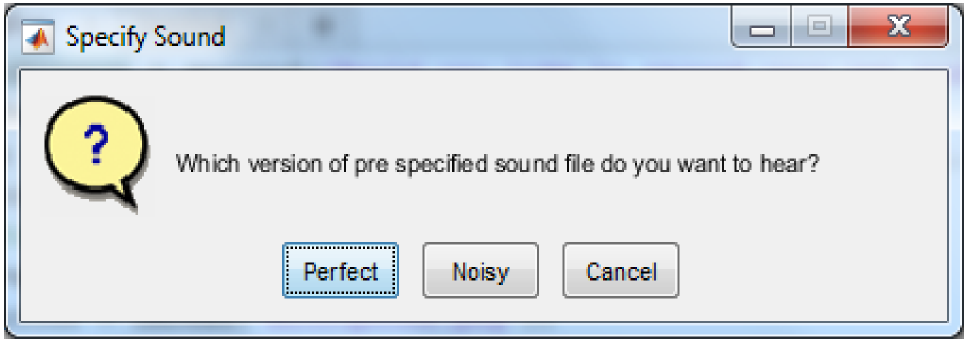
Would you like to record your own audio for further processing?

Speak Up, I am Recording...

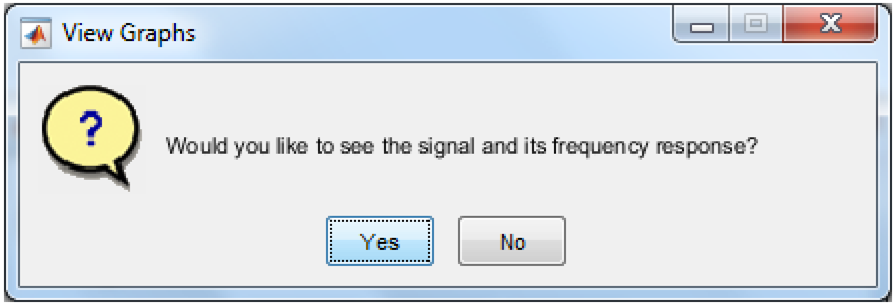
Which version of pre specified sound file do you want to hear?



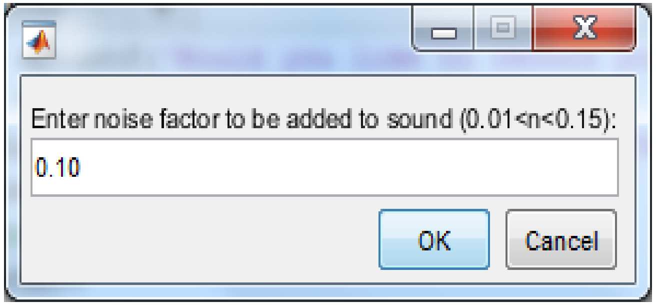
Do want to play your recorded file?



Which version of pre specified sound file do you want to hear?



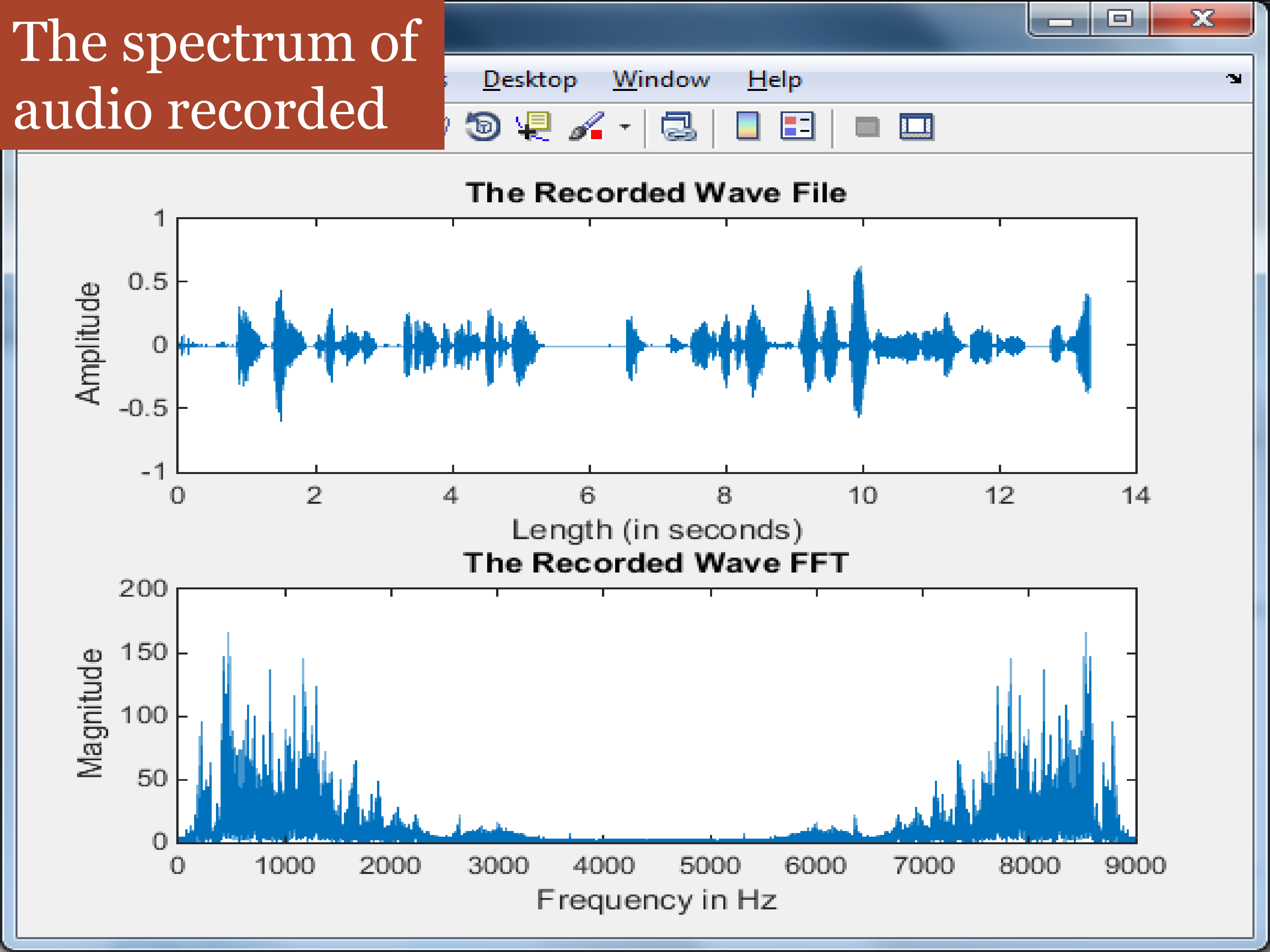
Would you like to see the signal and its frequency response?

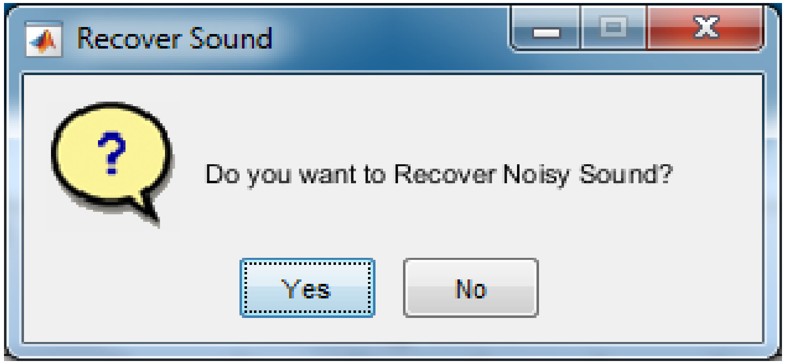


Enter noise factor to be added to sound (0.01<n<0.15):

0.10

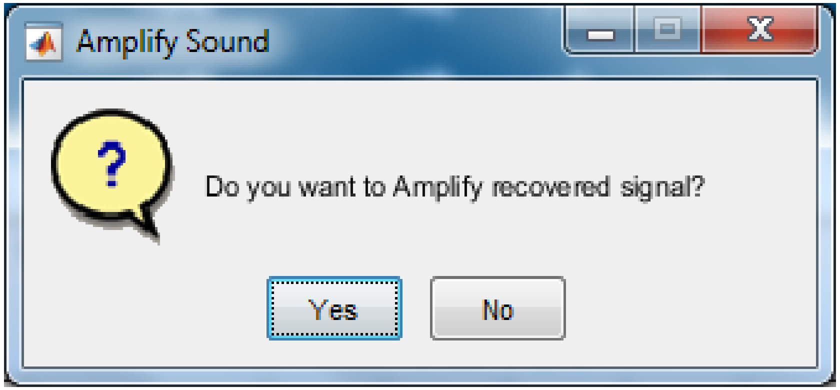
The spectrum of audio recorded





Recover Sound

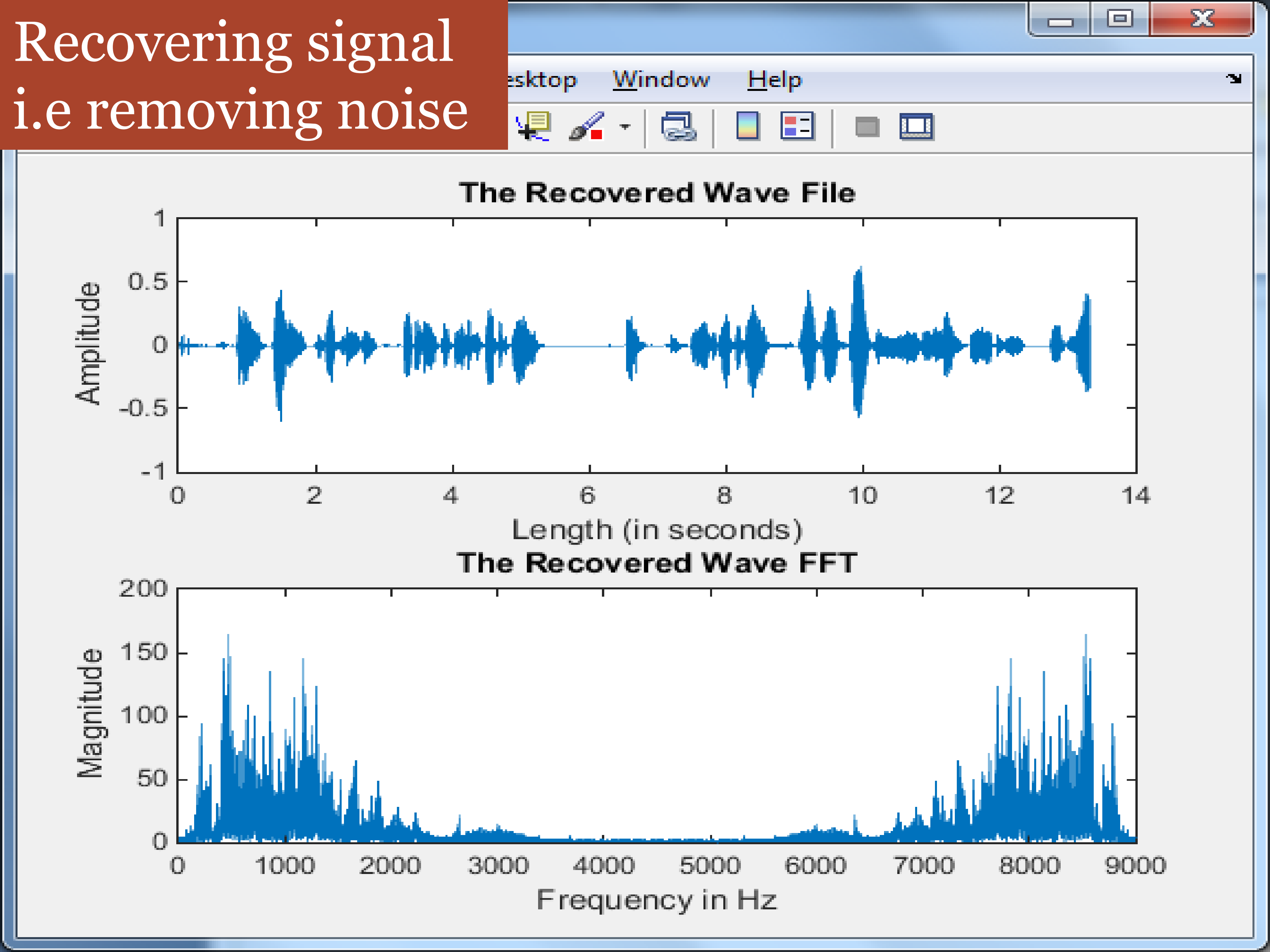
Do you want to Recover Noisy Sound?

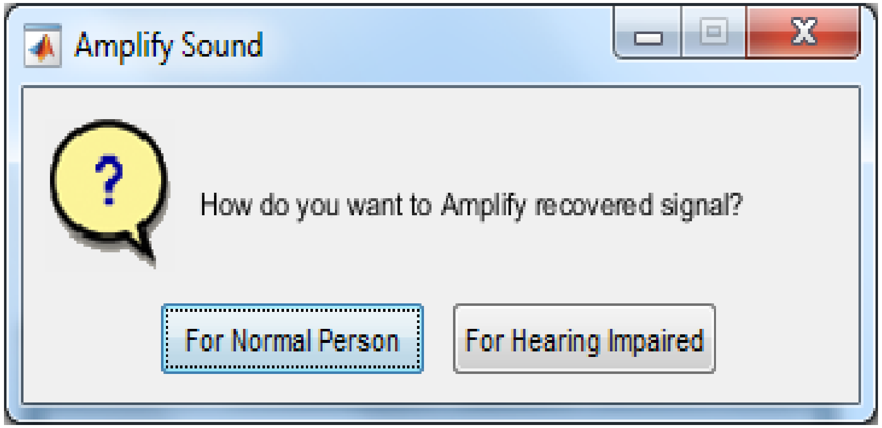


Amplify Sound

Do you want to Amplify recovered signal?

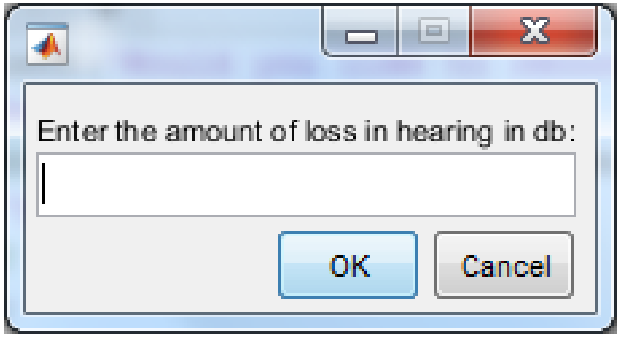
Recovering signal i.e removing noise





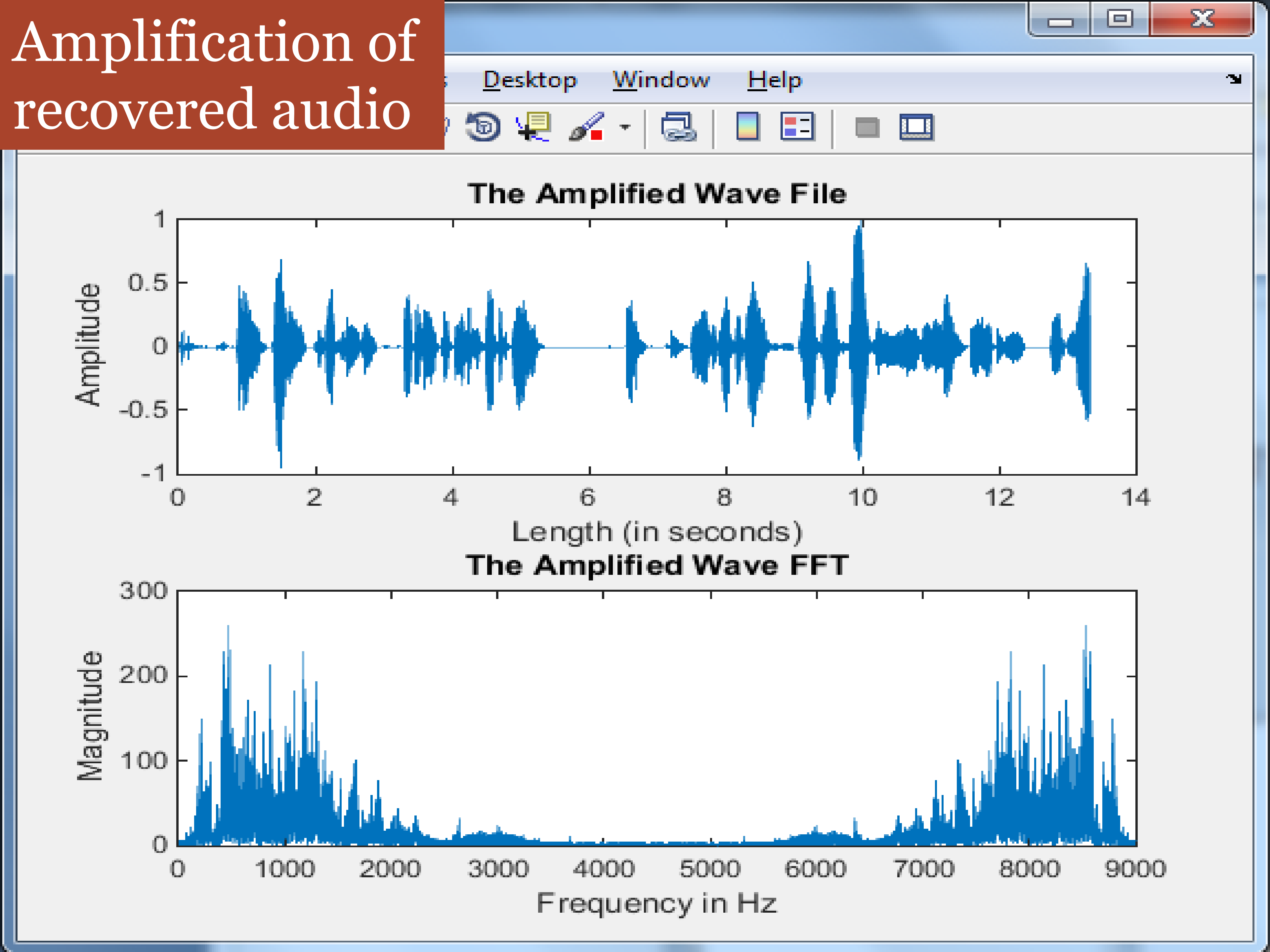
Amplify Sound

How do you want to Amplify recovered signal?



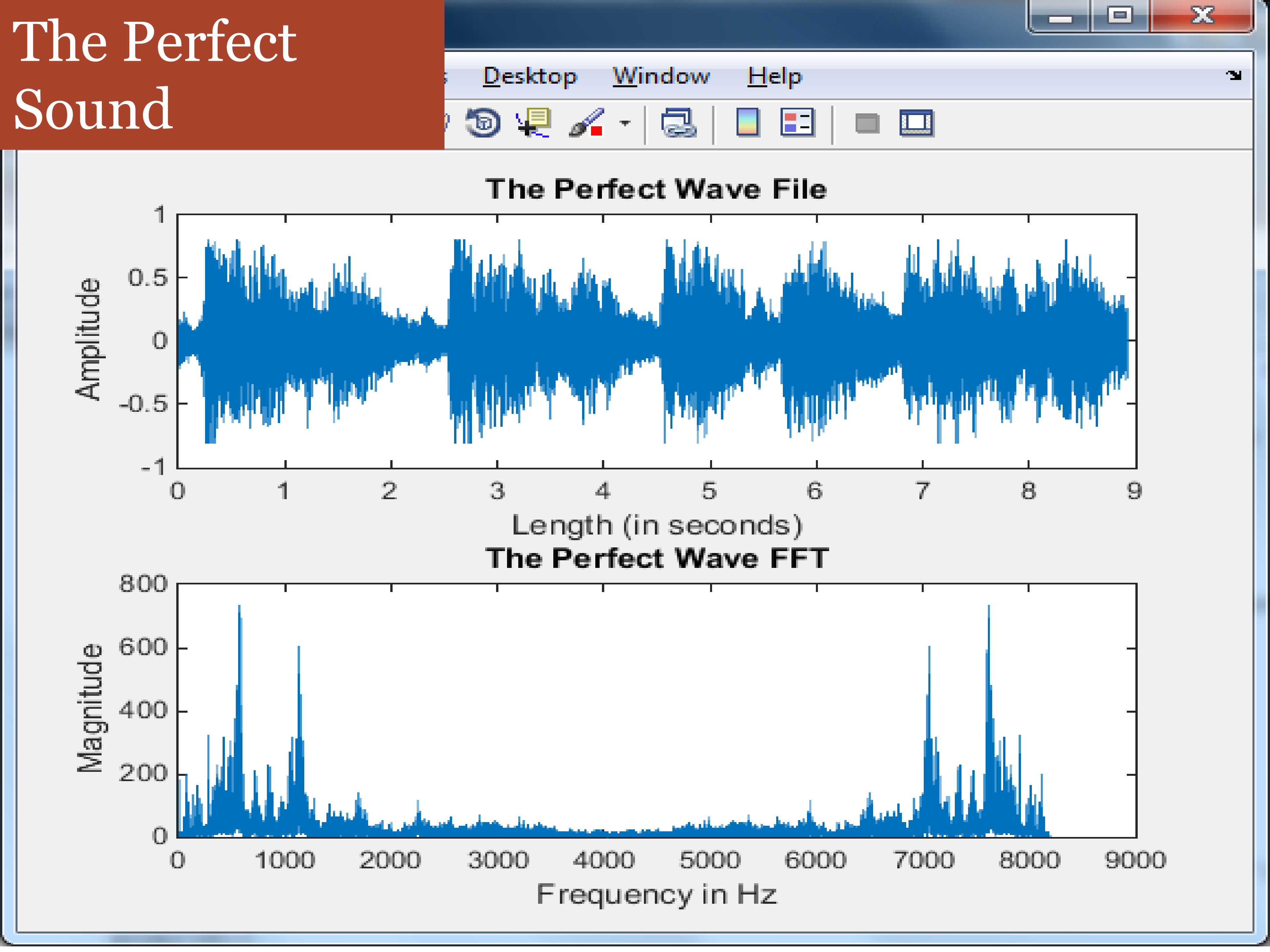
Enter the amount of loss in hearing in db:

Amplification of recovered audio

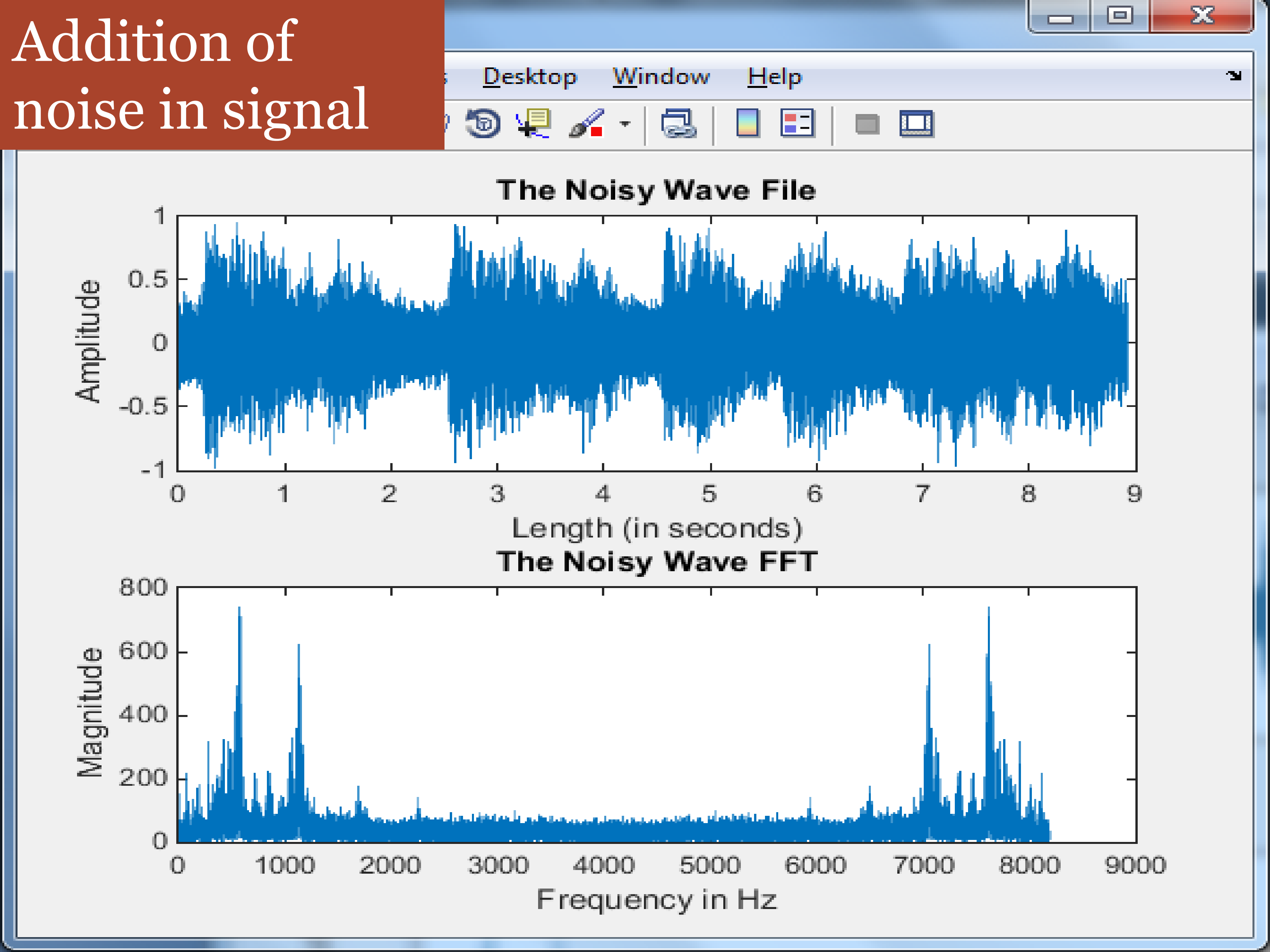


RESPONSES FOR SAMPLE FILE OF MATLAB

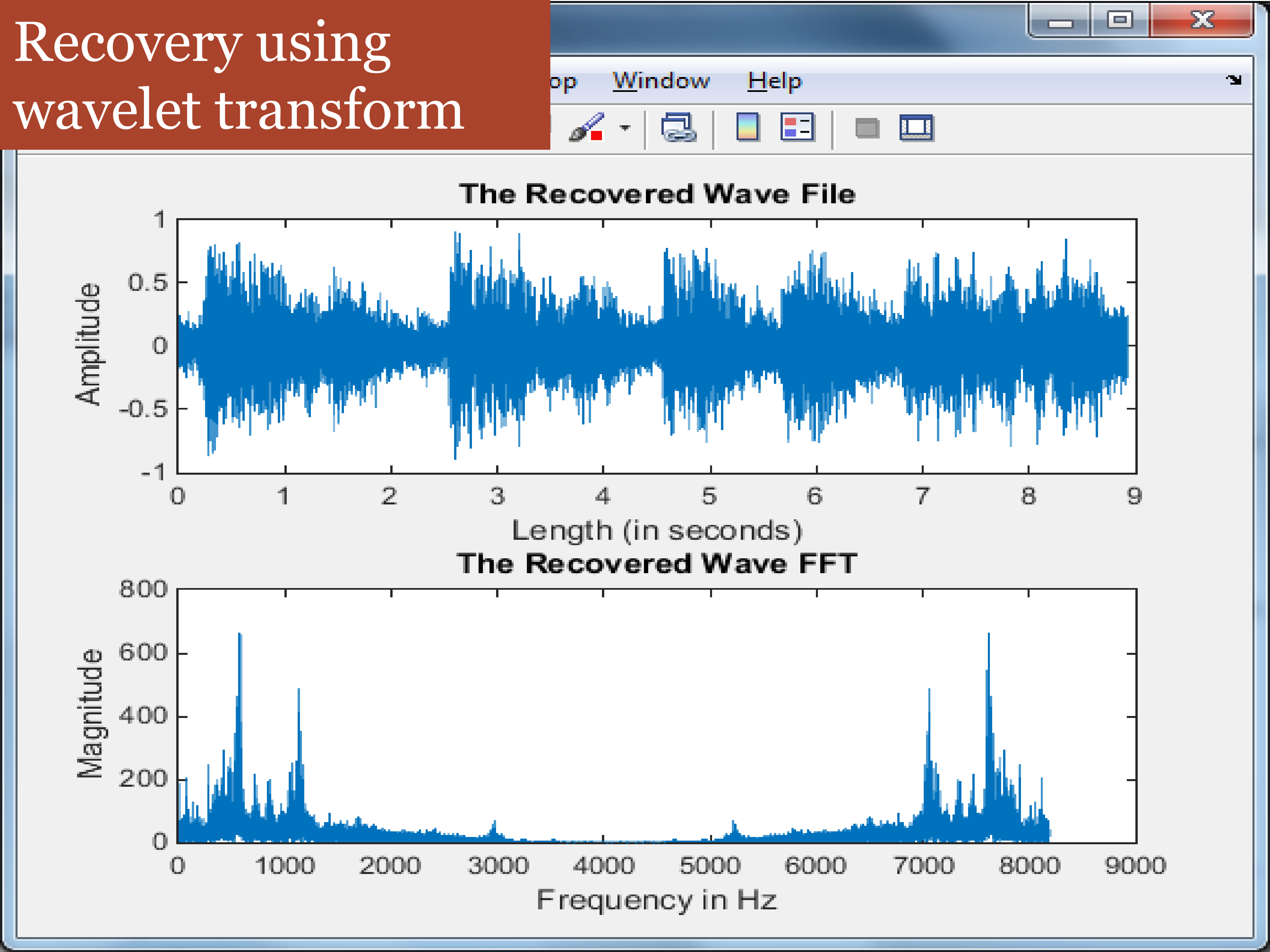
The Perfect Sound



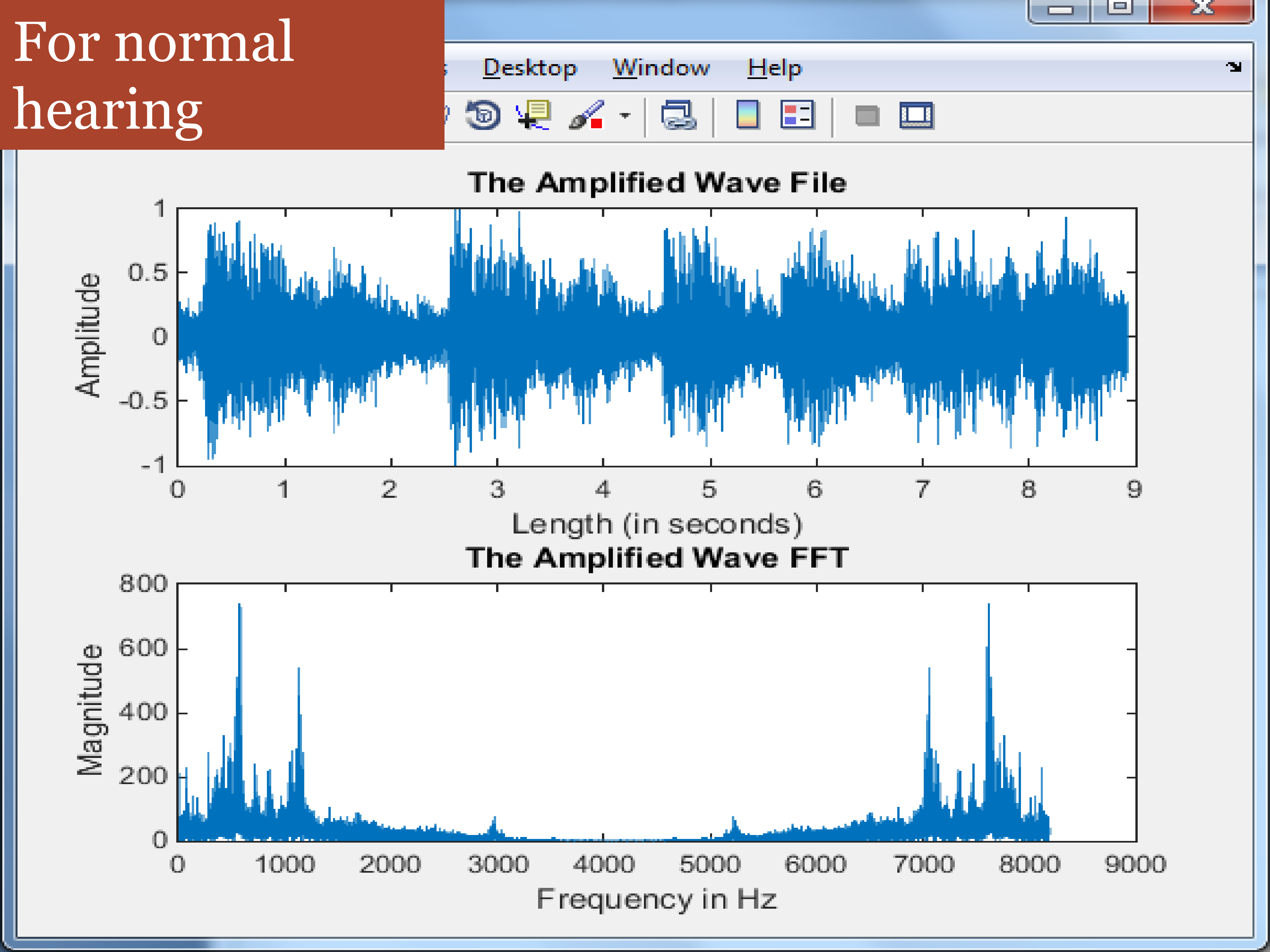
Addition of noise in signal



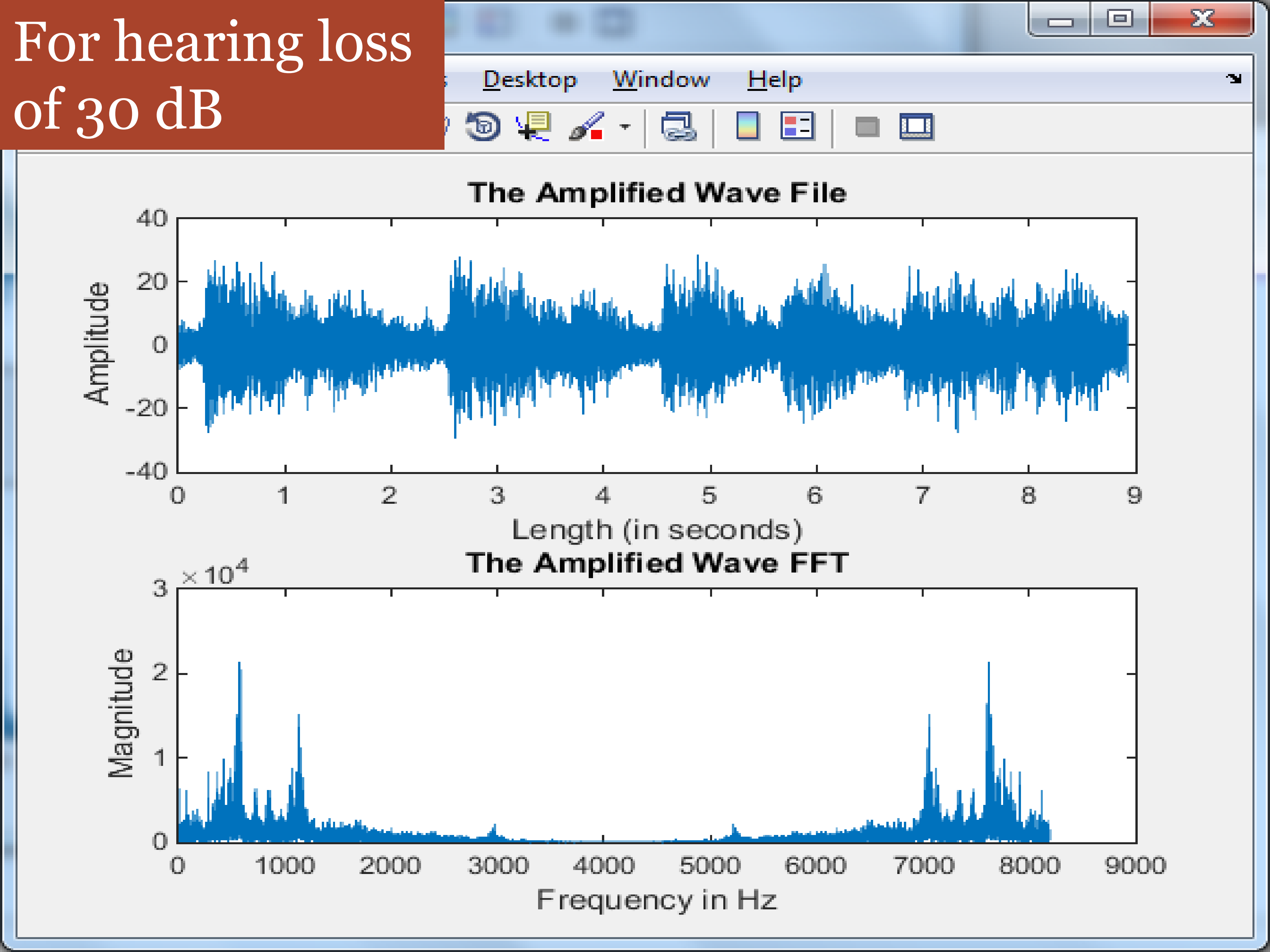
Recovery using wavelet transform



For normal hearing



For hearing loss of 30 dB



Desktop
Window
Help
The Amplified Wave File
Amplitude
40
20
0
-20
-40
0
1
2
3
4
5
6
7
8
9
Length (in seconds)
The Amplified Wave FFT
× 10^4
Magnitude
3
2
1
0
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Frequency in Hz