

MATLAB Functionality for Digital Speech Processing

- MATLAB Speech Processing Code
- MATLAB GUI Implementations

Basic Functionality

- read a speech file (i.e., open a .wav speech file and read the speech sample into a MATLAB array)
- write a speech file (i.e., write a MATLAB array of speech samples into a .wav speech file)
- play a MATLAB array of speech samples as an audio file
- play a sequence of MATLAB arrays of speech samples as a sequence of audio files
- record a speech file into a MATLAB array
- plot a speech file (MATLAB array) as a waveform using a strips plot format
- plot a speech file (MATLAB array) as one or more 4-line plot(s)
- convert the sampling rate associated with a speech file (MATLAB array) to a different sampling rate
- highpass filter a speech file (MATLAB array) to eliminate hum and low frequency noise
- plot a frame of speech and its associated spectral log magnitude
- plot a spectrogram of a speech file (MATLAB array)
- plot multiple spectrograms of one or more speech files (MATLAB arrays)

Read a Speech File into a MATLAB Array

- `[xin, fs, nbits] = wavread(filename);`
- `[xin, fs] = loadwav(filename);`
 - filename is ascii text for a .wav-encoded file which contains a speech signal encoded using a 16-bit integer format
 - xin is the MATLAB array in which the speech samples are stored (in double precision format)
 - fs is the sampling rate of the input speech signal
 - nbits is the number of bits in which each speech sample is encoded (16 in most cases)
 - program wavread scales the speech array, xin, to range $-1 \leq xin \leq 1$, whereas loadwav preserves sample values of the speech file and hence array xin is scaled to range $-32768 \leq xin \leq 32767$
- `[xin1, fs, nbits] = wavread('s5.wav');`
- `[xin2, fs] = loadwav('s5.wav');`

Read a Speech File into a MATLAB Array

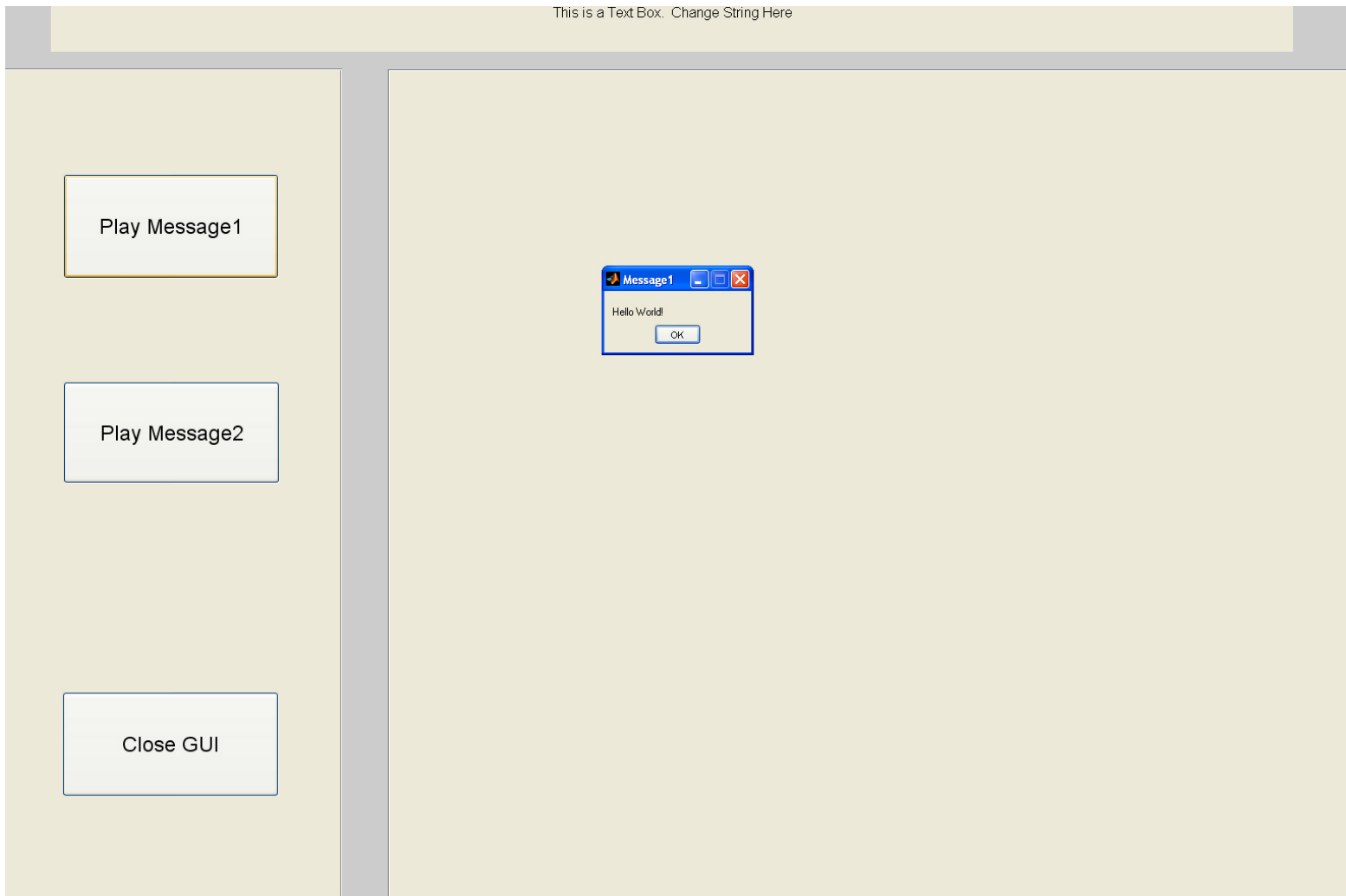
- % test_wavread.m
- % test waveread function
- %
- % read speech samples from file 'test_16k.wav' into array x1 using wavread
- % routine
- filein='test_16k.wav';
- [x1,fs1,nbits]=wavread(filein);
-
- % print out values of fs1, nbits, wavmin1, wavmax1
- wavmin1=min(x1);
- wavmax1=max(x1);
- fprintf('file: %s, wavmin/wavmax: %6.2f %6.2f, fs1: %d, nbits: %d \n',...
- filein,wavmin1,wavmax1,fs1,nbits);
-
- % read speech samples from same file into array x2 using loadwav routine
- [x2,fs2]=loadwav(filein);
-
- % print out values of fs2, nbits, wavmin2, wavmax2
- wavmin2=min(x2);
- wavmax2=max(x2);
- fprintf('file: %s, wavmin/wavmax: %d %d, fs2: %d \n',...
- filein,wavmin2,wavmax2,fs2);

Terminal Display:

file: test_16k.wav, wavmin/wavmax: -1.00 1.00, fs1: 16000, nbits: 16

file: test_16k.wav, wavmin/wavmax: -32768 32767, fs2: 16000

HelloWorld GUI25



GUI25 Initial Screen

GUI Lite v2.5

Select Workplace Directory

Current Workplace Directory: C:\data\matlab_gui_current\hello_goodbye_world_gui25

New

Create New GUI

Run 1

Run with runGUI.m File

Run 2

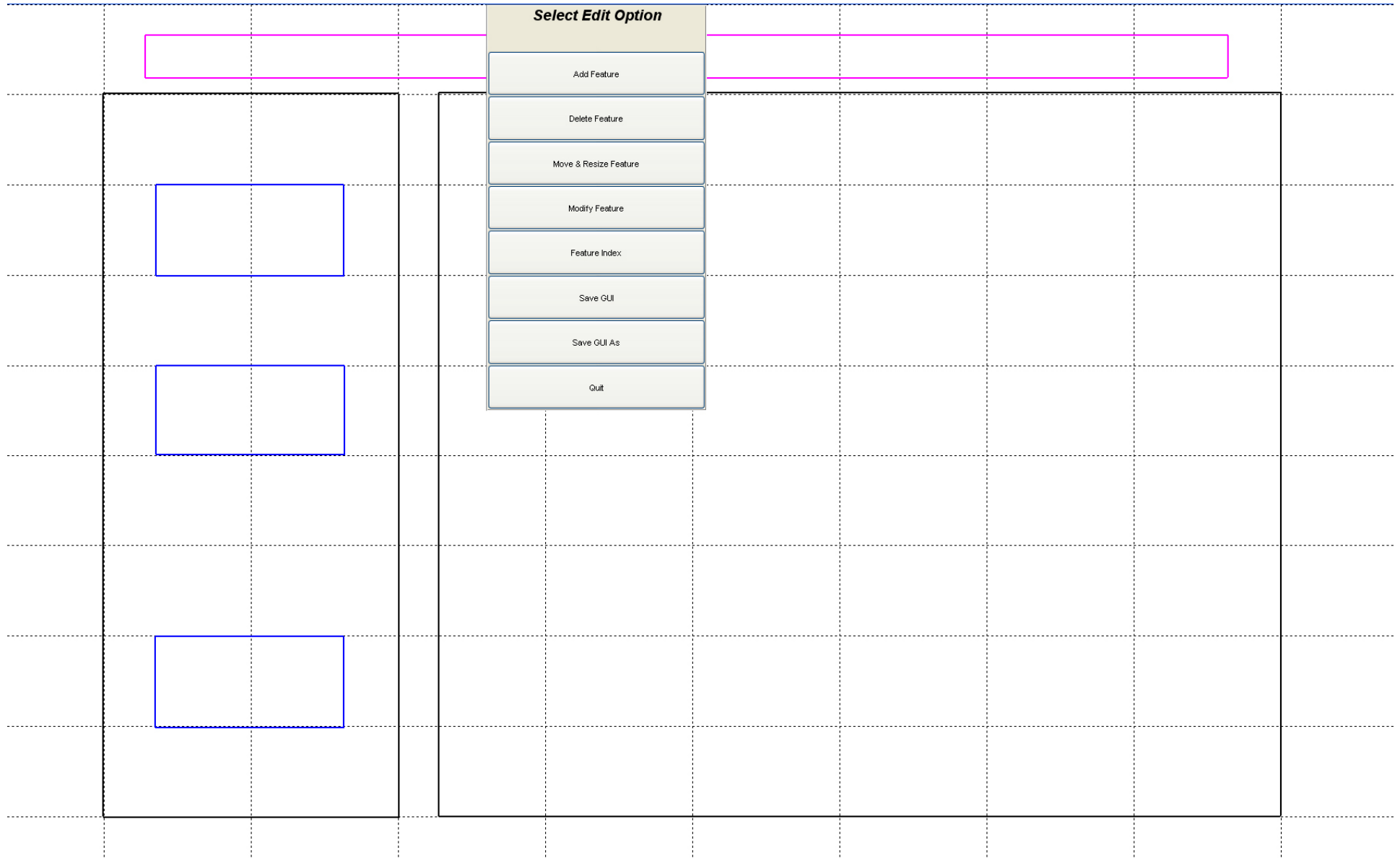
Run w/ .mat & callBack.m Files

Mod

Modify Existing GUI

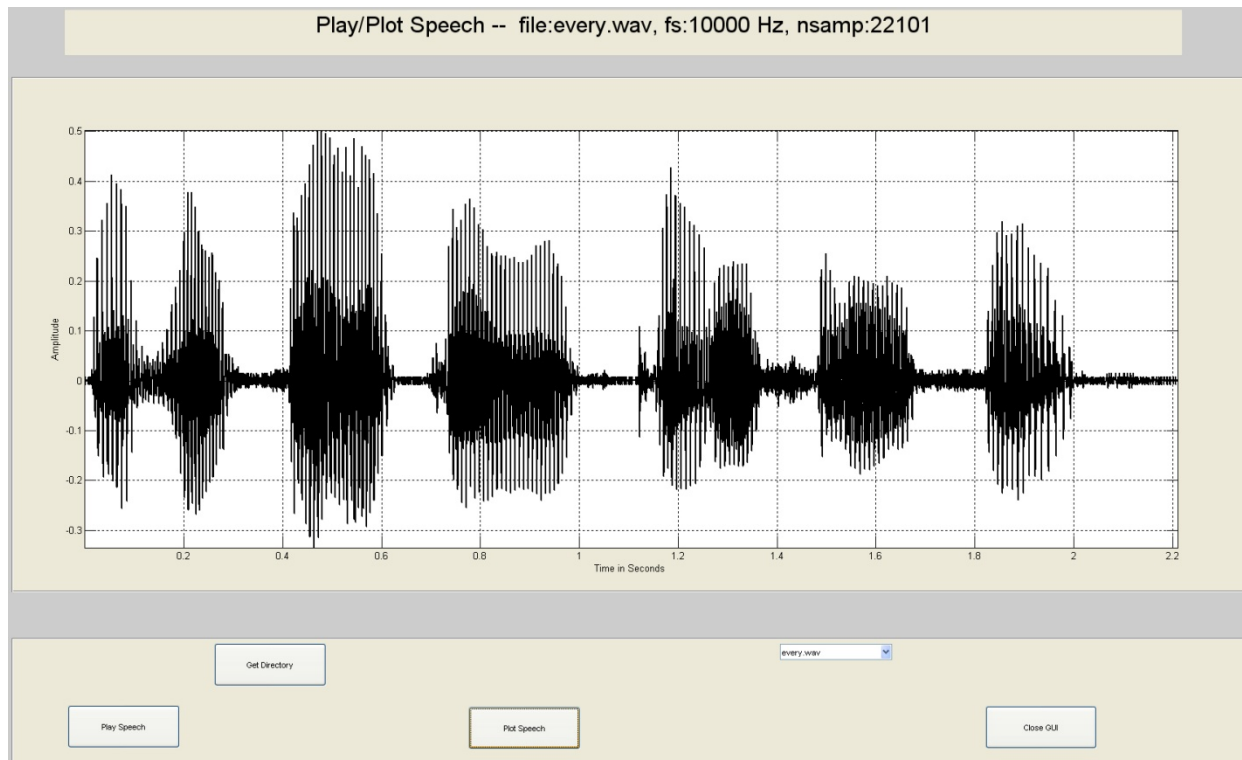
close

GUI25 Edit Screen



Play/Plot Existing Speech File

- Play_Plot_Speech_GUI25.m
 - MATLAB GUI for basic operations of reading in a file, playing the speech array, and plotting the speech waveform



Write a Speech Array into a Speech File

- `wavwrite(xout, fs, nbits, filename);`
- `savewav(xout, filename, fs);`
 - `xout` is the MATLAB array in which the speech samples are stored
 - `fs` is the sampling rate of the output speech signal
 - `nbits` is the number of bits in which each speech sample is encoded
 - `filename` is the ascii text for the .wav-encoded file in which the MATLAB signal array is to be stored
 - for `wavwrite` the MATLAB array `xout` needs to be scaled to the range $-1 \leq x_{in} \leq 1$ whereas for `savewav` the MATLAB array `xout` needs to be scaled to the range $-32768 \leq x_{out} \leq 32767$
- `wavwrite(xin1, fs, 's5out.1.wav');`
- `savewav(xin2, 's5out.2.wav', fs);`

Write a Speech Array into a Speech File

- % write out array x1 into speech file using wavwrite routine
- `wavwrite(x1,fs1,nbits,'file1out.wav');`
- % write out array x2 into speech file using savewav routine
- `savewav(x2,'file2out.wav',fs2);`



file1out.wav



file2out.wav

Play a Speech File

- `sound(x, fs);`
- `soundsc(x, fs);`
 - for `sound` the speech array, `x`, must be scaled to the range $-1 \leq x \leq 1$
 - for `soundsc` any scaling of the speech array can be used
 - `fs` is the sampling rate of the speech signal
- `[xin, fs] = loadwav('s5.wav');` % load speech from s5.wav;
- `xinn = xin/abs(max(xin));` % normalize to range of -1 to 1 ;
- `sound(xinn, fs);` % play out normalized speech file;
- `soundsc(xin, fs);` % play out unnormalized speech file;

Play Multiple Speech Files

- `play_multiple_files.m`;
 - sequence of filenames read in via `filelist`, keyboard or file search
- Example of usage to play out 3 speech files in sequence:
 - `kbe=filename` entry via `filelist(2)`, `keyboard(1)`, or file search(0):1; % keyboard chosen
 - `N=number of files to be played in a group:3; % play out 3 files`
 - `i=1; filename: s1.wav;`
 - `i=2; filename: s2.wav;`
 - `i=3; filename: s3.wav`

Play Multiple Speech Files

- test_play_files.m
 - play the following sequence of files:

Maple_short.wav

s1.wav

beep.wav

test_16k.wav

beep.wav

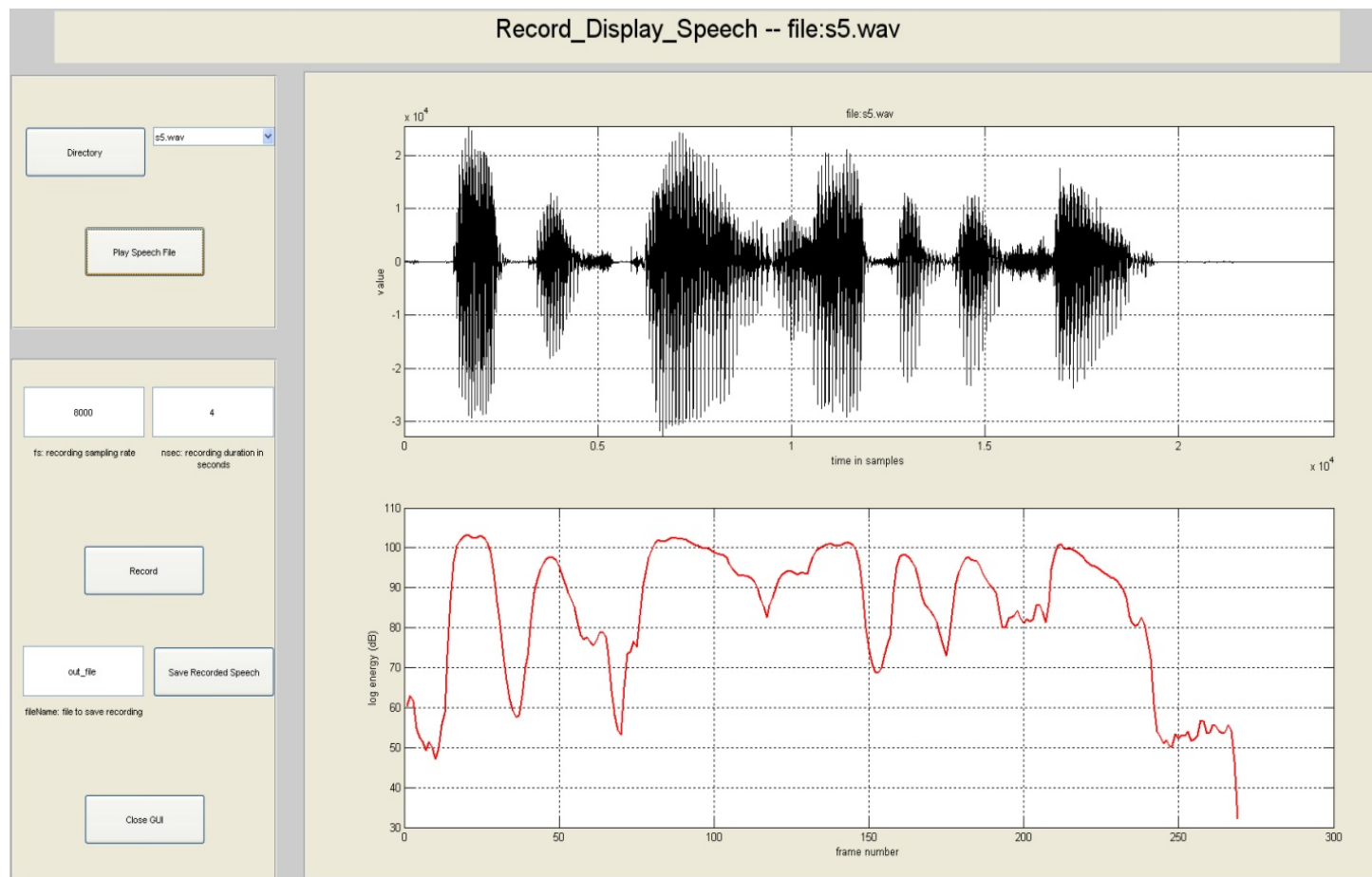
s2.wav

Record Speech into MATLAB Array

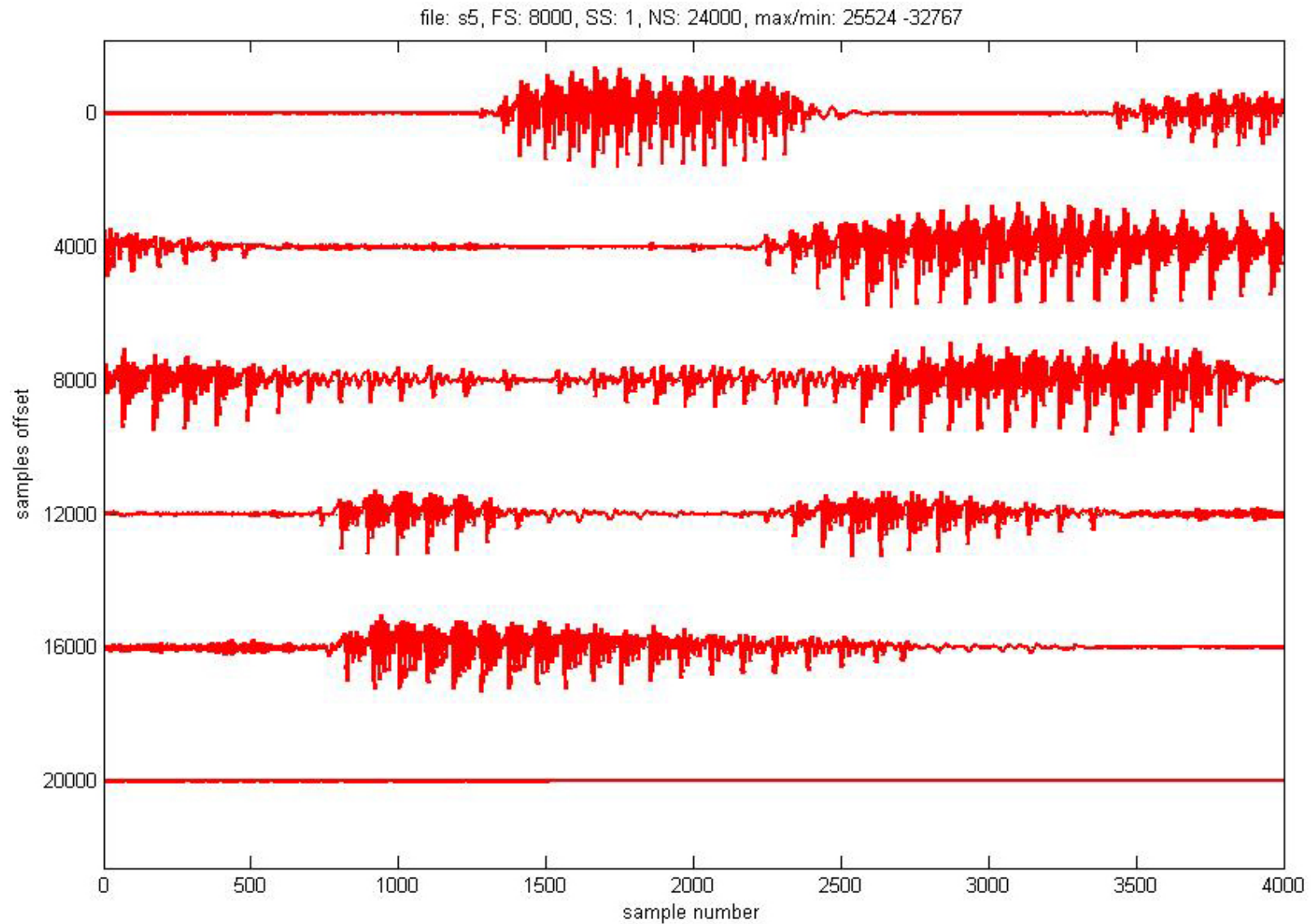
- record_speech.m (calls MATLAB function wavrecord.m)
- function y=record_speech(fs, nsec);
 - fs: sampling frequency
 - nsec: number of seconds of recording
 - y: speech samples array normalized to peak of 32767

Record Speech into MATLAB Array

- record_display_speech_GUI25.m

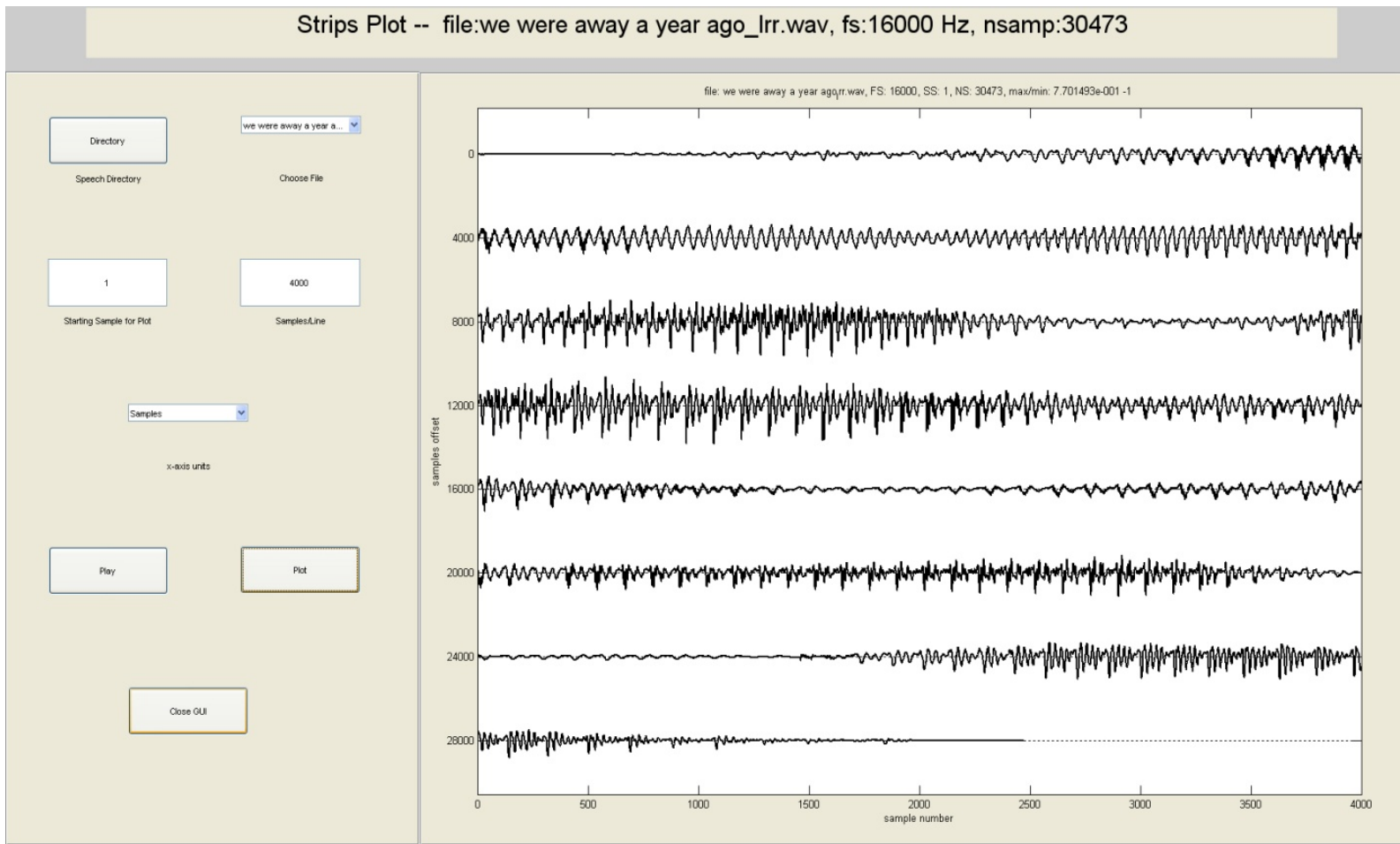


Plot Speech Using Strips Plot

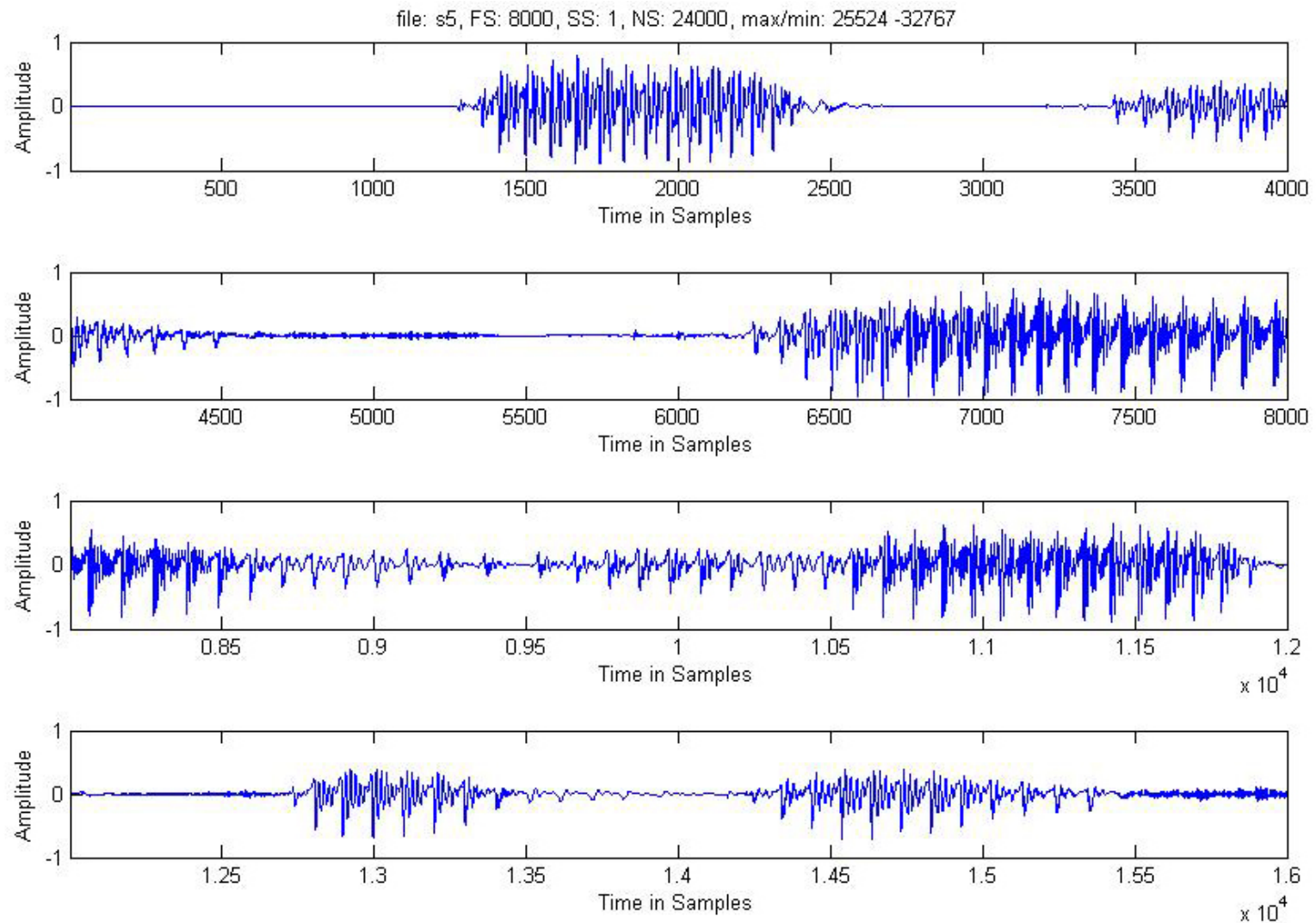


Plot Speech Using Strips Plot

- strips_plot_GUI25.m



Plot Speech Using 4-Line Plot

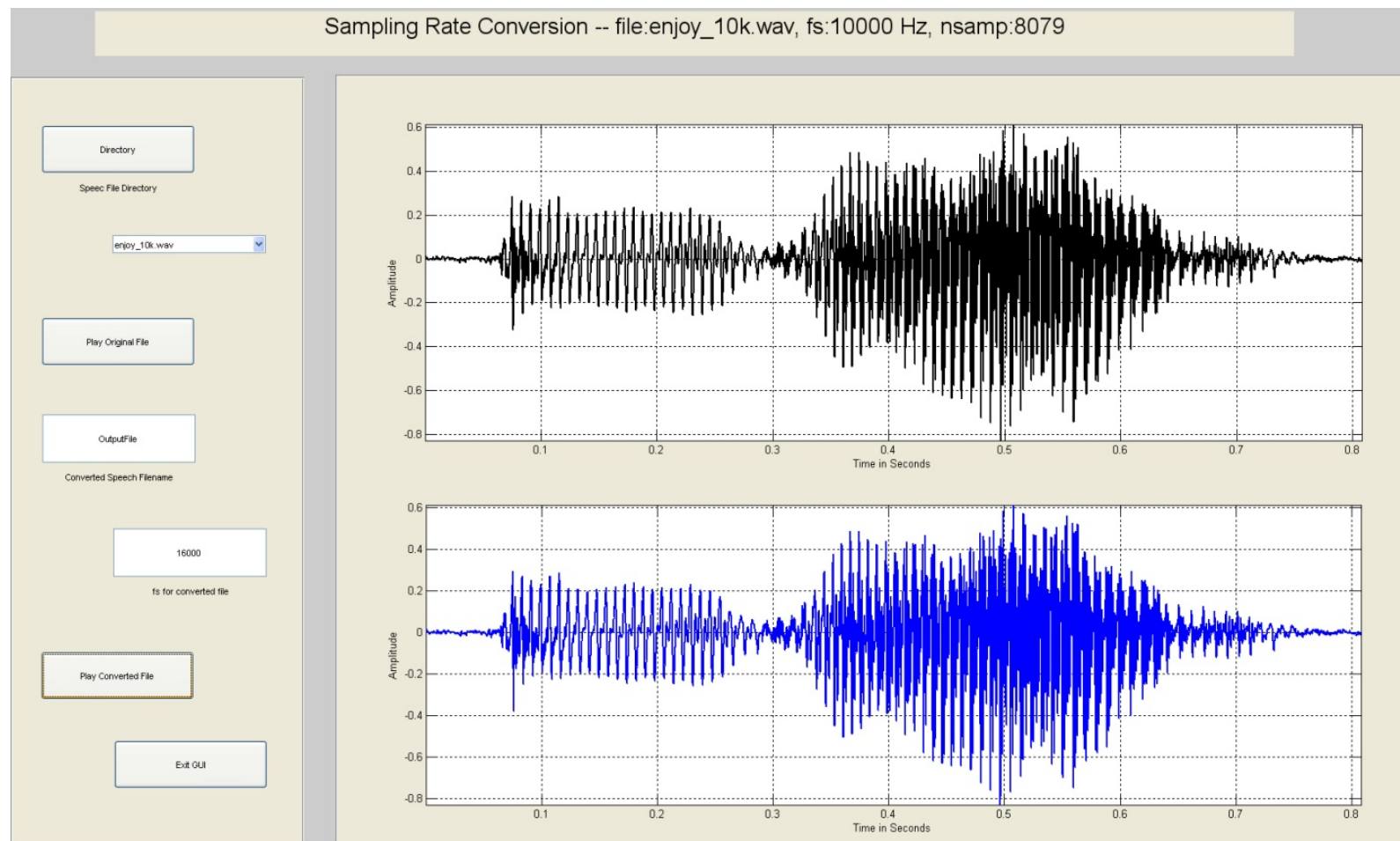


Sample Rate Conversion

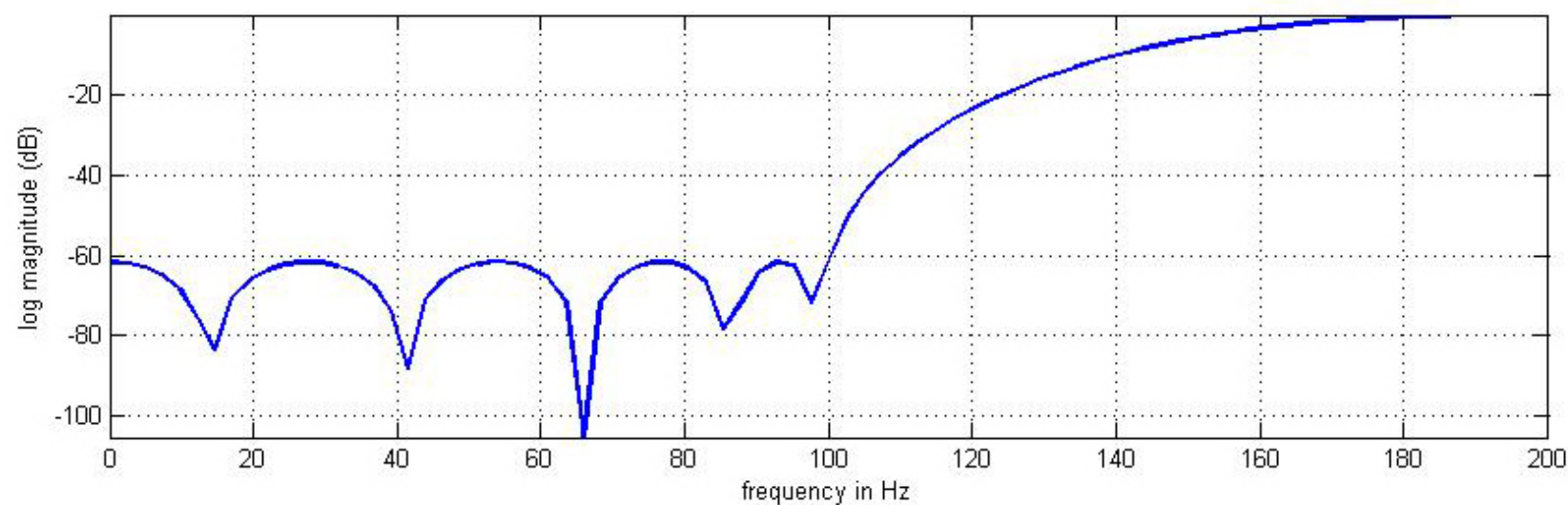
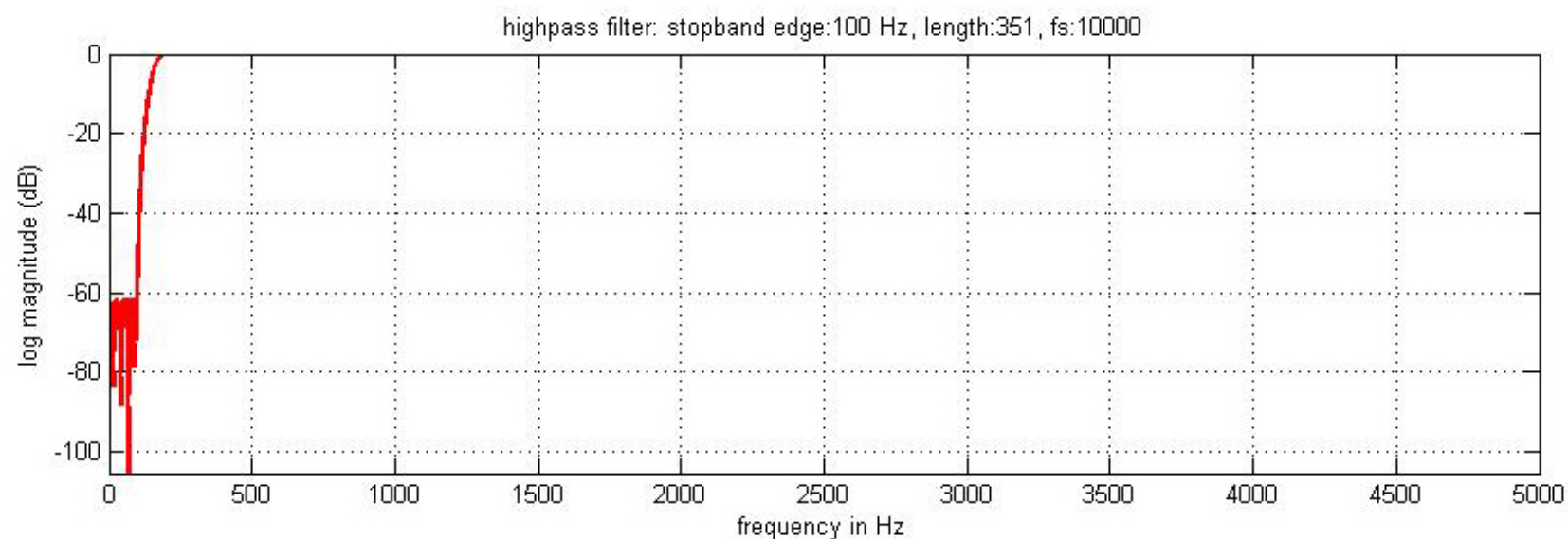
- `y = srconv(x, fsin, fsout);`
 - `x`: input speech array;
 - `fsin`: input speech sampling rate;
 - `fsout`: desired speech sampling rate;
- Example:
 - `[xin, fsin] = loadwav('s5.wav');` % `fsin=8000`;
 - `fsout = 10000;` % desired sampling rate;
 - `y = srconv(xin, fsin, fsout);`

Sample Rate Conversion

- SRC_GUI25.m

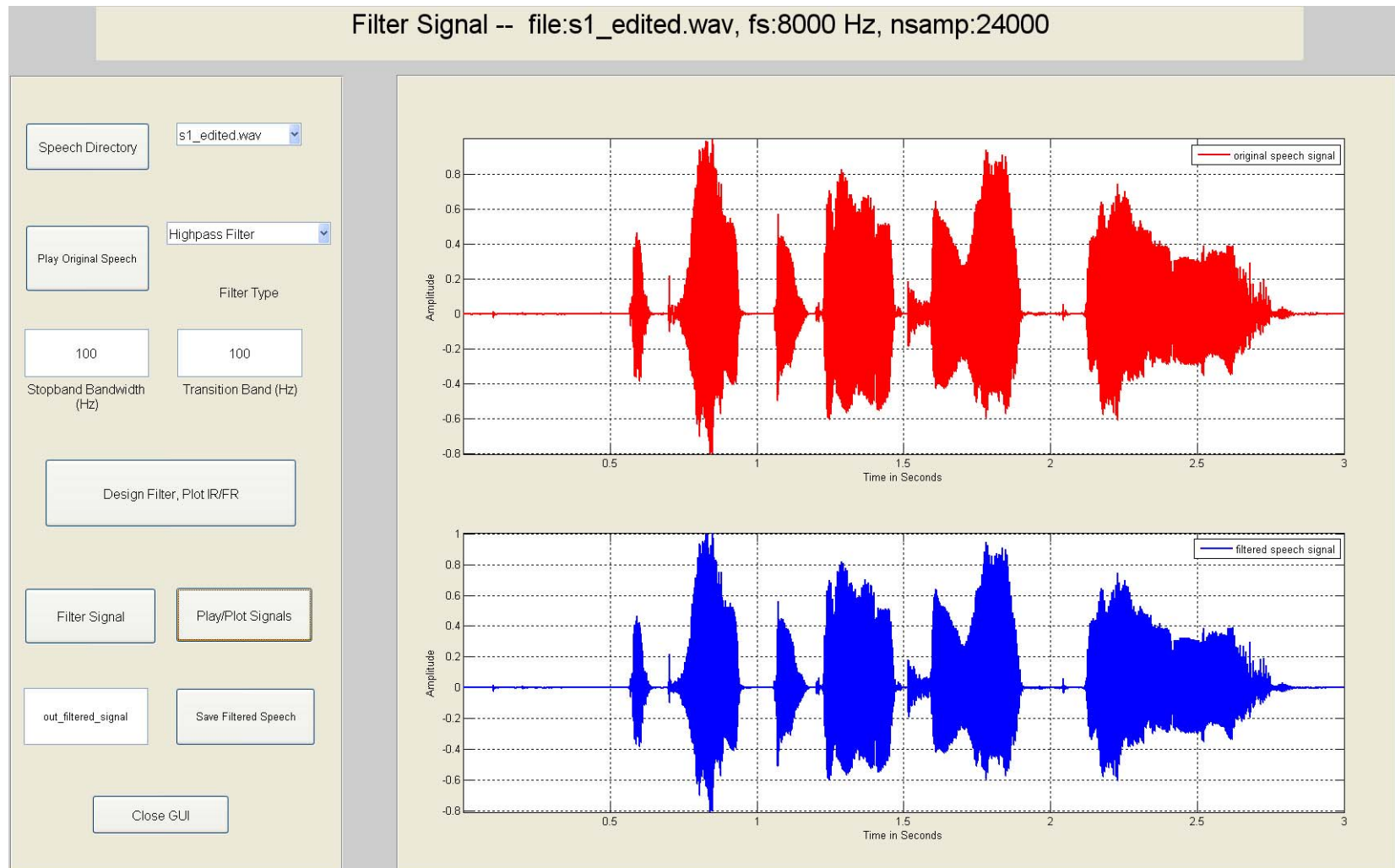


Filter Speech Waveform

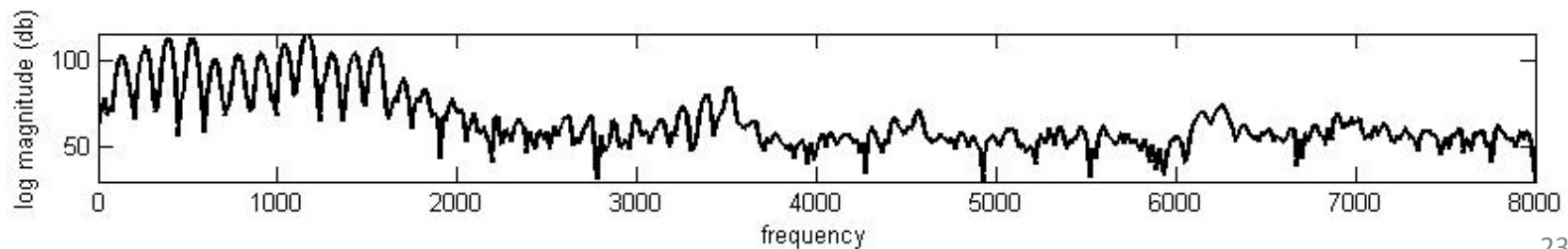
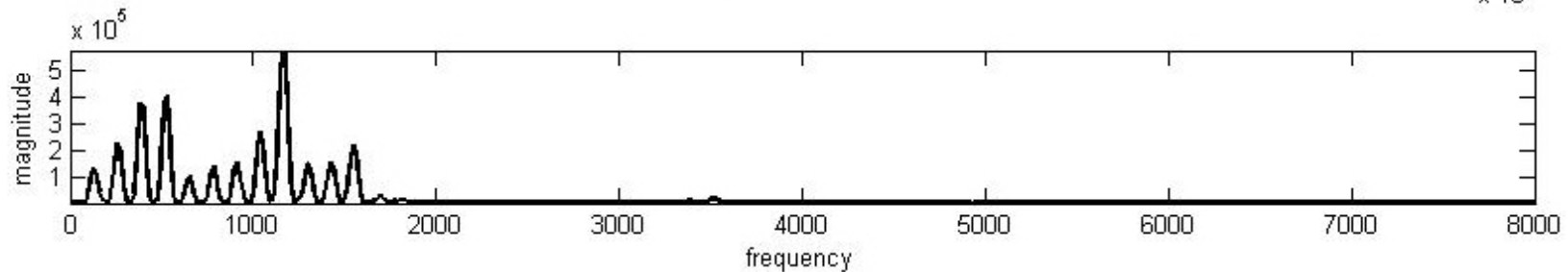
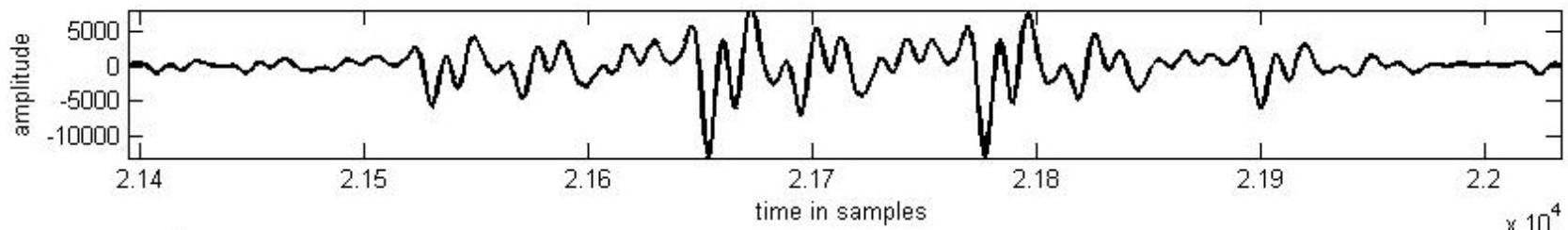
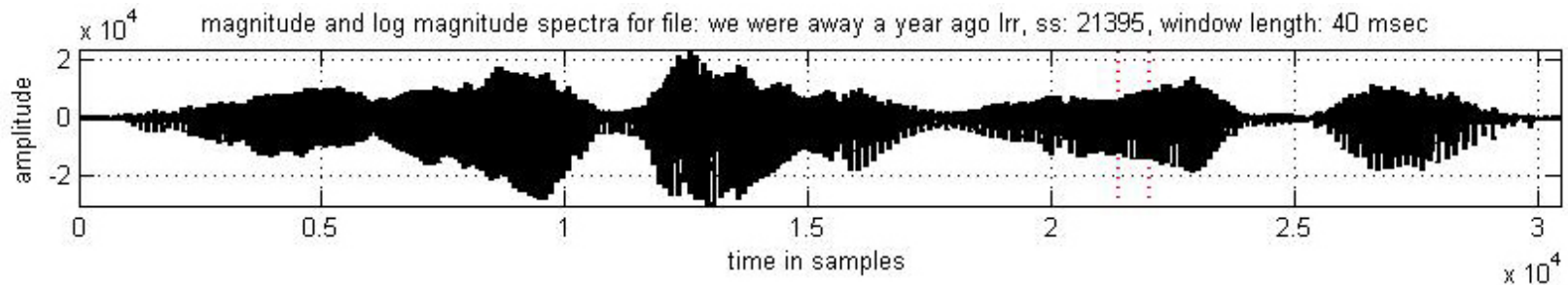


Filter Speech Waveform

- filter_GUI25.m

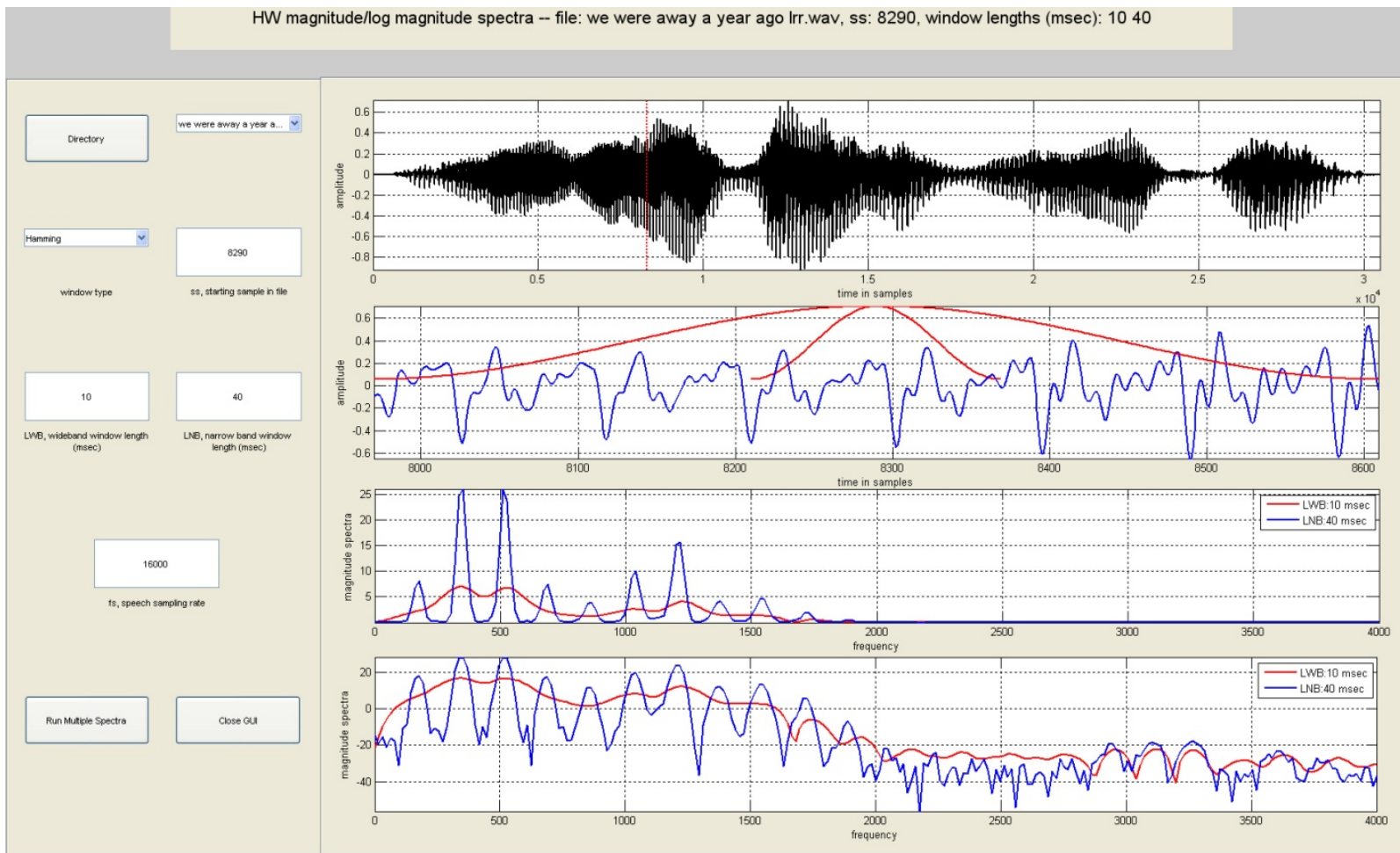


Plot Signal and STFT Log Magnitude

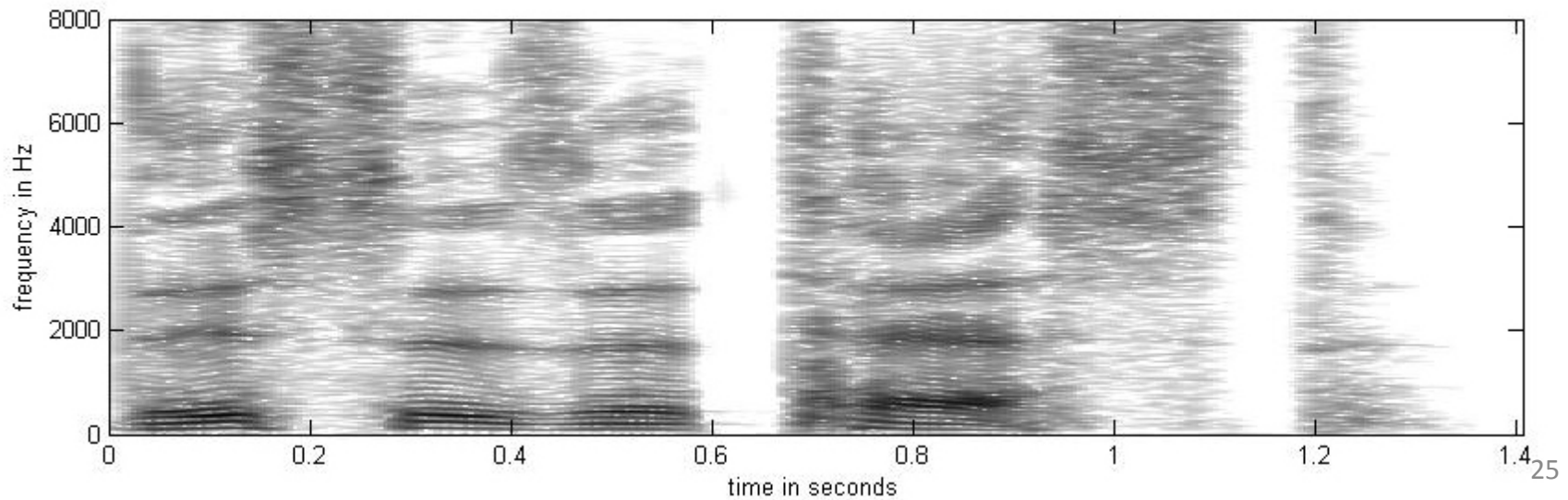
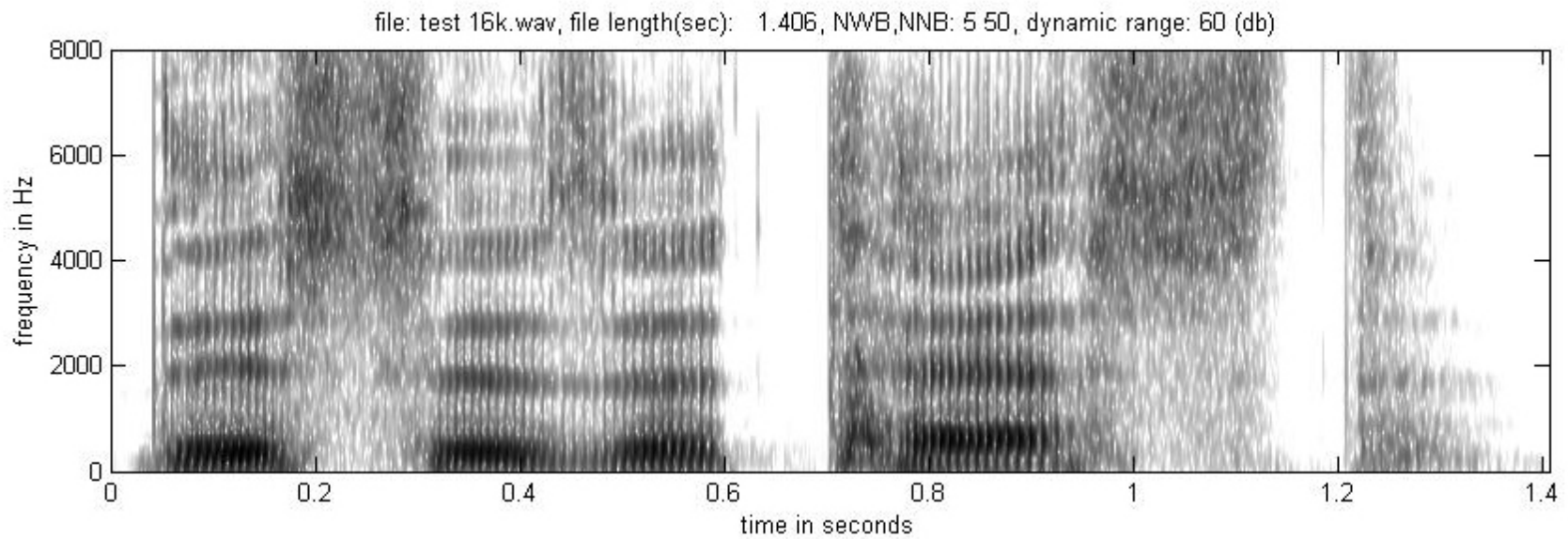


Multiple Spectra GUI

- multiple_spectra_GUI25.m

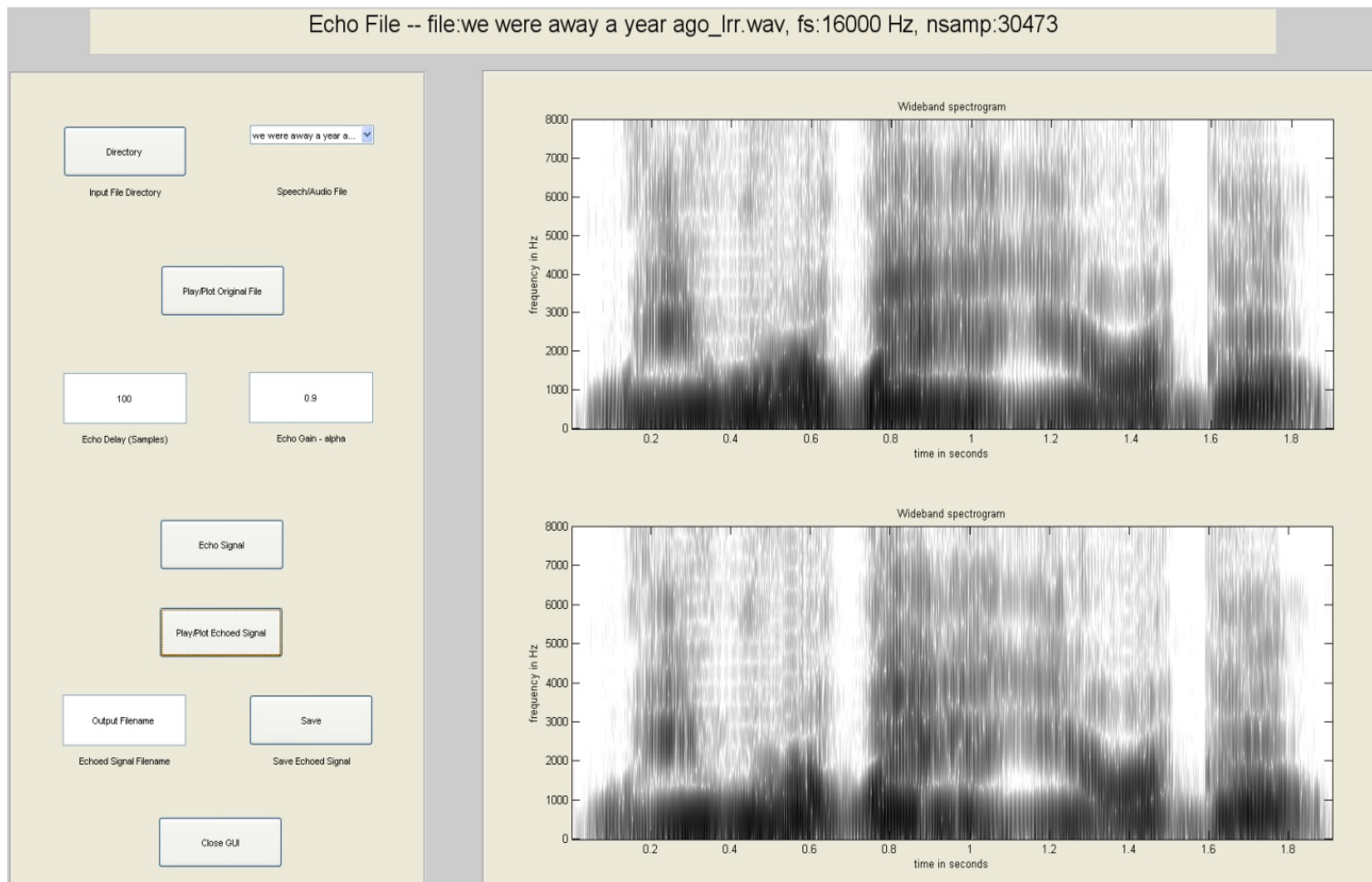


Plot Spectrogram



Plot Spectrogram

- spectrogram_GUI25.m



Plot Multiple Spectrograms

