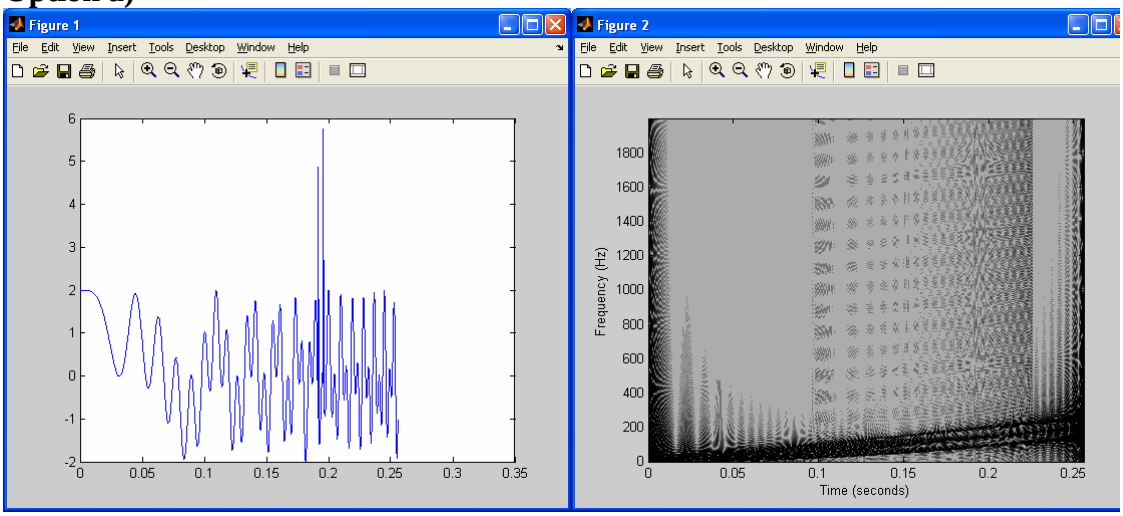
Physics 640
November 8, 2007

Project 5
Week 6 & 7: Time-Frequency Analysis
Project 5:

a) Develop a Matlab code that allows you to recognize a vowel from a recording (wav file) using the Wigner transform.
b) Write a Matlab code to demonstrate the advantage of using wavelet transform versus Fourier transform in signal recovery

Matlab code to calculate the Wigner function; and wavelet subroutines will be available

Option a)



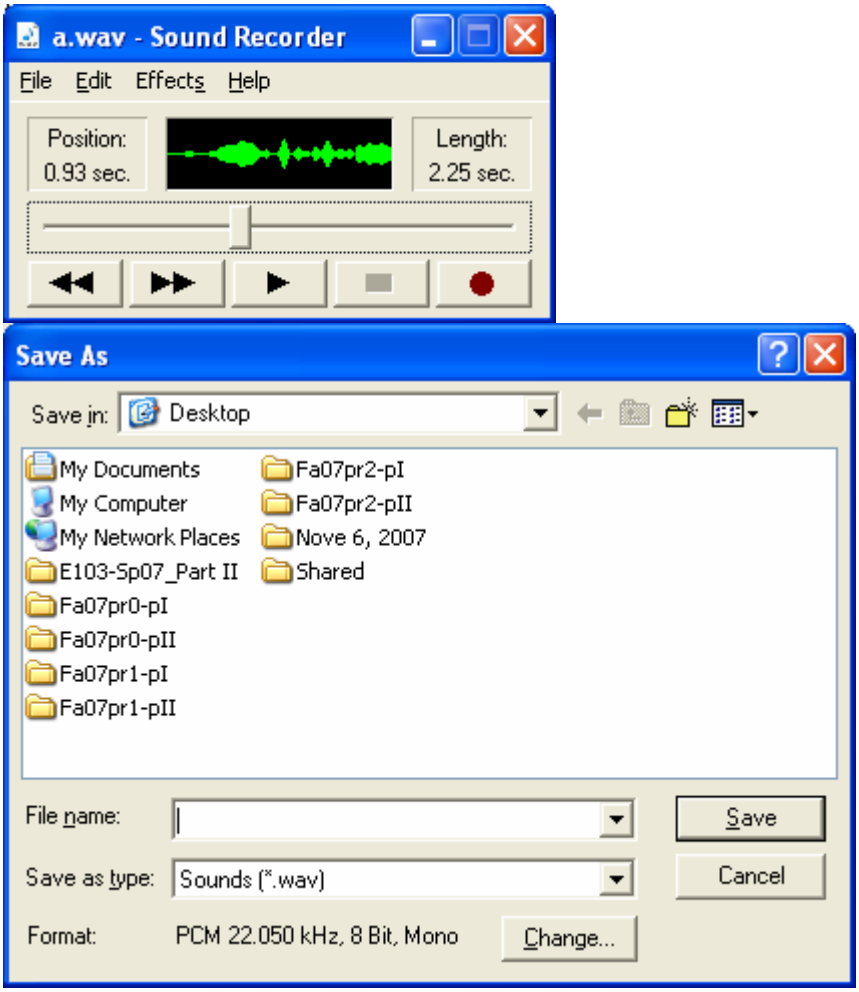
Chirp signal with two perturbations in time Wigner transform showing linear dependence of frequency w.r.t. time

Start by recording one vowel to use as a gold standard. Should be able to determine if a given wav file contains that same vowel or not by doing correlation between the two Wigner function 2D plots ("corr2")

Human voice processing is very intensive, will need to use a very short piece of your recording.

How do we get the wav file ?

-Plug the microphone into the back of the computer, then use Microsoft Sound Recorder (under Accessories/Entertainment). Use "Save As" to save it into a .WAV file.



You can do some manual editing of the sound sequence by using the sliding bar and select “Delete Before/After Current Position”

What reference files should we use?

To identify a vowel between a,e,i,o,u, record at least one file per vowel, then perform the Wigner transform on each vowel. When you are given a new file, perform the Wigner transform, then use “corr2” to find max correlation with your five references. Suppose the new file has highest correlation with a reference file containing an “e”, then you say the new file contains a recording of an “e”

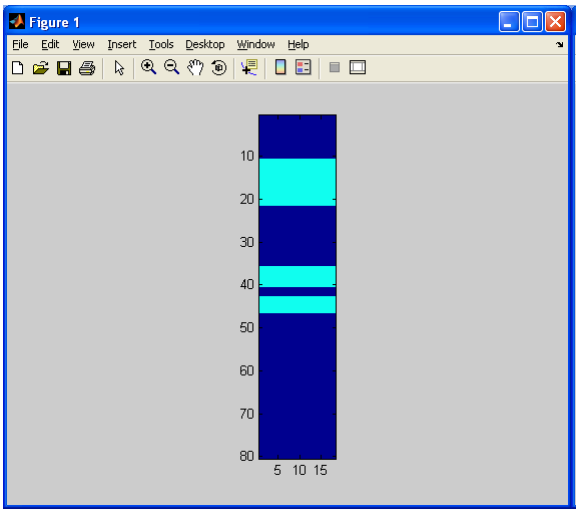
How to perform the Wigner transform?

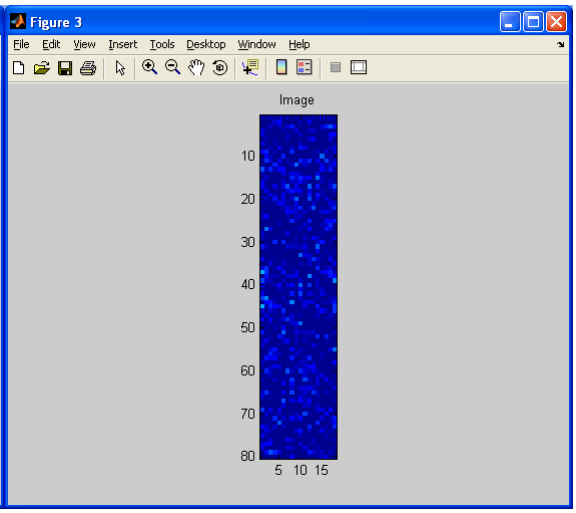
The Matlab code provided does not start with a subroutine name and defined arguments as with the “perform_wavelet_transform”

```
%Program wvd.m
```

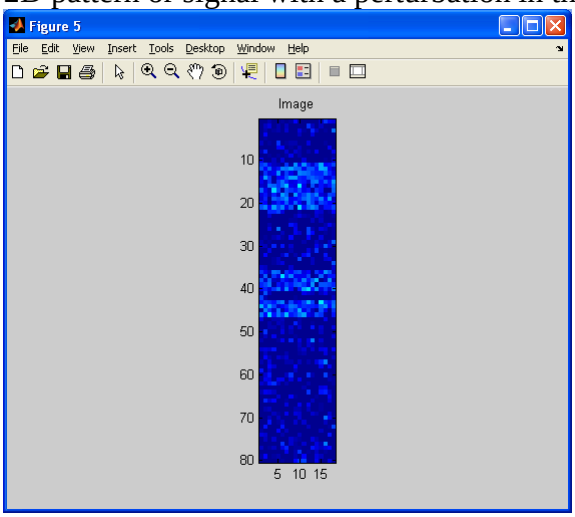
In this case you can embed your code within this same file. You will need to replace the defined signal f with the input from your WAV file.

Option b)





2D pattern or signal with a perturbation in the lower band Masked by added noise



Recovered pattern using wavelet transform

The code provided, “perform_wavelet_transform.m”, can perform direct and inverse 2D wavelet transforms. You would need to create your own 2D signal, add noise and do the analysis to recover the signal . Write your own Matlab code, when wavelet transform is needed, call in this subroutine.

```
y = perform_wavelet_transform(x, Jmin, dir, options);
%
%   'x' is either a 1D or a 2D array.
%   'Jmin' is the minimum scale (i.e. the coarse channel is of size
2^Jmin
%       in 1D).
%   'dir' is +1 for fwd transform and -1 for bwd.
%   'options.wavelet_vm' is the number of Vanishing moment (both for
primal and dual).
%   'options.wavelet_type' can be
%       'daubechies', 'symmlet', 'battle', 'biorthogonal'.
```

How to call a subroutine in Matlab?

-Use m.file name containing the subroutine (without the .m), plus the required arguments (within parentheses). For the perform_wavelet_transform:
a) signal x
b) use Jmin = 5.5
c) “dir” indicates whether you want to do direct (+1), or inverse (-1) wavelet transform

For example: perform_wavelet_transform(x, 5.5, +1) will do the direct wavelet transform on the signal x
Currently this subroutine works with 2D signal x

Nov. 2007

S	M	T	W	Th	F	Sat.
4	5	6 Pr. 5 assign	7	8	9	10
11	12	13 Pr 5 due Term Pr.	14	15	16	17
18	19	20 Term Pr. Prelim report	21	22	23	24
25	26	27	28	29	30	

Dec. 2007

S	M	T	W	Th	F	Sat.
						1
2	3	4	5	6	7	8
9	10	11 Term Pr. due: Pres	12	13 Last class Pres.	14	15
16	17	18	19	20	21	22