

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN
Department of Electrical and Computer Engineering,
Department of Speech and Hearing Sciences, and
Department of Linguistics

ECE 598 THE SPEECH CHAIN

Laboratory Exercises 4
Fall 2006

Labs for the week of: Monday, October 16, 2006

Write-up due in lab during the week of: Monday, October 23, 2006

Problem 4.1

Create a wideband spectrogram of yourself or your lab partner saying something (recite a poem or a slogan or any favorite saying. Make sure that it has examples of fricatives, stops, nasals, vowels, and glides).

“Wideband” means that the spectrogram window is shorter than one pitch period, e.g., 3-6ms in length, with an inter-window spacing of about 2ms. This is equivalent to saying that each of the frequency bins (each row on the spectrogram) is a bandpass filter with a relatively wide bandwidth — $B = f_2 - f_1$ is between about $(1/0.003) = 333\text{Hz}$ and $(1/0.006) = 167\text{Hz}$.

Put the mouse over the window, and hit the “print screen” button in order to put a copy of the image into the Windows clipboard. Open Powerpoint or other document editor, and select “paste;” you should get a copy of your spectrogram image.

In each of the following sections, add arrows and text to your powerpoint file, highlighting the desired features of the spectrogram. When you are done, mail your powerpoint to the TA, or copy it to your netfiles and print a copy for her, or give her a copy in some other way.

- (a) Find a vowel.
- (b) Find a stop.
- (c) Find a fricative.
- (d) Find a nasal.
- (e) Find a glide.
- (f) Choose a region in which the pitch pulses are visible on the spectrogram. Count the pitch pulses within some reasonable period of time, and estimate your pitch period.
- (g) Find a vowel with clear first and second formant bands. Estimate your first and second formant frequency. What vowel is it? Do these formant frequencies make sense for this vowel?

Problem 4.2

Create a narrowband spectrogram of the same waveform. “Narrowband” means that the window used to create the spectrogram is longer than two pitch periods. A 25ms window is usually plenty. This is equivalent to saying that each row of the spectrogram looks like the output of a bandpass filter with a narrow bandwidth — $B = f_2 - f_1$ is approximately $(1/0.025) = 40\text{Hz}$.

Make a copy of this spectrogram to your powerpoint file, and answer the following question.

How can you calculate the pitch frequency from this spectrogram?