HW#1

EEL 6586 – Spring 2002

Due Friday, January 25, 2002 in class. Late homework will lose $e^{\#\ of\ days\ late} - 1$ percentage points. To see the current late penalty, click on http://www.cnel.ufl.edu/hybrid/harris/latepoints.html

In this assignment you will record a phoneme and try to match it using formant synthesis. You must both hand in your homework AND email your two audio files as attachments to to the TA (Mark Skowronski, markskow@cnel.ufl.edu) by the due date/time[1] Make sure that you properly answer all of the questions and describe your solution technique for each problem. You may talk to other students, in fact you are strongly encouraged to do so. However, the final work and matlab code you turn in MUST be your own. Some parts of this assignment are open-ended where there are many possible solution methods.

You writeup should contain an appendix that includes all of the matlab code that you wrote for this assignment. You do not need to include any of the code in Parts A, B, or C but you should describe your solution technique in these parts.

PART A: Recording a Voiced Phoneme

A1 Record yourself on a computer saying the phoneme /iy/ for about 0.5 seconds. Remember the /iy/ is the vowel sound in "me". Make sure to hold the microphone to the side of your mouth to reduce noise from the airflow. Email in the sound file as described above. The prefered format is an 8KHz .wav file. If you have no capability to record sound on a PC and have no friends who can help, talk to the TA. The recording must be your voice.

A2 Hand in a portion of the time domain plots for the phoneme showing a few pitch periods. The axes of this plot (and all plots) should be clearly labelled. Clearly indicate the pitch period and note its numerical value.

A3 Plot the magnitude spectrum of the phoneme. Clearly indicate the values of F_1, F_2 and F_3 on the graphs.

A4 Estimate the bandwidth and amplitude of each formant using whichever definition you like. However, be sure to explain your calculation.

A5 Plot the spectrogram of the vowel. Show results from using both short and long windowing functions. Explain what features you can see each version of the spectrogram that you cannot see in the other.

[1]Call your files with your first initial and lastname with a -a for recorded and -b for synthetic. So for example, my files would be called jharris-a.wav and jharris-b.wav Use a subject line of "EEL6586 HW#1 *your full name*", so for example my subject line would be "EEL6586 HW#1 John Harris"

PART B: Formant Synthesis of a Voiced Vowel

B1 Write a matlab program that can filter a signal using the sum of the output of three bandpass filters. Each bandpass filter will be specified by a center frequency, a bandwidth and an amplitude. Draw a block diagram of your computation. This is an open-ended question, use your best judgment in the filter design but explain your reasoning. Hint: if your formants are too narrow then your phoneme will sound like a musical tone.

B2 Use the code in [B1] to filter a train of impulses of appropriate pitch to mimic the recorded phoneme from part A. Use the pitch period you derived in part [A2]. In one sentence, describe how the synthetic sound sounds.

B3 Filter an impulse train of more realistically shaped pulses–assume a duty cycle of about 50%. Feel free to tweak other parameters and add anything to the algorithm in order to improve the quality of the sound. Hand in a 1/2 second sound file (8KHz .wav file) of your best synthetic sound. Make sure you describe exactly what you have done to create this sound. Bonus points will be given to the highest quality, most realistic synthetic sound(s) in the class.

B4 Plot time and frequency domain representations of the vowel (don't use spectrograms). Compare your synthetic sound results to the recorded sound. In what ways do they differ, if any?

B5 Listen to the real and synthetic sounds. In what ways do they sound different?