Homework 1 (ECE6255 Spring 2010) Grade = 3/100

These following exercises are designed to familiarize you with the speech tools and observe the properties of speech sounds (due on 1/27).

1. Use wavesurfer to display the eight waveform files in the speech_data/wave folder. Identify the gender of the speakers.

2. Take 1.wav in speech_data/wave and produce a figure like the example you have downloaded from the class webpage, using some available options in wavesurfer. Do the same for 5.wav. You can use the corresponding word transcription and phone transcription files to display the content. This is a very useful feature for your projects and homework exercises in this course.

3. Use wavesurfer to cut one word from each of the eight utterances and concatenate them into a new utterance. Do the same as in problem 2. Observe the power, pitch and formant parameters in this "mixed" utterance and describe what you have observed of the "mixed" characteristics. You want to pay more attention to the speaker transition parts of the utterance and see the differences.

4. Pick a phone symbol from each of the five sound categories, i.e. vowel, semi-vowel, nasal, fricative and stop, and find three different contexts for each of the five phone symbols. The best way to do this is to select all three contexts from the same utterance (by the same speaker), but in some cases they can come from different sentences. Start with the vowel, cut the three corresponding phones together with their preceding and following phone segments in these utterances, and produce three spectrogram plots one for each context. Then describe the similarity and difference of the formant and spectral properties. Repeat the for the other four phones.

5. Work out Problem 2.9 in Quatieri.

6. Write a MATLAB program to read in a speech file and filter it to bandwidths of 5.5 kHz and 3.2 kHz. Listen to each of the resulting files and describe the effect of lowpass filtering on speech intelligibility and quality. (Use the speech 1.wav and 5.wav to test your program).

7. The frequency response of an ideal bandpass filter is

$$H(e^{j\omega}) = 1 \text{ for } \omega_1 \le |\omega| \le \omega_2 \text{ and } 0 \text{ otherwise}.$$

a) Find the impulse response of an ideal bandpass filter;

b) Sketch the impulse response for $\omega_1 = \pi/4$ and $\omega_2 = 3\pi/4$.

8. Find the *z*- and Fourier transform of the following two sequences and sketch the magnitude of the Fourier transform in each case.

a) Rectangular window

$$w_1(n) = 1 \text{ for } 0 \le n \le N-1$$
$$= 0 \text{ otherwise};$$

b) Hamming window

$$w_2(n) = 0.54 - 0.46\cos[2\pi n/(N-1)] \text{ for } 0 \le n \le N-1$$
$$= 0 \text{ otherwise}.$$