ELEN E6820 Speech & Audio Processing & Recognition   **Assignment 5**

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Assigned: Thursday 2009-02-19   Due: Thursday 2009-02-26

Background reading: In Gold & Morgan, read chapters 19, 20, and 21 (filterbanks, cepstrum, and LPC), and chapter 29 (speech synthesis).

Reading assignment: "Unit selection in a concatenative speech synthesis system using a large speech database," Hunt and Black, ICASSP 1996.

http://www.ee.columbia.edu/~dpwe/e6820/papers/HuntB96-speechsynth.pdf

Our coverage of speech synthesis is very superficial, but this paper will give you a glimpse of the basis of the currently most successful approach. Again, post your comments to Courseworks.

Practical assignment: In this weeks practical you will generate your own sinewave replicas of natural speech by using LPC analysis to track formants. The provided function `lpcfit.m` will perform short-time LPC analysis of a given signal (see the usage example in this weeks Matlab diary); each row of the resulting `a` matrix describes a frame (128 samples by default) in the form `[1 a1 a2 ... ap]` defining the denominator of the all-pole filter; the corresponding value from vector `g` gives the gain for that frame. The following code converts frame `i` into a set of approximate frequencies and magnitudes (assuming `sr` is set to the sampling rate):

```
[a,g,e] = lpcfit(d,ord);
poles = roots(a(i,:));
freqs = angle(poles)*sr/2/pi;
mags = g(i) ./ (1 - abs(poles));
```

(a) Explain why the code fragment above gives us the desired result.

(b) Write a program to convert the matrix of LPC rows returned by `lpcfit.m` into two matrices, one containing the frequencies of the lowest 3 poles (sorted in frequency, ignoring poles with zero or negative frequency – see `help sort`, `help gt`, and `help find`), and the second containing the corresponding magnitudes.

(c) Resynthesize 'sinewave replicas' (see the Haskins Sinewave Speech page for an explanation) based on these matrices with the provided `synthtrax.m`, i.e.

```
sws = synthtrax(frqmatrix, magmatrix, sr, 128);
soundsc(sws);
```

Compare the spectrograms of original and resynthesis to check that it is working.

Project: It is three weeks to the project proposal presentations on March 10th and 12th; start planning what to say!