EE679: Computing Assignment 3 Due date: Oct 15, 2017

LP synthesis; Cepstral analysis

Make a single document presenting each question followed by the corresponding solution (method, code fragment, plots, discussion).

1. This is a direct continuation of Comp Assn 2. We analysed the natural speech sounds /a/, /n/, /I/, /s/. Using a suitable set of parameter estimates for each sound as obtained there, we wish to reconstruct each of the sounds. That is, use the best estimated LP filter with an ideal impulse train of the estimated pitch period as source excitation (for the voiced sounds). Carry out de-emphasis on the output waveform. For the unvoiced sound, use a white noise signal as source excitation. Set the duration of the synthesized sound to be 300 ms at 8 kHz sampling frequency (use 16 kHz for the /s/), and view/listen to your created sound. Comment on the similarity with the original sound. What would be a good application for this analysis&synthesis system?

2. Next, consider the synthetic signal (for /a/) reconstructed from LP coefficients (p=10) and pulse train in part 1. Compute the real cepstrum and obtain the spectral envelope (dB) via cepstral liftering. Compare this estimated spectral envelope with the true LP magnitude spectrum. Observe and comment on the changes in cepstral estimate with different duration lifters.

3. Finally, we wish to carry out the cepstral analyses of the same natural speech sounds. Obtain the real cepstrum from a 30 ms segment for each of the phones (of the natural speech as in part 1). Use cepstral filtering to obtain the spectral envelope (dB) in each case. Compare it with the corresponding LP (p=10) magnitude spectrum obtained previously by superposing both on the actual magnitude spectrum of the windowed signal. Estimate the pitch of the segment from the real cepstrum. (Obtain the vocal tract magnitude response of /s/ sampled at 16 kHz using LP order = 18.)