EE 679 Speech Processing

Computing Assignment 1: Signal synthesis and DTFT based analysis Due: 23/8/2013

Note: You can use Scilab or Matlab

1. Given the following specification for a single-formant resonator, obtain the transfer function of the filter H(z). Plot its magnitude response (dB magnitude versus frequency) and impulse response.

   F1 (formant) = 1 kHz
   B1(bandwidth) = 200 Hz
   Fs (sampling freq) = 16 kHz

2. Excite the above resonator (filter) with a source given by an impulse train of F0 = 150 Hz. Compute the output of the source-filter system over the duration of 0.5 second. Plot the time domain waveform. Also play it out and comment on the sound quality.

3. Vary the parameters as indicated below and comment on the differences in waveform and sound quality for the different parameter combinations.

(a) F1 = 300 Hz, B1 = 100 Hz; F1=1200 Hz, B1 = 200 Hz

(b) F0 = 120 Hz; F0 = 180 Hz

4. In place of the simple single-resonance signal, synthesize the following more realistic vowel sounds at two distinct pitches (F0 = 120 Hz, F0 = 220 Hz). Keep the bandwidths constant at 100 Hz for all formants. Duration of sound: 0.5 sec

   Vowel F1, F2, F3
   /a/ 730, 1090, 2440
   /i/ 270, 2290, 3010
   /u/ 300, 870, 2240

5. Signal Analysis:

   Compute the DTFT magnitude (dB) spectrum of any 2 of the vowel sounds you have synthesized. Use rectangular and Hamming windows of lengths: 10 ms, 40 ms, 100 ms. (i) Comment on the similarities and differences between the different spectra. (ii) Estimate the signal parameters from each of the spectra and compare with the ground-truth.