CS3570 Introduction to Multimedia

Homework #3

Due: 11:59pm, 5/14/2015

Q1. (50%) Create your own FIR filters to filter audio signal:

With the ideal impulse responses given in Table 5.2 (slide #77) and the windowing functions in Table 5.3 (slide #80), we can design a filter according to algorithm 5.1 (slide #81) by using Hamming windowing function. In this homework, you need to design different filters and test their effects.

- "hw3_mix.wav" is a mix of 3 songs, and you need to apply appropriate filters to separate the three audio signals from this audio file.
- Apply appropriate FIR filters in time domain, and matlab built-in function "conv" is not allowed to use in this homework. You need to implement 1-D convolution by yourself.
- **Store the filtered audio files, and plot**
  (1) The spectrums of the original audio signal and the three separated audio signals
  (2) The spectrums of the filters
  (3) The shapes of the filters (time domain)
- Discuss how you determine the filters for this homework problem.
- You have to upload m-files and three filtered audio files. Show the plots and the discussions in your report.

Q2. (50%) There are noise and sharp stair-step effect in "AnJing_4bit.wav" after bit reduction from 8-bit to 4-bit. To eliminate the noise, you need to apply audio dithering, noise shaping, and use low-pass filter you finished in Q1 to filter out the high frequency components.

- **Plot the spectrum and shape** of the input wave file.
- Add random noise (uniform distribution) into the input wave, and **plot the spectrum and shape**.
- Apply the first-order feedback loop for noise shaping. You can choose the coefficient **c** yourself. **Plot the spectrum and shape** after the noise shaping.
- Determine an appropriate cutoff frequency to apply low-pass filtering. **Plot the spectrum of the filtered signal**. And **store the filtered audio file**.
- **Discuss** the effect of dithering and noise shaping according to the spectrums and shapes.