Homework #5: Equalization and Filtering
Due Date: June 6, 2009

Problem 1. [**30 Points**]

1(a). [**20 Points**] Write a Matlab script to compute the linear phase impulse response associated with a transfer function magnitude $|H(\omega)|$. Turn in your script.

1(b). [**7 Points**] Use the script to convert the impulse response in `ps05.mat` to linear phase. Plot the original and linear-phase impulse responses. Plot the transfer function dB magnitude of the original and linear-phase impulse responses. Are the transfer function magnitudes the same? Turn in the plots.

1(c). [**3 Points**] Use the Matlab function `fftfilt(h,signal)` to convolve a white noise sequence generated using `randn` with the original impulse response and with its linear-phase version. Do the convolutions sound the same?

Problem 2. [**30 Points**]

2(a). [**20 Points**] Write a Matlab script to compute the minimum phase impulse response associated with a transfer function magnitude $|H(\omega)|$. Turn in your script.

2(b). [**7 Points**] Use the script to convert the impulse response in `ps05.mat` to minimum phase. Plot the original and minimum-phase impulse responses. Plot the transfer function dB magnitude of the original and linear-phase impulse responses. Are they the same? Turn in the plots.

2(c). [**3 Points**] Convolve a white noise sequence with the original impulse response and its minimum-phase version. Do the convolutions sound the same?

Problem 3. [**40 Points**]

3(a). [**25 Points**] Write a Matlab script to perform critical-band smoothing on an input transfer function according to a smoothing bandwidth measured in critical bands, e.g., `tfs = cbsmooth(tf,beta)`. The Matlab functions `khz2erb`, and `erb2khz` can be used to convert between frequency and critical band number. Turn in your script.

3(b). [**7 Points**] Use your script to smooth the transfer function associated with the impulse response in `ps05.mat`. Plot the smoothed transfer function magnitude for smoothing bandwidths of 0.5, 1.0 and 2.0 critical bands. Turn in the plots.

3(c). [**8 Points**] At what width does white noise filtered by the smoothed impulse response sound different from the same white noise filtered by the original impulse response?