BME 402 Biomedical Signal Processing II
Homework I

Due Date: 17:00, Tuesday, 1 April 2008

1) Download the data files E11 to E2424 which is zipped in ERPaveraging-datafiles.zip file. The signals were filtered to the band 0.1-100 Hz and sampled at 1000 Hz. The number of samples in each signal is N = 511. (Signal data courtesy Dr. R. Rangayyan and Dr. M.V. Kamath)

   The signals are numbered as Ekk, where k is the trial number, with k=1,2,…,M where M=24. The signals are numbered in the time sequence of the stimulus trials.

   Develop a Matlab program (function) to **display** (with actual time information) and **average** M of the ERP signals as follows:
   a) Using the signals E11 to E44 (M=4)
   b) Using the signals E11 to E88 (M=8)
   c) Using the signals E11 to E1212 (M=12)
   d) Using the signals E11 to E2424 (M=24)

   In each case plot the signals used as well as the result of averaging. Show that when we increase the number of realizations SNR improves. Analyze the results and report findings.

2) Download the data files ecg_noisy.dat and ecg_hfn.dat. The signals were sampled at 1000 Hz. (Signal data courtesy Dr. R. Rangayyan). Design and interprete all filters with this sampling rate.

   a. Using ecg_noisy.dat and ecg_hfn.dat, write a Matlab code to apply a 10-point moving-average filter with the help of equations given in the textbook (Eqns. 3.19 and 3.20).
   b. Using ecg_noisy.dat and ecg_hfn.dat, write a Matlab code to apply the derivative-based filter to remove low-frequency artifact, given by Equation 3.47 in the textbook.
   c. Using ecg_hfn.dat write a Matlab code to apply a low-pass Butterworth with 30 and 70 Hz cutoff frequencies for filter orders 4 and 8. Select appropriate parameters to achieve satisfactory filtering of the given ECG signal and record your observations.

   Study the effect of each filter on the noisy ECG signal. Plot both the noisy and the filtered ECG signals on one figure using subplots.