DSP Project #1
Due Date: March 15, 2008

This project aims at making the student familiar with the use of Matlab to implement the basic DSP techniques and analyze/display the results. This project uses ECG samples taken from the world-famous MIT-BIH arrhythmia database to make the tasks given more interesting through their application to real data. Details about the data set are given in a README file contained within the ZIP file provided for download on the class web site. An example read/display Matlab code is also available for download on the class web site for your convenience.

Project Tasks:

1. Compute and display the DFT of ECG signals for normal, ventricular couplet, ventricular tachycardia, ventricular bigeminy, and ventricular fibrillation types. Compute the DFT for only one sample signal from each type.

2. Compute and display the power spectrum of ECG signals for normal, ventricular couplet, ventricular tachycardia, ventricular bigeminy, and ventricular fibrillation types. Use all signals and periodogram averaging to do compute the power spectrum for each type.

3. Since ventricular fibrillation sample are given at a different sampling rate, design a signal processing technique to resample the samples obtained at 250 samples/s to become sampled at 360 samples/s.

4. It is desired to filter the ECG samples with a low pass filter with cut-off frequency of 40 Hz. Transition band must be not more than 8 Hz to avoid having the 50 Hz noise interfere with the signal. The attenuation of the stop-band must not be less than 40 dB. Design and compare the digital filter that can do that using the following approaches:

   a. FIR filters with 3 different approaches (e.g., windowing, least squares, etc.)
   b. IIR filter with 3 different approaches (e.g., Butterworth, Chebyshev, elliptic, etc.)

5. Starting from one sample from each of the normal, ventricular couplet, ventricular tachycardia, ventricular bigeminy, and ventricular fibrillation ECG signal types, use a modeling technique to allow the estimation of features to describe each of these signals and at the same time predict future samples from the input signals. Compare the predicted and original signals.

6. It is desired to compute the Fourier transformation of a normal ECG signal with a frequency resolution of 1 mHz starting from the original samples of one normal signal. Design a signal processing method that enables you to do that.

Notes:
1. Please properly label all figures with correct axis scales.
2. Please submit your report in PDF electronic form on a CD or send it to ymk@k-space.org.