ECE-497/BME-491: Applied Biomedical Signal Processing

Exam #1
Due at the beginning of class, January 22, 2007

You are allowed to use any materials from this class (notes, homework assignments, laptop assignments, and the book). You are not allowed to get help from anyone else. Your results should be neat and I should be able to determine whatever parameters you used to create your plots.

1) In addition to the "short-cut" algorithms we have already examined, there are other methods for estimating a normalized autocorrelation. You are to implement the following two algorithms for estimating the normalized autocorrelations, and apply them the the data from homework 1. You are to summarize your results and determine if the algorithms can be used to discriminate VT from VF for both patch and closely spaced bipolar signals.

$$\text{polarity coincidence} \quad \rho_k = sin\left\{ \frac{\pi}{2} \frac{1}{N} \sum_{i=k}^{i=N-1} sign(x(i)x(i-k)) \right\}$$

$$\text{ADA} \quad \rho_k = 1 - 2\left\{ \frac{\sum_{i=k}^{i=N-1} |x(i)-x(i-k)|}{\sum_{j=k}^{j=N-1} (|x(i)|+|x(j-k)|)} \right\}^2$$

Table 1: Algorithms for estimating the normalized autocorrelation ρ at lag k.

2) The file *bob_ecg.dat* is a data file sampled at 200 Hz. The ECG signals in the file are difficult to read because of baseline wander, 60 Hz noise, and additive white noise. You are to "clean up" the signal as much as possible. Your final output must look as much like the original signal as possible. As a minimum you must plot the original signal and your final signal, though it may be useful to you to plot any intermediate signals you develop. You must also explain how you processed the signal to get your final signal.

3) Implement the Pan-Tompkins algorithm for QRS detection by filling in the m-file *Pan_Tompkins_fill_in.m* Run the file for both *ecg_pvc.dat* and *ecg5.dat* and be sure all beats are detected (except maybe the first and last beats.) You can use different parameters for the different files. For the filters you do not need to worry about the beginning and ending points in the file.

Turn in code for all problems.