Automated ECG Arrhythmia Diagnosis

Motivation

Conventional methods of monitoring and diagnosing arrhythmia rely on detecting the presence of particular signal features by a human observer. Due to the large number of patients in intensive care units and the need for continuous observation of such conditions, several techniques for automated arrhythmia detection have been developed in the past two decades to attempt to solve this problem. In this project, we attempt to build our own computer-aided ECG diagnosis system.

The project aims to diagnose ECG signals from the MIT-BIH Arrhythmia Database [1]. The data set provided for this project is composed of five different types including normal (NR), ventricular couplet (VC), ventricular tachycardia (VT), ventricular bigeminy (VB), and ventricular fibrillation (VF). Each type is represented by 64 independent signals for the design set and another 32 signals for the test with each signal 3 s long. The VF signals were sampled at 250 samples/s, while the others were sampled at 360 samples/s. The complete file descriptions and records/segments included in the data set are given in "readme.txt" file.

The signal window length for this analysis was chosen such that it is significantly less than 10 s. This is to satisfy the ANSI/AAMI EC13-1992 standard, which requires alarms for abnormal ECG signals to be activated within 10 s of their onset. The number of points within this duration is not crucial as long as the ECG signal is sufficiently sampled but all signal types must have the same sampling rate [2].

Research Tasks Involved

A. Design a simulation program that generates data with desired distribution for testing.
B. Compare performance of different classification methods on simulated data sets with different specs.
C. Design a feature extraction methodology for ECG signals.
D. Design a feature selection strategy that maintain only useful features and remove the rest.
E. Design a methodology to detect abnormal ECG signals. (Binary classification).
F. Design a methodology to classify ECG signals into one of the five types above.
G. Design a methodology to change the sampling rate of a signal to a different desired one.
H. Design quantitative evaluation criteria to assess the results of different methods.

Design Input

- The ECG data set for learning and testing ECG classifiers as described above.
- Matlab code to read the data set provided.

Design Output

- A lab notebook (preferably in Microsoft OneNote® format) with all the experiments done to address each of research tasks listed above including documented Matlab code for each.
- A 2-page paper in the IEEE conference paper format that summarizes your work.

Design Evaluation Criteria

- Quantitatively using the measures of diagnostic performance given in Lecture #2.

References

[1] MIT-BIH Arrhythmia Database, Available at:
http://www.physionet.org/physiobank/database/mitdb/

[2] Mohamed I. Owis, Ahmed Hammad, Abou-Bakr M. Youssef, and Yasser M. Kadah, "Study of features based on nonlinear dynamical modeling in ECG arrhythmia detection and classification," *IEEE Trans. on Biomedical Engineering*, vol. 49, no. 7, pp. 733-736, July 2002. Available at: http://www.k-space.org/Publications/papers/tbme-02-1.pdf