

The signals **n2000850**, **n2092910**, **n2321529** and **n2322353** were obtained from the MIT/BIH Arrhythmia Database. The first three digits in each name indicate the record number in the database and the last 4 digits indicate the mm:ss minutes and seconds of the beginning of each record. The original records in the database contain 2 channels (lead MLII and lead VI sampled at 360 samples/sec). The 4 files that you are given contain **only lead MLII (modified lead II)**. In addition **uniformly distributed noise (zero mean) has been added to the records**. The four signals are contained in a Matlab © ".mat" file; bspekgpr.mat .

The following sequence of steps should be performed *for each ECG segment* :

I) Reconstruct the signals, removing the offset due to the Analog-to-Digital conversion process.

During the A/D conversion, the hardware was such that a value of 1024 converter counts corresponded to 0V. Subtract that amount from each signal and **plot it without the offset**. In the plots **include a horizontal bar indicating 1 second, or draw a grid of vertical lines separated by 1 second from each other**.

II Initial QRS localization / Definition of an "Average beat"

Manually select one of the beats in each file and use it as a template to define the location of each R wave, using correlation *in time*. (i.e., shifting the discrete-time data sequences with respect to each other and evaluating the sum of products).

- Implement and list an algorithm that finds the location of the R-peaks in each data file using the correlation approach*.
- **List the sample number where each identified R wave was determined.**
- In your implementation, include the use of the identified locations of the R waves to align as many beats as possible and **obtain an "average beat" for the file**. (Indicate which beats were included in the average and explain why any beat(s) are discarded, if any.)
- **Comment on the improvement in signal-to-noise ratio obtained through averaging.**
- **List values of the R-R intervals in the file.** Calculate the **mean and the standard deviation of the R-R intervals. Identify the most prominent rhythm** (Normal Sinus Rhythm, Tachycardia, Bradycardia) in the file. If different rhythms are present in the file, identify them.

III. QRS identification using an average template.

Repeat all the steps in part II, but **this time use the "average beat" found in part II as template** (instead of arbitrarily picking-up one of the noisy beats).

In addition to the comments requested in part II, this time **compare the results obtained in part II with the results obtained in part III**.

What are the advantages / disadvantages of performing the correlation in the frequency domain?

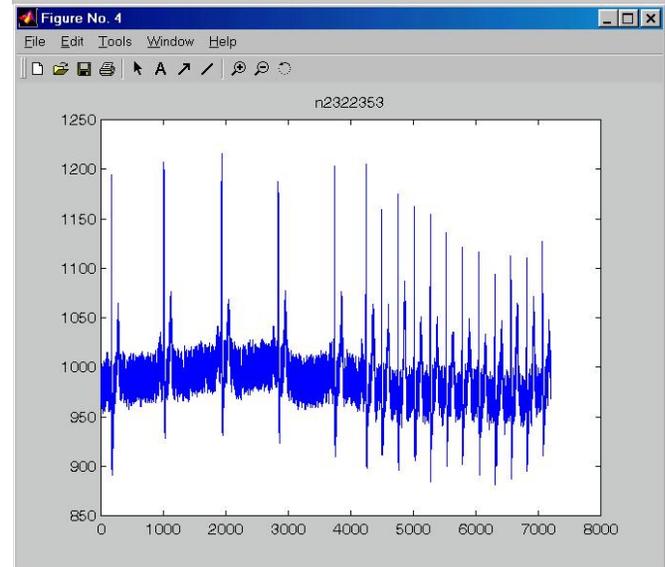
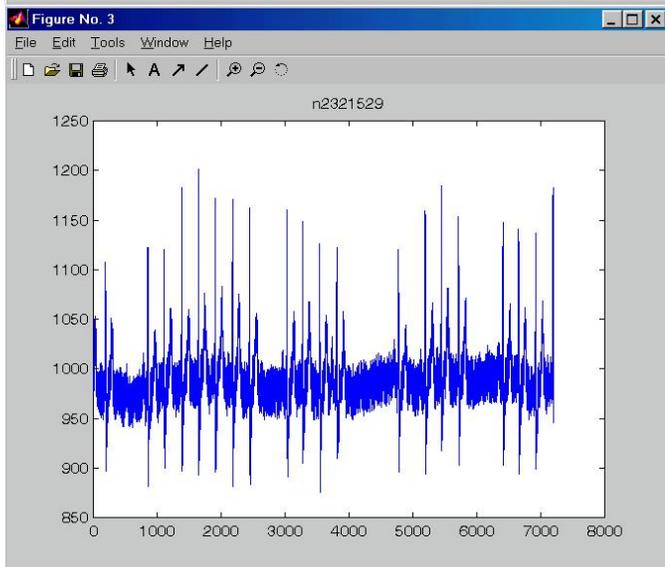
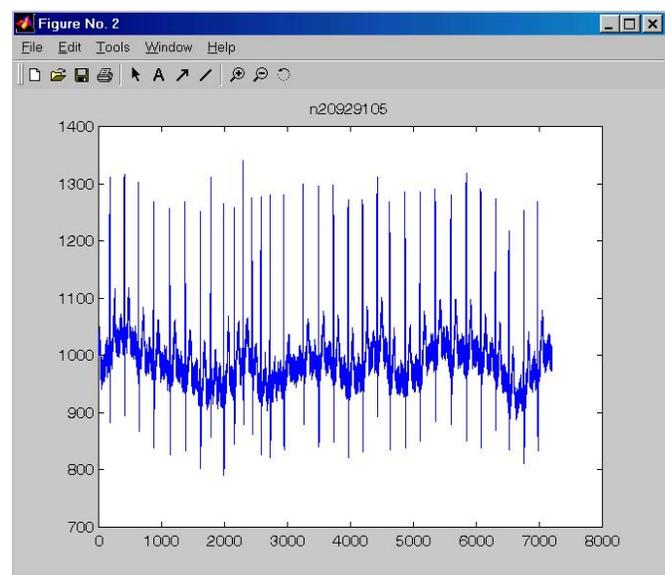
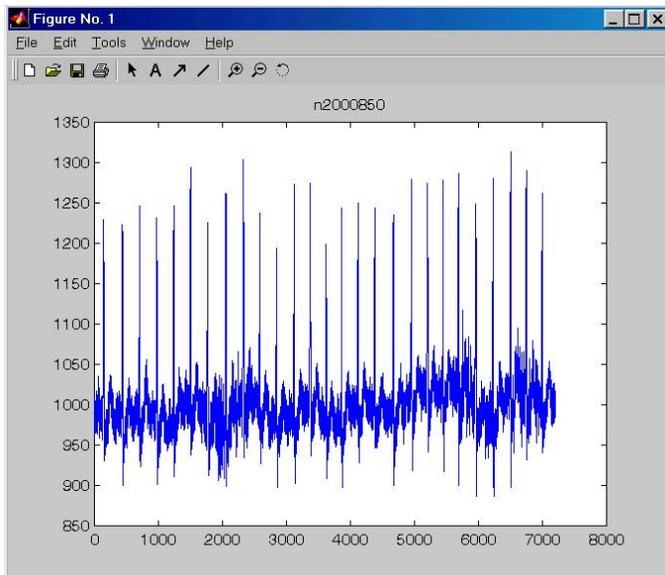
* (*Similar to the method used in the paper "High Resolution ECG", by Reddy, Christenson, Rowlandson and Hammill, Medical Electronics, April, 1992*).

The matlab file bspekgpr.mat containing the four signals can be retrieved from the following URL:

<http://dsplab.eng.fiu.edu/DSP/Courses/BSP1/Index.htm>

Four individual ASCII files: n2000850.asc, n2092910.asc, n2321529.asc, and n2322353.asc , can also be retrieved from that URL.

The following figures show the overall appearance of the four ECG segments you will work with. You should be able to verify that you are correctly retrieving the signals by plotting them and matching them with these figures. (These figures are also available at the URL mentioned above).



PLEASE NOTE:

- [1] YOUR WRITTEN REPORT MUST CONTAIN THE PRINTED VERSION OF YOUR CODE
- [2] YOU MUST ALSO SUBMIT A CD-ROM WITH ALL YOUR CODE