

EE622: Biomedical Signal Processing

Assignment-1

Please implement your programs using Python before 22.01.2022

1. The ECG signal is given in MATLAB file format as “givenECG3.mat”. Sampling frequency is 360 Hz.
 - (a) Detect the R-peak in each beat of the ECG signal.
 - (b) Evaluate the RR-interval between the consecutive beats of the ECG signal.
 - (c) Derive the heart rate signal from the ECG (i.e., Plot between the RR-interval and time).
 - (d) Evaluate the mean and standard deviation value of the heart rate signal.
2. Given an ECG signal “inputECG.mat”, add random noise to it. The sampling rate is 360 Hz. (*You may use numpy.random package for generating noise*)
 - a. Perform synchronized averaging to remove the noise. Vary the number of realizations used for reconstruction of ECG signal. Plot the percentage root mean square difference (PRD) value versus the iteration number.
3. Given the ECG signal, “givenECG3.mat”. The sampling rate is 360 Hz.
 - a. Add baseline wander noise (0-1 Hz sinusoid) and powerline interference (50 Hz sinusoid) to it. Use various filters to eliminate these noises from ECG.
 - b. Compute PRD value between the filtered signal and the original ECG signal for each filtering case.

References:

1. J. Pan and W. J. Tompkins, “A real time QRS complex detection algorithm”, *IEEE Trans. on Biomedical Engineering*, vol. 32, no. 3, March 1985.

2. Sharma, L. N., Samarendra Dandapat, and Anil Mahanta. "ECG signal denoising using higher order statistics in Wavelet subbands." *Biomedical Signal Processing and Control* 5.3 (2010): 214-222.
3. R. M. Rangayan, *Biomedical Signal Analysis*, John Wiley and Sons (2nd Ed.)