

ECG QRS Detection and SQI

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I. OBJECTIVE

The objective is to run a signal quality index (SQI) for all ECG and PPG waveforms for the RR estimation project. In this report, the focus is to measure the SQI for some ECG waveforms.

II. COMPLETED TASKS

A. Trial run on the QRS detection of ECG data

In order to run the signal quality index (SQI) for the ECG waveforms of our Dialysis 1, Dialysis 2, Dialysis 3, MIMICII, Fantasia, CapnoBase, and soon to be included datasets, i.e. PICRAM, CALMS-2, Vortal, LISTEN; for ECG, the steps are identified as the following.

- 1) To obtain the QRS annotations from the two (2) QRS detectors. As an experiment, for Physionet wfdb format data, the two (2) peak detectors that have been used are *wqrs* [1] and *gqrs* [2]. For Matlab data format (.mat), the functions used are those that have been developed by Joachim Behar, *qrs_detect2.m* [3] and Qinghua Zhang, *rpeak.m* [4].
- 2) To plot the QRS on top of ECG to ensure it makes sense across the whole record. The result using *wqrs* and *gqrs* peak detectors on Physionet ECG 'mitdb/101' ECG waveforms which contain '101.heg' and '101.dat', plotted for 5 secs is as shown in Fig.1. The QRS detectors process using Joachim and Zhang's have been carried out for one of MIMICII dataset (s00052_3036_03_14_12_15.mat) for the whole recorded data (8 mins). The plotted on top of ECG for 5 secs are as shown in Fig.2.
- 3) To pass the two sets of annotations (i.e. from the two QRS detectors) as an input to the *Bbx_compare.m* function and the output will be F1. This step has been done for .mat data i.e. MIMICII and the SQI evaluation result for 36 MIMICII data is as shown in Fig.3.
- 4) To decide on a threshold at which the segment is of GOOD/BAD quality. Giving the SQI range is 0-1. From Fig.3, there are 69% (25 out of 36) data are more than 0.8 SQI, if 0.8 considered as the threshold.

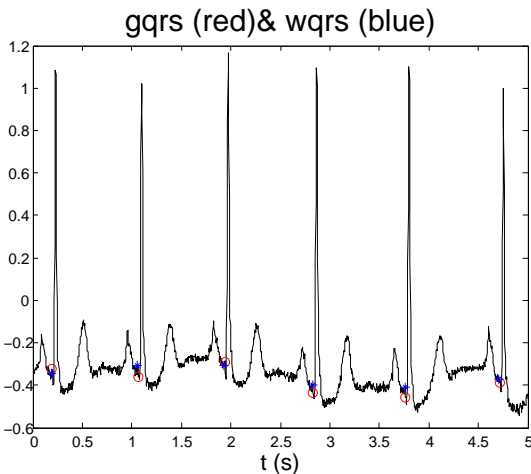


Fig. 1. QRS detector for wfdb format data

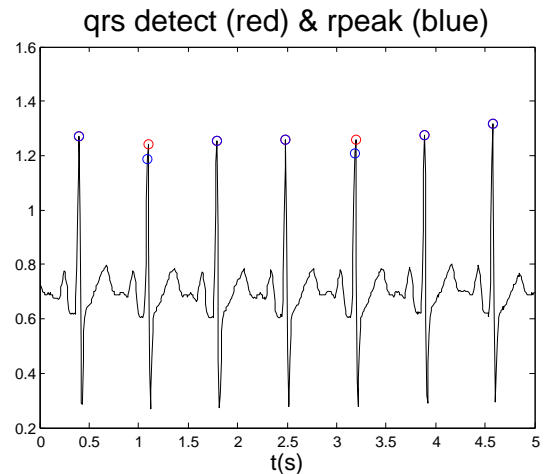


Fig. 2. QRS detector for .mat format data

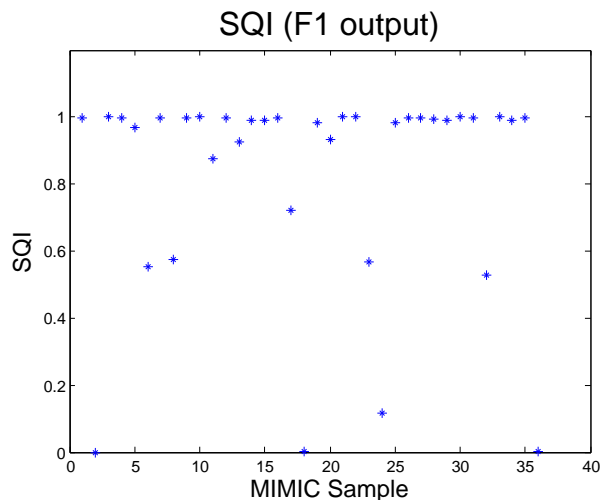


Fig. 3. QRS detection using *qrs_detect* and *rpeak* for 36 randomly taken MIMICII data

III. CONCLUSION

The preliminary approach to determine SQI for ECG data using .mat data format has been carried out using a few selected functions.

REFERENCES

- [1] Zong, W., G. B. Moody, and D. Jiang. A robust open-source algorithm to detect onset and duration of QRS complexes. *Computers in Cardiology*, 2003. IEEE, 2003.
- [2] Silva, I, Moody, G. An Open-source Toolbox for Analysing and Processing PhysioNet Databases in MATLAB and Octave. *Journal of Open Research Software* 2(1):e27, 2014
- [3] Behar, Joachim and Oster, Julien and Li, Qiao and Clifford, Gari D. ECG signal quality during arrhythmia and its application to false alarm reduction, *IEEE Trans. on Biomedical Engineering*, 60(6), 1660–1666, 2013.
- [4] Q. Zhang, A. Illanes Manriquez, C. Mdigue, Y. Papelier, and M. Sorine. An algorithm for robust and efficient location of T-wave ends in electrocardiograms. *IEEE Trans. on Biomedical Engineering*, 53(12):2544-2552, 2006.

IV. PREVIOUS REPORTS

All the progress reports are stored in <http://goo.gl/5yASrs>

- 20 Feb 2015 - Datasets for respiratory estimation
- 06 Mar 2015 - Format of the Datasets for Respiratory Rate Estimation
- 20 Mar 2015 - Dialysis 1, 2 and 3 data sets
- 01 Apr 2015 - Completion of Dialysis 1 and 2
- 17 Apr 2015 - Data Screening
- 01 May 2015 - ECG QRS Detection and SQI