A Moving Average based Filtering System with its Application to Real-time QRS Detection

Jure Zajc

University of Ljubljana
jz4314@student.uni-lj.si

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Abstract

In this assignment we needed to complete one of the assignments connected to heartbeat detection. I choose to complete assignment in Matlab, I choose Chen algorithm.

I. Introduction

To fully complete the assignment you have to satisfy the following requirements: The QRS detector has to accept the name of the record (.dat and .hea files of the database) as a parameter. The program has to open this record and detect the QRS complexes in the record. The program has to write an annotation file (.det) in the ASCII format, which contains sample indexes of the fiducial points (FPs) of the detected QRS complexes. The performance of the program has to be evaluated in the sense of sensitivity (Se) and positive predictivity (+P) with regard to manually annotated fiducial points (FPs) of the QRS complexes (.atr files of the database).

II. Methods

In the assignment I used Matlab, Ubuntu interpreter in Windows10 subshell and shell scripts. I used physionet long term database.

- Our program accepts the name of the record as .mat file as parameter
- High pass filter: We used equation in the reference article.
- Low pass filter: This filter perform a non linear amplification and full wave rectification
- Decision making. We used equation in reference article
- Output is .det file with QRS detections.

III. Results

Results are in the file results.txt. Definitions for results:

- $Sensitivity = \frac{TP}{TP+FN}$ Proportion of actual positives that are correctly identified as such (e.g., the percentage of sick people who are correctly identified as having the condition).
- $Positive\ predictivity = \frac{TP}{TP+FP}$ Positive predictive value is the probability that subjects with a positive screening test truly have the disease

For window size we tried lots of different combinations, for windows size within the low-pass filtering and decision making stage. Sample frequency is 360 Hz which means that points are sampled every 3 ms. So every 3 minutes we get 60 samples. Only problem we had with finding the true frequency was that win-

dow size wasn't too large, therefore causing 2 heart beats in one window and only selecting one. If the window was too small, there could be many miss detections. For first window size for low pass filter we tried values between 10 and 100, and for window size between 100 and 300, after couple of tries we decided for values 10 and 180.

IV. Conclusion

Despite its simplicity and low time complexity, the algorithm bring good results, the sensitivity and true predictivity are above 92%. Results depend on paramater values, so this might not be the best possible result if I would change values for, lets say, only one instead of 30, I could get better results. Parameter values also depend on dataset aswell.

References

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