

The background features a complex geometric pattern. On the left side, there is a dense network of thin grey lines connecting various black dots, forming a web-like structure. Scattered across the entire light grey background are numerous thin-outlined triangles of different sizes and orientations. Some of these triangles are solid black, while others are white with black outlines. The overall aesthetic is minimalist and technical, suggesting a focus on geometry or computer graphics.

BSP-Homework 4

F94051089

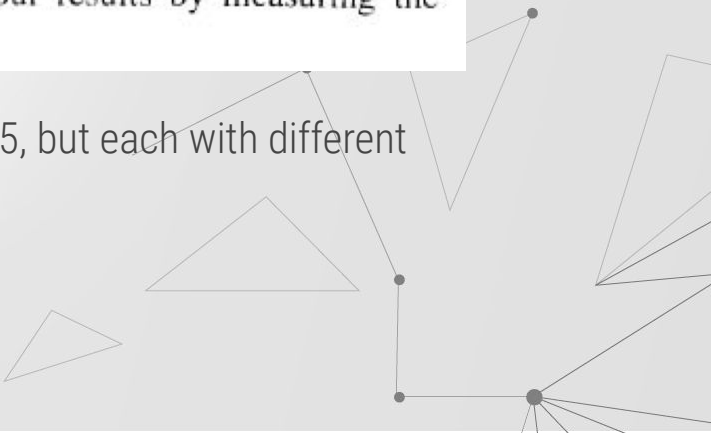
Chia-Hung Cho



Problem-1

1. Implement the Pan-Tompkins method for QRS detection in MATLAB. You may employ a simple threshold-based method to detect QRS complexes as the procedure will be run off-line.

Apply the procedure to the signals in the files ECG3.dat, ECG4.dat, ECG5.dat, and ECG6.dat, sampled at a rate of 200 Hz (see the file ECGS.m). Compute the averaged heart rate and QRS width for each record. Verify your results by measuring the parameters visually from plots of the signals.

- Signal ECG3, ECG4, ECG6 are more stable than ECG5, but each with different heart rate.
- 



Methods

•

Use
ECGS.m
Read
ECG

Low
Pass
Filter
(12Hz)

High
Pass
Filter
(5Hz)

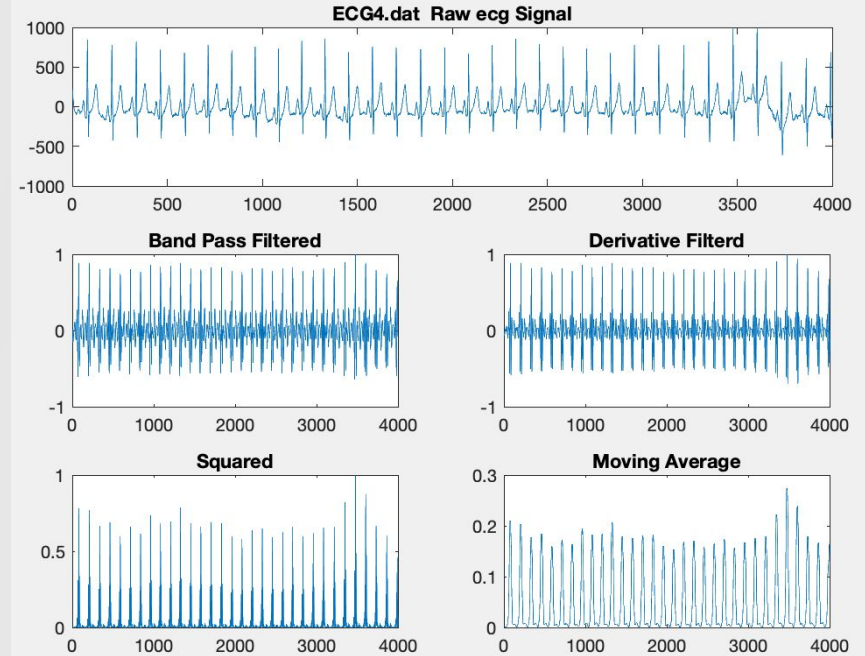
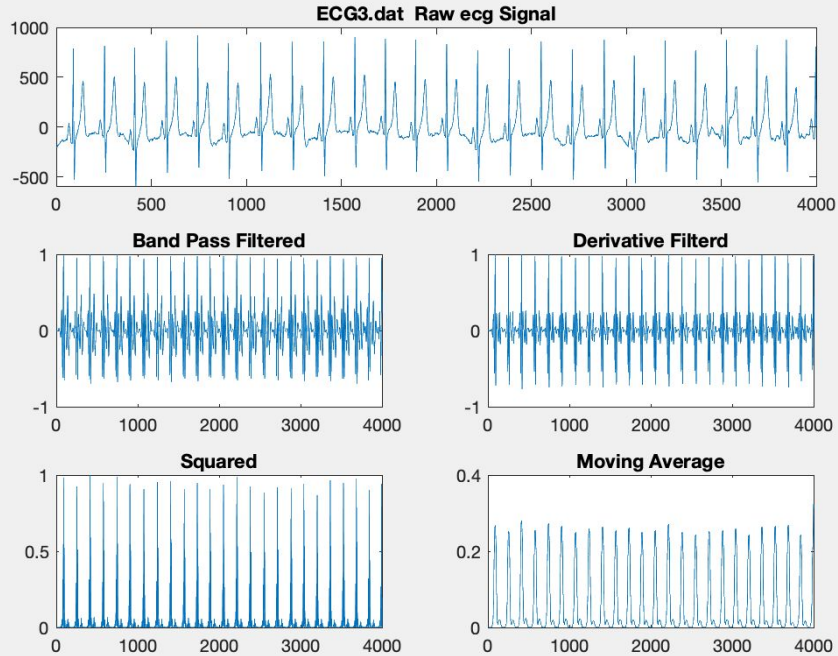
Derivat
ive
Filter

Square

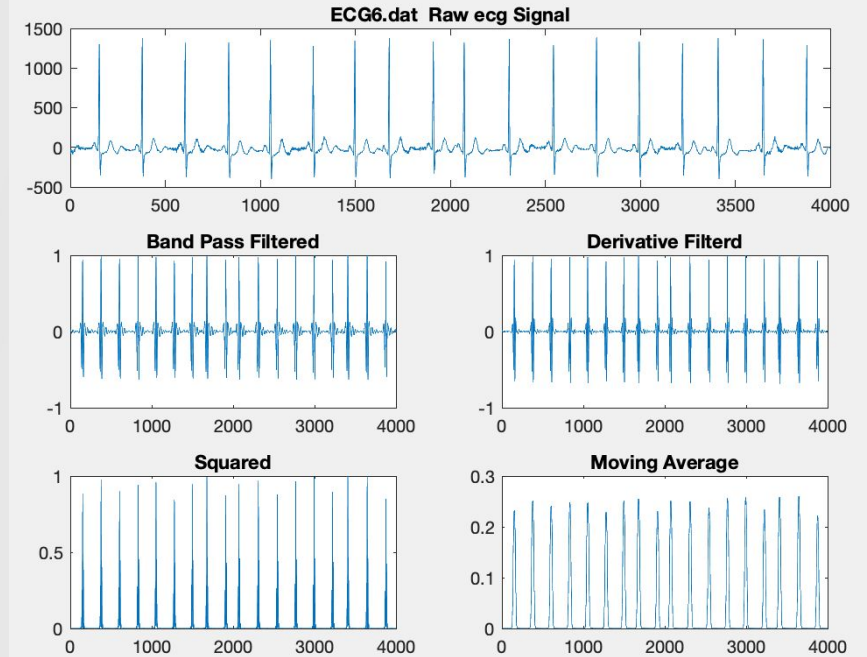
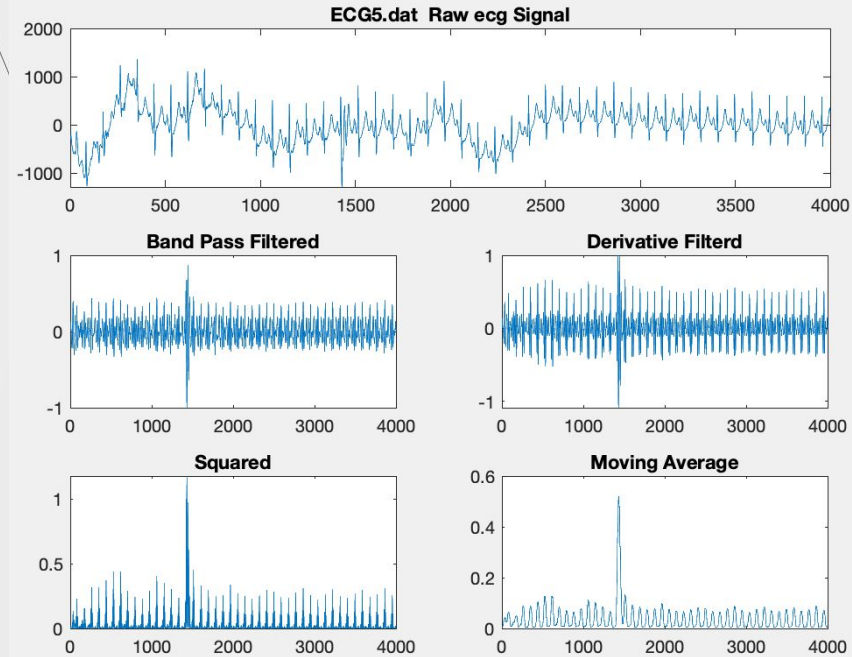
Moving
Average
(N=30
for
200Hz)

Find
Peaks

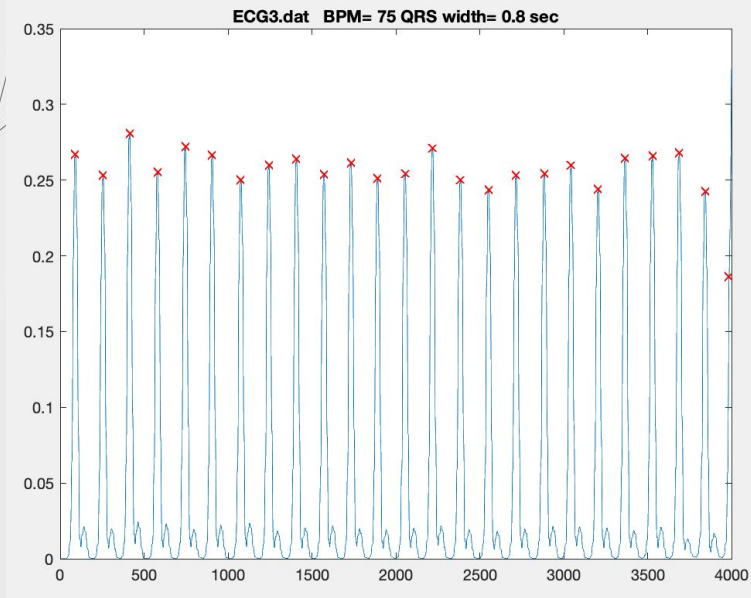
Method



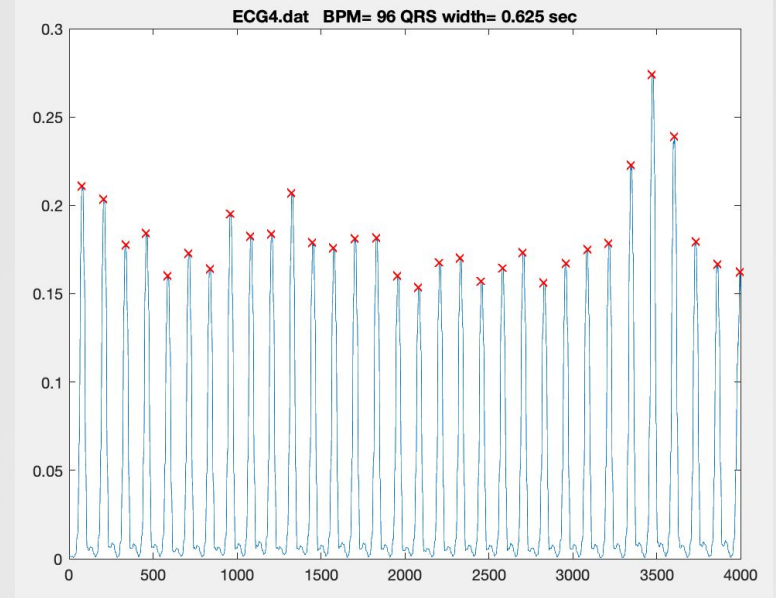
Method



Results

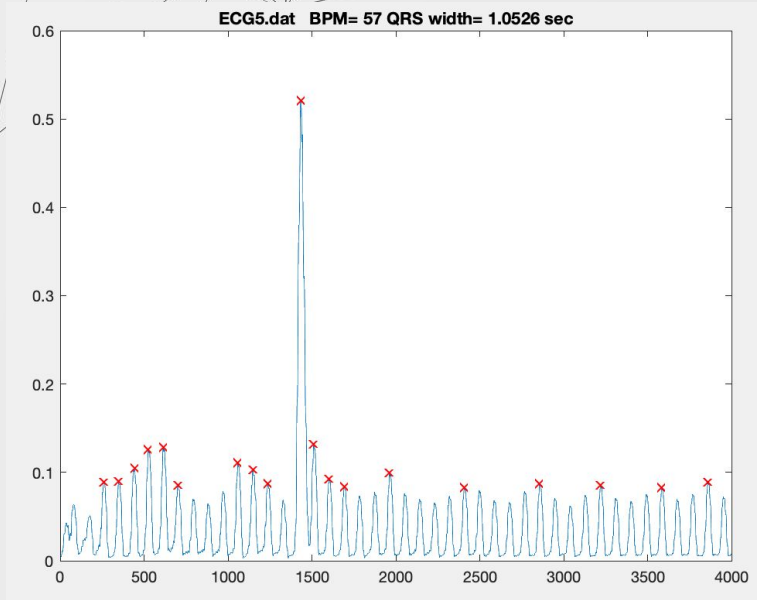


Visual Measure from Raw Data :
BPM=75
Width=0.816sec

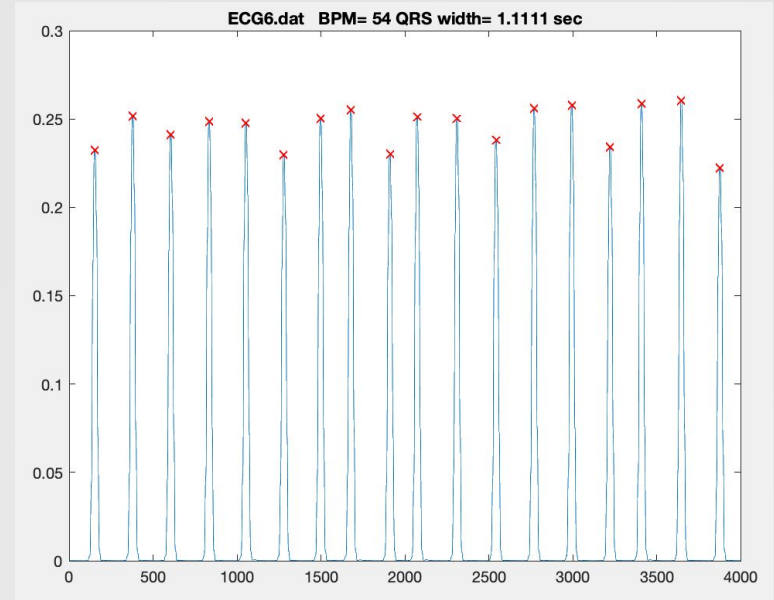


Visual Measure from Raw Data :
BPM=96
Width=0.63 sec

Results



Visual Measure from Raw Data:
BPM=132
Width=0.45sec



Visual Measure from Raw Data:
BPM=54
Width=1.11 sec



Discussion

- Using “findpeaks” function might have good performance in detection of regular peaks and calculate the correct BPM.
- But bad in QRS complex width evaluation and also bad in power line shifted, unusual ECG signal. (ECG5.dat)

Problem-2

1. Implement the Pan-Tompkins method for QRS detection in MATLAB. You may employ a simple threshold-based method to detect QRS complexes as the procedure will be run off-line.

Apply the procedure to the signals in the files ECG3.dat, ECG4.dat, ECG5.dat, and ECG6.dat, sampled at a rate of 200 Hz (see the file ECGS.m). Compute the averaged heart rate and QRS width for each record. Verify your results by measuring the parameters visually from plots of the signals.

2. Implement the adaptive thresholding and searchback procedure to your P-T method and redo problem 1.

Methods

Use
ECGS.m
Read ECG

Low
Pass
Filter
(12Hz)

High
Pass
Filter
(5Hz)

Derivati
ve
Filter

Square

Moving
Average
(N=30)

Initialize
Signal level
Noise level
Threshold

Thresholding
and decision

Search Back
(1.66 of averaged
RR duration)

Methods

**Initialize
Signal level
Noise level
Threshold**

**Thresholding
and decision**

**Searchback
(1.66 of averaged
RR duration)**

Initialize Signal level and Noise level as a percentage of the maximum and average amplitude of the integrated signal, respectively.



Methods

Initialize
Signal level
Noise level
Threshold

Thresholding
and decision

Searchback
(1.66 of averaged
RR duration)

$$SPKI = 0.125 PEAKI + 0.875 SPKI \quad \text{if } PEAKI \text{ is a signal peak; (4.15)}$$

$$NPKI = 0.125 PEAKI + 0.875 NPKI \quad \text{if } PEAKI \text{ is a noise peak;}$$

$$THRESHOLD I1 = NPKI + 0.25(SPKI - NPKI); \quad (4.16)$$

Methods

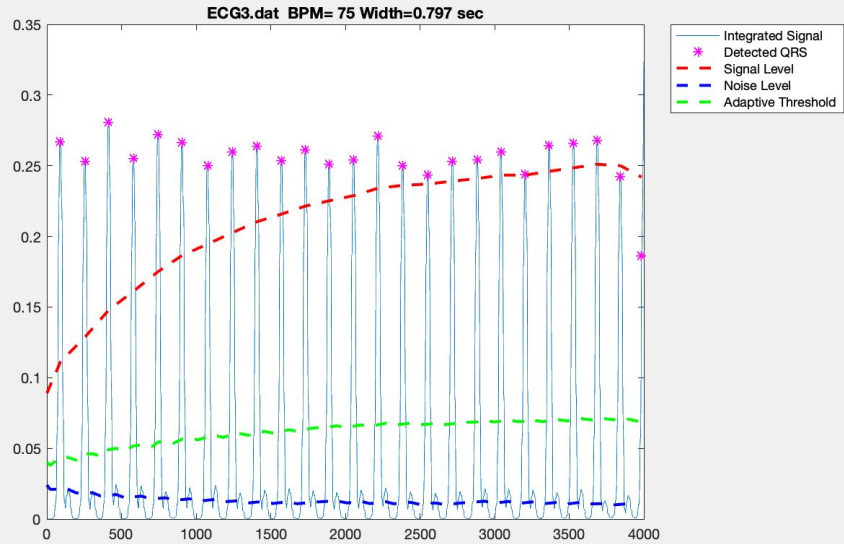
Initialize
Signal level
Noise level
Threshold

Thresholding
and decision

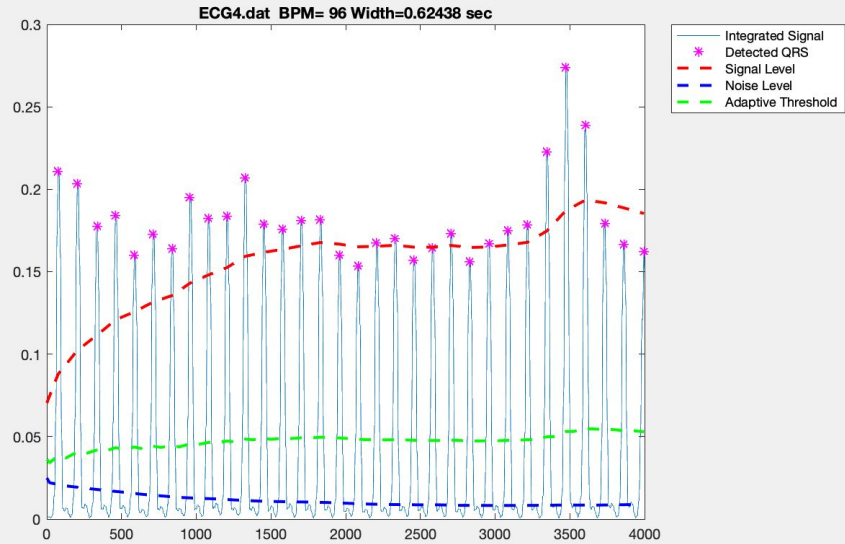
Searchback
(1.66 of averaged
RR duration)

$$THRESHOLD\ I2 = 0.5\ THRESHOLD\ I1.$$

Results

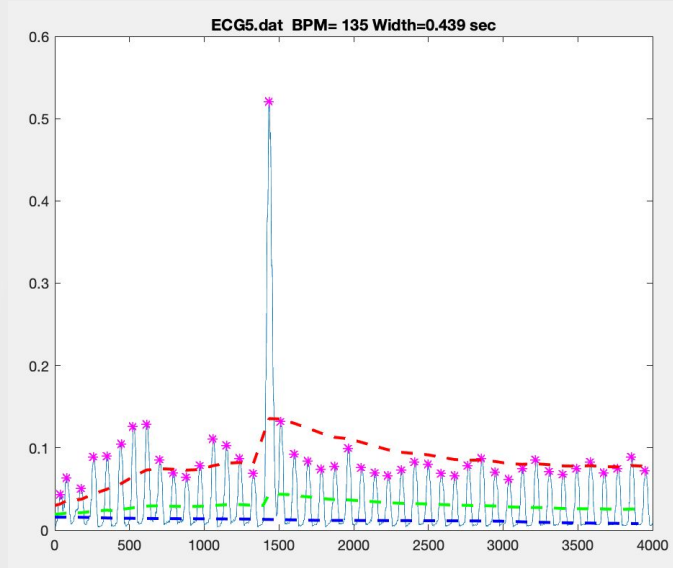


Visual Measure from Raw Data :
BPM=75
Width=0.816 sec

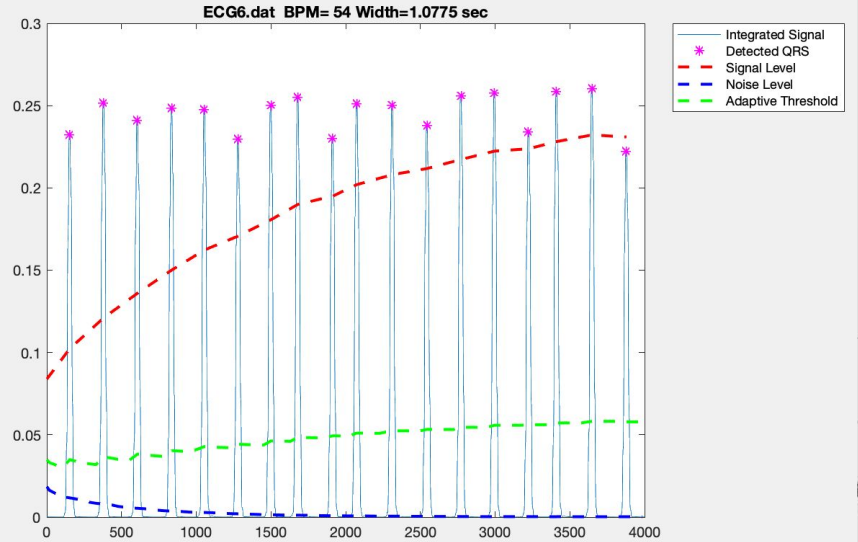


Visual Measure from Raw Data :
• BPM=96
Width=0.63 sec

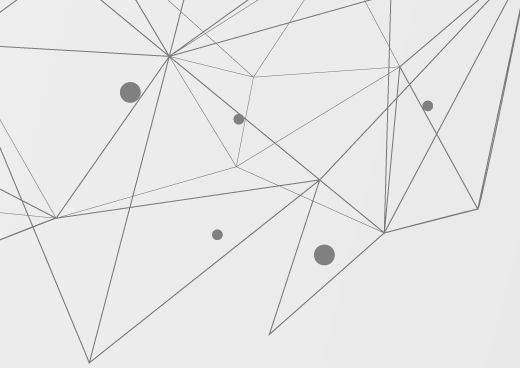
Results



Visual Measure from Raw Data:
BPM=132
Width=0.45 sec



Visual Measure from Raw Data:
• BPM=54
Width=1.11 sec



Discussion

- Using adaptive threshold and searchback procedure will have a better result in processing signals with baseline shifted or unusual ECG signal.

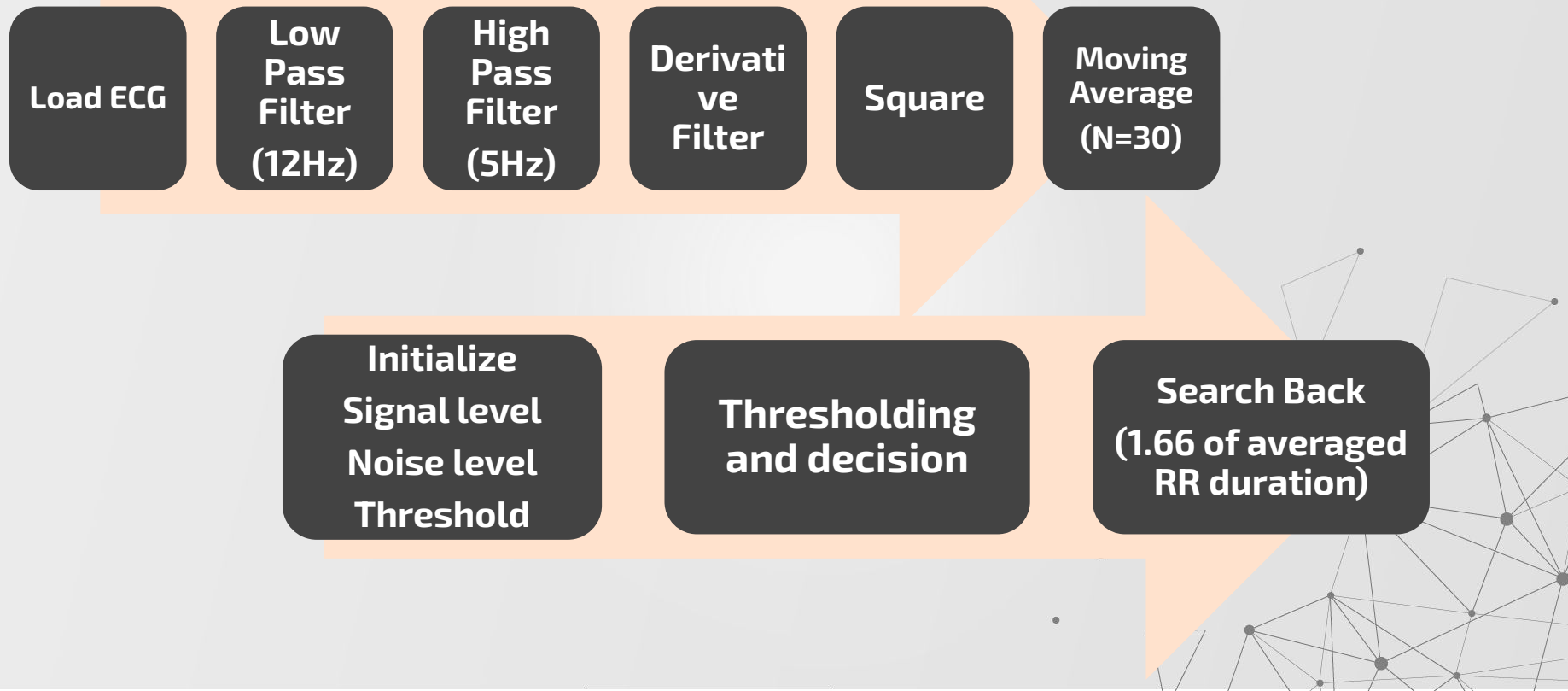
Problem-3

3. Apply your P-T method to your personal ECG.

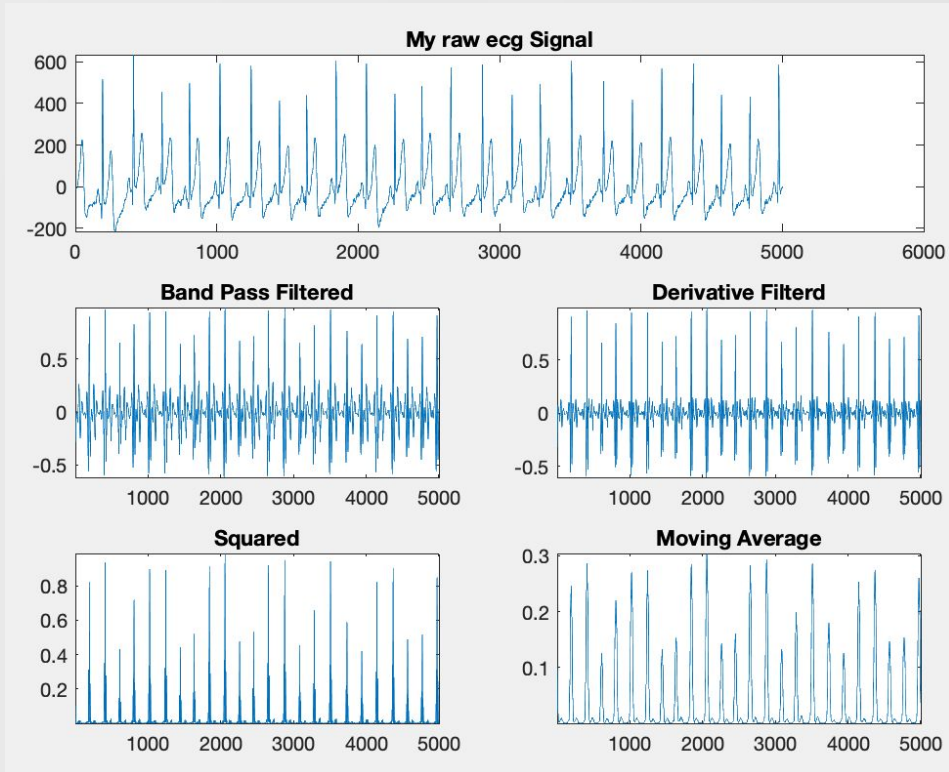
- Load .mat data type as a struct, get values as .data (fs=250Hz)
- Cut noise signal at the beginning
- A bit power line interference



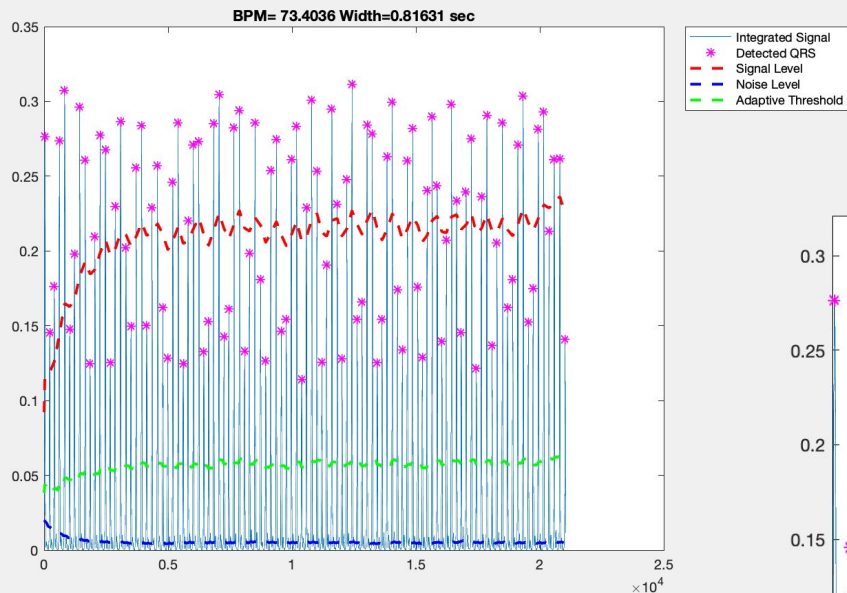
Methods



Results



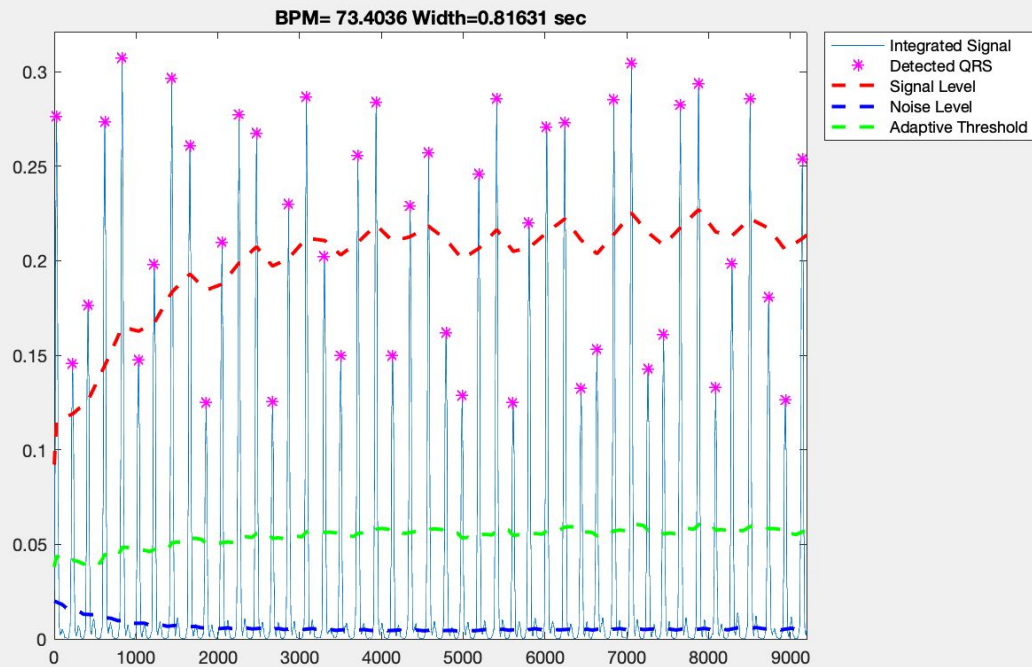
Results-Adaptive Thresholding



Visual Measure from Raw Data:

BPM=72

Width=0.8sec





Discussion

- Although my signal contains a baseline shifting, adaptive thresholding can correctly measure my BPM.
- We can clearly observe the floating of the signal level and the threshold while doing adaptive thresholding.

The background is a light gray with abstract geometric patterns. On the left, there is a dense network of thin gray lines connecting small black dots, forming a complex web. Scattered across the middle and right are several thin-lined triangles of various sizes and orientations. In the top right corner, there are small, faint circles and dots, resembling a starry sky or a distant galaxy.

THANKS