Implement Pan-Tompkins filters

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0 solutions submitted (max: Unlimited)

Open Problem in MATLAB Online

Introduction

The Pan-Tompkins algorithm identifies QRS complexes (see Fig. 1) based on analysis of the slope, amplitude and width of the QRS. The various stages of the algorithm are shown in Fig. 2.

Figure 1.Schematic representation of normal ECG

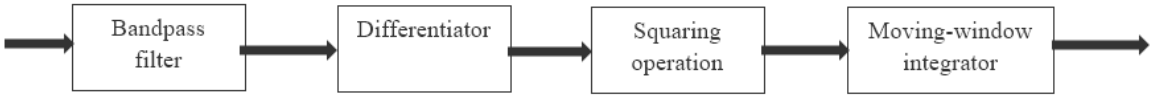

Figure 2. Block diagram of the Pan-Tompkins algorithm

The bandpass filter, formed using lowpass and highpass filters, reduces noise (such as muscle noise, 60 Hz interference and baseline drift) in the ECG signal. After that, the signal is passed through a differentiator to provide a large response at the high slopes that distinguish QRS complexes from low-frequency ECG components such as the P and T waves.

The next operation is the squaring operation, which emphasizes the higher values expected within QRS complexes and suppresses smaller values related to the P and T waves among noise in the output of the preceding stage. The squared signal is then passed through a moving-window integrator of window length N = 30 samples (for the sampling frequency of FS = 200 Hz). The expected result is a single smooth peak related to the QRS complex for each ECG cycle. The output of the moving-window integrator may be used to detect QRS complexes, measure RR intervals, and determine the duration of the QRS complex (see Fig. 3).

Read Section 4.3.2 of the course book for more details. The eBook is accessible within the university network, which you can also reach remotely with VPN.

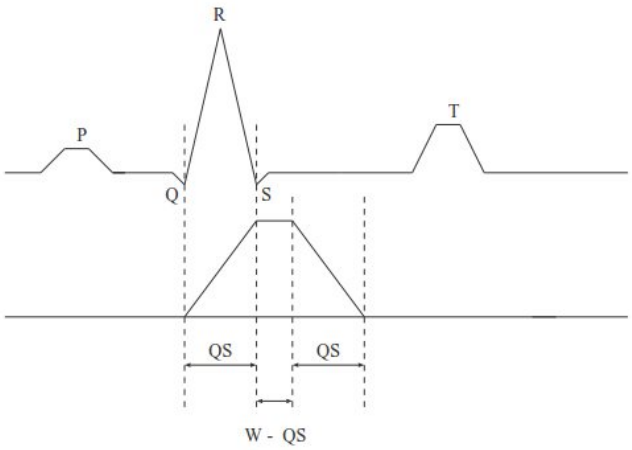

Figure 3. The relationship between a QRS complex and the moving-window integrator output

Data

The data file *ECG.txt* contains the input ECG sampled at 200 Hz rate. For the task, you are also supplied with a black box function named *findQRS* that finds the beginning and endings of the QRS complexes when supplied with the filtered signals, and detection thresholds.

Useful MATLAB commands

filter, ones