Automated ECG Feature Extraction with Mathematical Morphology

Ng, Jonah

Electrical activities in the heart can be detected using metallic electrodes in an electrocardiography procedure that produces the recording known as electrocardiogram (ECG). Characteristic ECG features, such as the R peak in the QRS complex, are important for medical diagnoses. For many applications, e.g., implantable or wearable devices, it is necessary to extract or detect these features automatically with limited computational power. Signals from other processes, like electric cable interference, can contaminate the ECG signal, making the detection difficult. The purpose of this project was to study the performance of mathematical morphology in cleaning the contaminants and detecting the R peak. Mathematical morphology involves simple operations that only require additions and comparisons, so the amount of computation is small. Structuring element functions were used to clean the contaminants. As an ECG signal was slid through the window or domain of the structuring element, morphology operations allowed desirable features to be separated from unwanted signals so they could be detected. A MATLAB code was developed to implement the mathematical morphology procedure and test it using the ECG signals in the Massachusetts Institute of Technology–Beth Israel Hospital (MIT-BIH) Arrhythmia Database. Test results for 25 ECG signals showed an overall detection accuracy of 99.51%, confirming the effectiveness of mathematical morphology.

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