Robust Delineation of High-Resolution Ambulatory Holter ECG Events via False-Alarm Controlled Segmentation of a Wavelet-Based Geometrical Decision Statistic

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In this study, a new long-duration holter electrocardiogram (ECG) major events detection-delineation algorithm is described which operates based on the false-alarm error bounded segmentation of a decision statistic with simple mathematical origin. To meet this end, after implementation of the required pre-processings, a uniform length window is slid sample to sample on the synthetic scale and in each slid, six features namely as summation of the nonlinearly amplified Hilbert transform, summation of absolute first order differentiation, summation of absolute second order differentiation, curve length, area and variance of the excerpted segment are calculated. Then all feature trends are normalized and superimposed to yield the newly defined geometric index (GI) metric for the detection and delineation of ECG events. In the next step, a -level Neyman-Pearson classifier (which is a false-alarm probability-FAP controlled tester) is implemented to detect and delineate QRS complexes. To show advantages of the presented method, it is applied to MIT-BIH Arrhythmia Database, QT Database, and T-Wave Alternans Database and as a result, the average values of sensitivity and positive predictivity Se = 99.96% and P+ = 99.96% are obtained for the detection of QRS complexes, with the average maximum delineation error of 5.7 msec, 3.8 msec and 6.1 msec for P-wave, QRS complex and T-wave, respectively.