Continuous Time Analysis Method for TWave Alternans Detection

Manuel Blanco-Velasco*, Fernando Cruz-Roldán, Eduardo Moreno-Martínez, Juan Pablo Martínez and Pedro Amo-López

Teoría de la Señal y Comunicaciones, Universidad de Alcalá, Alcalá de Henares, Madrid, Spain

Recent studies have demonstrated that T-wave alternans (TWA) is related with ventricular arrhythmias ant that its detection may help in the diagnosis of sudden cardiac death. Noise amplitudes similar to the alternant wave may make TWA detection difficult and poor SNR values lead to significant noise amplitudes that may cover the small variations associated with alternans. Limited solutions have been provided, except the inclusion of preprocessing stage for denoising. Thus, robust detection techniques against noise are welcome. Most of the detection techniques are applied over the time series obtained from the samples at the same phase taken from successive ST-T segments. The main drawback of processing temporal series obtained from ST-T complexes is that a relatively high number of beats are needed, at least from 64 to 128, which introduces a considerable delay. In this work, a new time domain method for TWA detection is presented. Its major advantage is the use of a reduced number of beats, from 16 to 32, which makes this methods less demanding in terms of signal stationarity. An extended study is performed to assess the performance of the new algorithm analyzing a wide set of long–term simulated ECG records with different SNR. The results are presented in terms of detection probability against the Alternans–to–Noise Ratio (ANR). This last parameter assesses the noise in the ventricular repolarization so that the lower the ANR, the higher the noise in the ST–T complex section of the ECG. The tests are carried out through a comparative study against the well known spectral method and different experiments are designed using muscle and motion artifact realizations. Although our method is tested with less number of heartbeats, it reports an improvement of more than 6 dB over the Spectral Method.