Indirect wavelet-based cardio arrhythmia detection algorithm

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Most of the cardio arrhythmia detection algorithms work directly on the ECG signal in spatial, frequency or both domains. They also must be synchronized at the same ECG pattern periods during the analysis [1-2-3]. In this paper, an indirect ECG handling represents the key idea for reliable and dependable analysis at variant and asynchronized ECG pattern periods. The process includes the ECG signal is sorted in ascending or descending order prior to the extraction of coefficients using Discrete Wavelet Transform (DWT). This represents a spatial transformation. The transformation helps in formulating the ECG signal in such a way that the sorted signal has the same form as shown in Figure 1(c) and (e) at different and variant periods as shown in Figure 1 (a), (b) and (d).

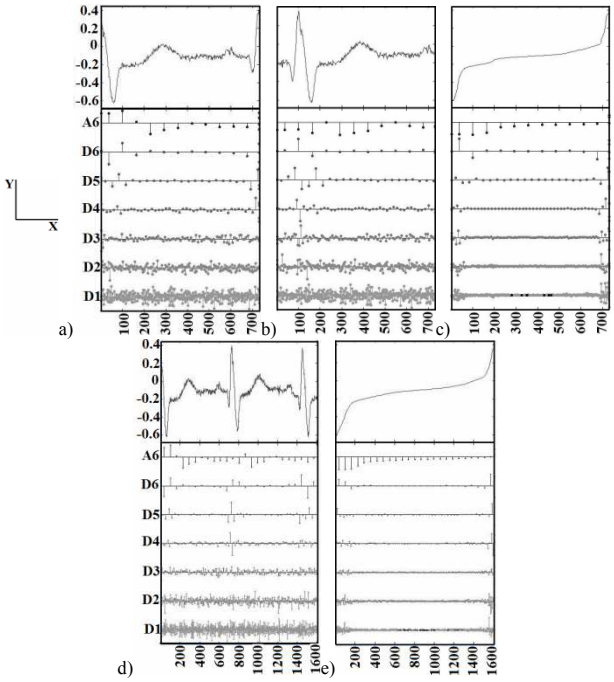

Figure 1 (a) R-R ECG period, (b) shifted ECG period, (c) same sorted ECG for both periods (a) and (b). (d) More than two ECG periods, (e) it's sorted period. D1 to D6 and A6 represents sex levels of DWT coefficients. The x and y axes represent number of the signal's samples and both the amplitude's values and DWT levels, respectively.

Any abnormal variations on ECG signal due to the ventricular arrhythmia or ischemia either large or small spreads along the sorted curve as shown in Figure 2. The DWT levels (D1 to D6 and A6) helps in exploiting the most important properties of DWT technique at accurately classifying, diagnosing and distinguishing the different features of abnormalities. Accordingly, the "zooming in" DWT scales arrives at more accurate and more exact representation of the given signal. Also, the sex levels of DWT-based sorted ECG signals offer less working coefficients in comparison with real ECG signals. Additionally most of the coefficients concentrate at the sides of the levels (D1 to D6) of the sorted ECG signal. This, in turn, requires less time at making early, fast, and dependable diagnostics and classification. It is worthy to note that Daubechies wavelet function (db4) is used throughout this work. And the MIT-BIH arrhythmia database has been used for testing and validating the proposed work [4].

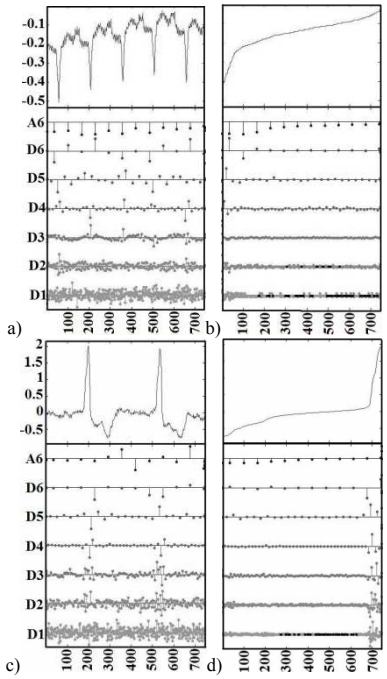

Figure 2 (a) Ventricular arrhythmia, and (c) Ischemia, with their sorted signals at (b) and (d), respectively. (Both abnormal and sorted ECG signals with their sex levels of DWT (D1 to D6 and A6))

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