Chapter 9
Review on Heart Studies

ABSTRACT

For many years, researchers have studied various aspects of heart disorder detecting. Noise removal, feature extraction and optimized approaches for classifications of heart signals are some of the main areas of their studies. In this chapter, some of the previous research on the mentioned areas is collected so that the readers may form a view from the total process of heart disorder detecting.

1 ECG SIGNAL NOISE REMOVAL

There have been several studies on ECG signal noise removal. Zhang and Sui (2010) proposed a method based on morphological filtering and wavelets to eliminate the noise in ECG signals and increase the diagnosis efficiency. In their method, the morphological filter is used to remove the baseline interference signal, and the wavelet transform is applied to remove high frequency interference. Results show that the proposed approach is efficient for noise removal.

In another study, Ling, Ho, Lam, Wong, Chan, and Tam (2008) proposed some fuzzy rules for formulating and integrating different multiwavelets with pre- and post-filters to incorporate expert knowledge at different noise levels. The computerized simulation shows that their proposed approach outperforms the traditional multiwavelet denoising algorithms by 30%. Yan, Kap and Shankar (2002) developed a modified morphological filtering (MMF) approach for baseline wander removal

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and noise suppression without signal distortion. Results show that MMF has good performance for noise filtering and low signal distortion ratio and baseline correction ratio.

Sotos, Melendez, Salort, Abad, and Ibanez (2007) presented a noise removal approach using multilayer ANN for different biomedical signals. Their method approach structure is similar to the Multiple ADAptive LINear Element (MADALINE) neural network. In another study of Sotos, Sanchez,, Mateo, Alcaraz, Vaya, and Rieta (2007), they worked on removing the baseline drift using ANN. The results obtained showed that the ANN-based method has better performance for baseline wander removal than the traditional approaches.

Chawla (2009), Independent Component Analysis (ICA) used for analysis to remove the artifcats and noise from ECG recordings. The reconstructed ECG signals were compared with the original ECG signal and the results showed that there was a significant improvement in signal quality in terms of signal-to-noise ratio (SNR). Zhang and Sui (2010) proposed a method based on morphological filtering and wavelets to eliminate the noise in ECG signals and increase the diagnosis efficiency. Although there are many new methods for noise removal, many systems for ECG signals still use the band-pass filter because of simplicity in implementation and less number of required coefficients (Losada, 2004; Orfanidis, 1996; Lian & Hoo, 2006; Engin, 2004; Minami, Nakajima, & Toyoshima, 1999; Lin et al., 2006; Naghsh-Nilchi & Kadkhodamohammadi, 2008).

The presented approaches have good performance to remove the noise. However, they have not proposed an idea for finding the cutoff frequency which is so critical in noise removal. Proposing an intelligent approach to help to automatically find the cutoff frequency will be the interest of many noise removal techniques such as Fourier transform. An automatic approach for finding the cutoff frequency will cause to develop a simple way for noise removal. Specially, for heart specialists who are involved with noisy ECG and do not have the filtering knowledge, proposing a simple automatic approach will be very effective and motivate them for using it because of its simplicity.

Previous research has indicated that the ANN is effective for denoising signals. Therefore, in this project an ANN-based method for calculating the cutoff frequency is investigated, since finding the correct cutoff frequency is an important issue for noise removal.

2 ANN SYSTEMS FOR ECG CLASSIFICATION

Solving the problem of classification is one the most important implementations of ANN. Solving classification problems requires ranging the available static pat-