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Abstract

Chapter-0 gives a brief survey of some important historical developments in the theory of wavelets and wavelet packets, which leads to the motivation of the study in the present thesis. The term signal denoising, some basic definitions and problems in processing signals are mentioned in this chapter. The fundamental denoising technique in wavelet domain is also discussed in this chapter.

All the basic concepts, notations and essential tools to be used throughout the thesis have been listed in Chapter-1. The whole chapter is divided into seven sections. The first section deals with the basic definitions, characteristics of wavelets and difference between a wave and a wavelet. The second section covers the evolution of wavelet transform and rest of the sections deal with the significant properties of wavelet transform, wavelet packet transform, reconstruction using these transforms and also basic characteristics of ECG signal.

Wavelet functions provide a new class of orthogonal expansions in $L^2(\mathbb{R})$, comprise a family of building block functions, localised in time and offer more flexibility than Fourier transform in representing different types of signals. In Chapter-2, we have studied performance comparison of wavelet threshold estimators for ECG signal denoising. A comparative study of various threshold estimators has been made for the ECG signal denoising. Mean square error is computed for different values of signal to noise ratio (SNR) of noisy ECG signal. The simulation is done using MATLAB 7.0.

In Chapter-3, we find the different values of signal to noise ratio and mean square error using wavelet transform with appropriate threshold value. An optimum threshold value is estimated by computing the minimum error between detailed coefficients of noisy ECG signal and the original noise free ECG signal. A very popular wavelet transform proposed by Daubechies (db3) is used. To evaluate the performance, we compare our method with universal threshold method.

The purpose of denoising methods can be used to improve the quality of ECG signal for the correct diagnosis of the problems of the patients. In Chapter-4, wavelet packets denoising methods have been considered. Wavelet packet transform is a simple but powerful extension of wavelets and multiresolution analysis, which yields basis functions with better frequency localisation at the cost of a slightly more expensive transform. A wavelet packet thresholding method has been proposed for denoising ECG signal. To choose optimal threshold value we have considered a basic assumption. Since noise in the signal is additive white Gaussian noise, that has a variance with invariant of time. Hence, the fixed global threshold is employed when noisy signal is analyzed in each scale. Again, in this chapter a very popular wavelet proposed by Daubechies (db3) is used as mother wavelet.

In ECG signals, baseline drift is the problem that can influence the accurate diagnosis of heart diseases, such as ischemia and arrhythmia. Muscle contraction, and electrode impedance changes due to movement of the body are the important sources of baseline drift in most types of ECG signal recordings. In Chapter-5, wavelet packet transform has been used for the correct estimation of baseline drift in ECG signal. Percentage root mean difference is computed using different levels. The simulation is done using MATLAB 7.0. The simulation result shows that level 8 is best for correct estimation of baseline drift in ECG signal.