ABSTRACT

Biomedical signals from many sources including heart, brain and endocrine system pose a challenge to researchers who may have to separate weak signals arriving from multiple sources contaminated with artifacts and noise. The analysis of these signals is important both for research and for medical diagnosis and treatment. The main difficulty in dealing with biomedical signals is the extreme variability of the signals and the necessity to operate on case to case basis. Another important aspect of biomedical signals is that the information of interest is often a combination of features that are well localized temporally or spatially and other that are more diffused. This requires the use of analysis methods sufficiently versatile to handle events that can be at opposite extremes in terms of their time-frequency localization. So, a robust method is to be designed which work in most circumstances rather than under very specific assumptions. Biomedical signals due to its enormous virtues are widely applied in several medical applications; Electrocardiogram, Electroencephalogram and Electromyogram are to name a few. However, these signals experience the addition of noise and result in an inefficient performance.

Denoising or the removal of noise is hence a major preprocessing task for such signals, and it has been carried out by different schemes for the past few years. Among the several schemes, wavelet-based denoising has taken the universal place in the signal-processing area. Wavelet transform has been an innovative method for the analysis and processing of non-stationary signals such as bio-signals in which both time and frequency information is vital. From the wide range of applications of wavelets, the most important application is the removal of noise from biomedical signals, which is gifted by thresholding wavelet coefficients in order to separate signal from noise. In the present work a combined scheme of applying denoising and compression for biomedical signals using wavelets has been presented. A detailed analysis of Discrete Wavelet Transform (DWT) denoising using various wavelet families on biomedical signals (ECG, EMG and EEG) is presented in the thesis. The main intention of the work is to explore the wavelet function that is optimal in identifying and denoising the various biomedical signals. Nevertheless, Wavelet transforms offer better results for denoising the bio-medical
signals, identification of the optimal Wavelet type is crucial. Therefore, the Artificial Neural Network (ANN) has been proposed in order to optimally select the Wavelet types to denoise the signals by using a learning back propagation algorithm. The application of ANN enables the selection of the optimal wavelet for each type of bio-medical signal. The proposed Wavelet Transform based frequency thresholding is used for noise removal of the noise corrupted decomposed biomedical signals. Then the signal is reconstructed using inverse wavelet reconstruction method. To reduce the storage size, hybrid wavelet Shannon-Fano coding is used for compression of denoised signal. Efficiency of the method used vis a vis existing techniques for the denoising of ECG, EEG and EMG signals has been evaluated and compared in terms of Signal to Noise Ratio (SNR), Percent Root Mean Square Difference (PRD), Mean Square Error (MSE) and Compression Ratio (CR).

**Index Terms**— DWT, ECG, EEG, EMG, Neural Network, Wavelet Frequency Thresholding