ECG DATA COMPRESSION USING WAVELET FAMILY

Hemlata Shakya[1], Shiru Sharma[2]

[1,2] *School of Biomedical Engineering, IIT BHU, Varanasi, U.P., (India)*

ABSTRACT

In this paper we have done ECG data compression using wavelet family. ECG compression methods classified into three categories: Direct compression method, Parameter extraction method and transform method. ECG is a diagnostic tool that records the electrical activity of the heart. Large amount of ECG signal data needs to stored and transmitted so, it is necessary to compress the ECG signal data. Wavelet methods are very powerful tools for signal and data compression. This paper evaluated the compression ratio (CR) and percent of root mean square difference (PRD). A high compression ratio is achieved with a relatively, low percent root mean square difference (PRD).

Keywords: Electrocardiogram, Compression ratio, PRD.

I. INTRODUCTION

ECG data compression is playing a vital role in biomedical application. An ECG is a diagnosis tool that records the electrical activity of the heart. It is used to measure the heart electrical conduction system. ECG is a simple and non invasive. Electrodes are placed on the skin of the chest and connected in a specific order and machine that, when turned on measure electrical activity all over the heart. The Output found on a long scroll of papers that displays a printed graph of activity on a computer screen. ECG signal has been extended for heart disease diagnosis and ambulatory monitoring for storage and transmission of large signal data, it is necessary to compress the ECG signal data [4].

ECG is a simple painless test that records the electrical activity. Shows on an example of a normal ECG waveform, which consist of a p wave, a QRS complex and a T wave. The u wave also some time visible. The p wave marks the activation of atria. This is the chamber of the heart that receives blood from the body, which collect oxygen rich blood from the lungs and the right atrium. The QRS complex represents the activation of the left ventricle. The T wave represents the repolarization of the ventricle.

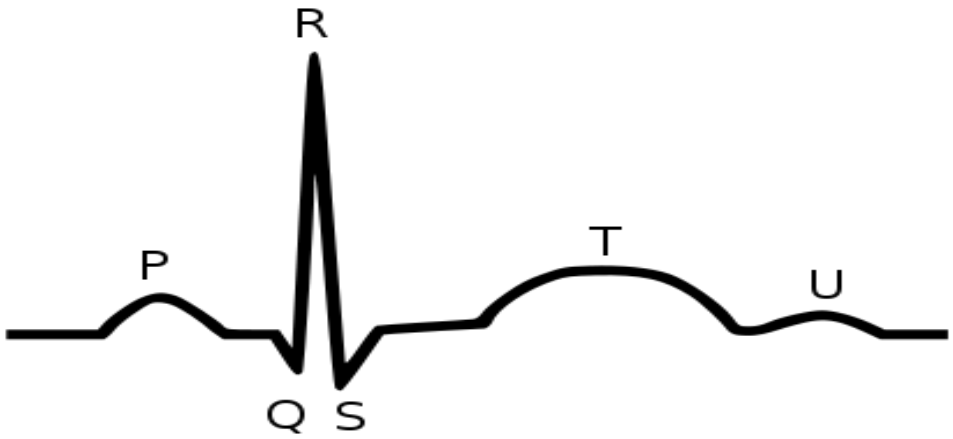

Fig.1 ECG Waveform

II. ECG DATA COMPRESSION

The goal of ECG compression techniques is to achieve a reduce information rate. A compressor can reduce the size of a file by deciding which data is more frequent by assigning it less bit than to less frequent data. To save time when transmitting and to save space when storing it.

ECG data compression methods are:

2.1 Lossless Compression

Lossless compression is a data compression algorithm that allows the original data to be perfectly reconstructed from the compressed data. Ex-It is used zip file format.

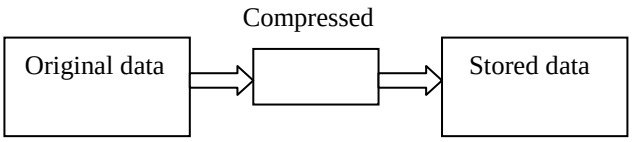

Fig.2 Lossless compression

2.2. Lossy Compression

Lossy compression is commonly used to compress multimedia data (audio, video and still images). It is the rate of the difference between original signal and the reconstructed signal.

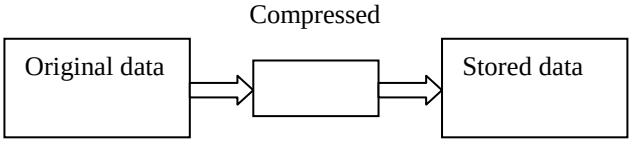

Fig.3 Lossy Compression

Wavelet transform is an excellent tool, an analyze the time and frequency signal. A number of time and

frequency methods are currently available for the high resolution decomposition the time frequency plane useful for signal analysis. The wavelet analysis procedure is to adopt a wavelet prototype function called an analyzing wavelet or mother wavelet. Wavelet was first introduced in seismology to provide a time dimension to seismic analysis that Fourier analysis lacked. Wavelets are used in a wide range of applications such as signal analysis, signal compression, differential equations and integral equations.

The wavelet transform is similar to the Fourier transform. Wavelets are better suited represent functions which are localized both in time and frequency signal.

The applications of wavelet transform are:

- Data and image compression
- Pattern recognition
- Partial Difference equation solving
- Texture analysis
- Transient detection

ECG signal is non stationary signal which includes different frequency component and different time location. Wavelet transform may localize the signal analysis in time and frequency domain simultaneously.

Wavelet families are Daubechies, Mexican, symlet, haar, Meyer wavelet, but I have taken two wavelet daubechies wavelet and symlet wavelets are used ECG data compression

2.3 Daubechies Wavelet

A family of wavelet transform discovered by Ingrid daubechies. This wavelet is similar to the haar wavelet. One of the brightest stars in the world of wavelet research invented what are called compactly supported orthonormal wavelet thus making discrete wavelet analysis. The names of the daubechies wavelet family dbN, where N is the order and db the surname of the wavelet.

2.4. Symlet Wavelet

The symlet wavelets are nearly symmetrical wavelet proposed by daubechies as modifications to the db family. The properties of the two wavelets families are similar.

III. COMPRESSION MEASUREMENT

To measure the performance for different compression methods, the original signal and reconstructed signal is measured by PRD.

3.1. Compression Ratio

The compression ratio defined as the ratio of bit rate of original signal to the bit rate of reconstructed signal.

CR= Original signal / Reconstructed signal

3.2. Percent of root mean square difference (PRD)

It is used for ECG signal reconstruction. It is the rate of difference between the original signals to the reconstructed signal [5].

$$PRD = \sqrt{\frac{\sum_{I=1}^{n}[X_{org(i)} - X_{rec(i)}]}{\sum_{I=1}^{n}[X_{org(i)}]}} * 100$$

IV. RESULT AND DISCUSSION

Wavelet family based ECG data compression proposed in this paper. The proposed wavelet based compression algorithm has been tested for the following parameters. In this paper two wavelet family daubechies and symlet wavelet are used. ECG data has been taken from the physionet database on the internet. I have taken the original ECG data and then decomposition of ECG signal. The daubechies wavelets (db3, db4) and symlet wavelet (sym2, sym3) are used. It is used for decomposition and then reconstruction of ECG signal. The work proceeds by taking the ECG signals and applies the wavelet transform and then calculate the compression ratio and percent root mean square difference. This processing is done with the help of matlab tool.

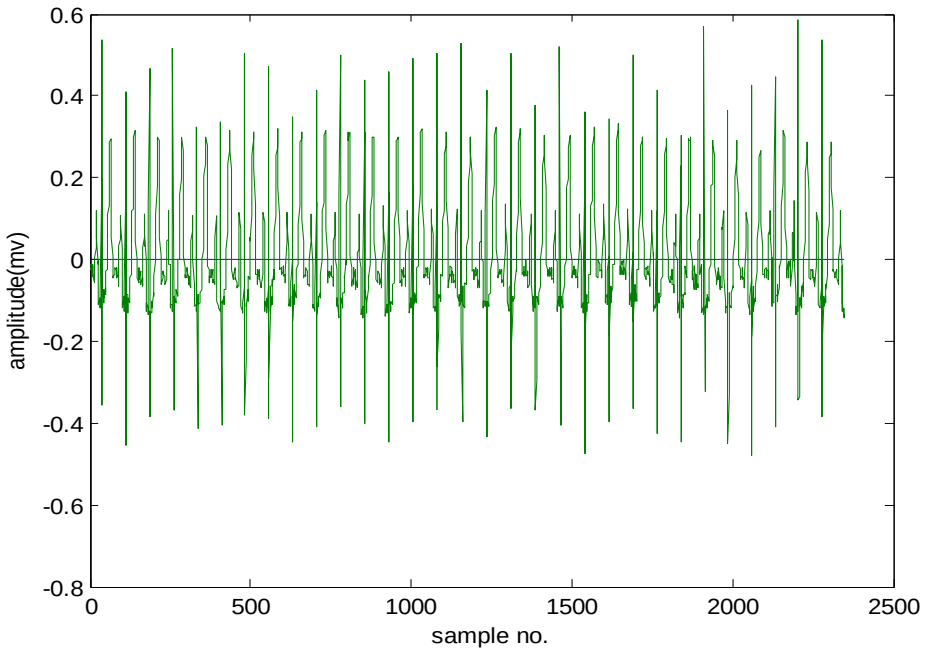

Fig.4 Original signal of ECG

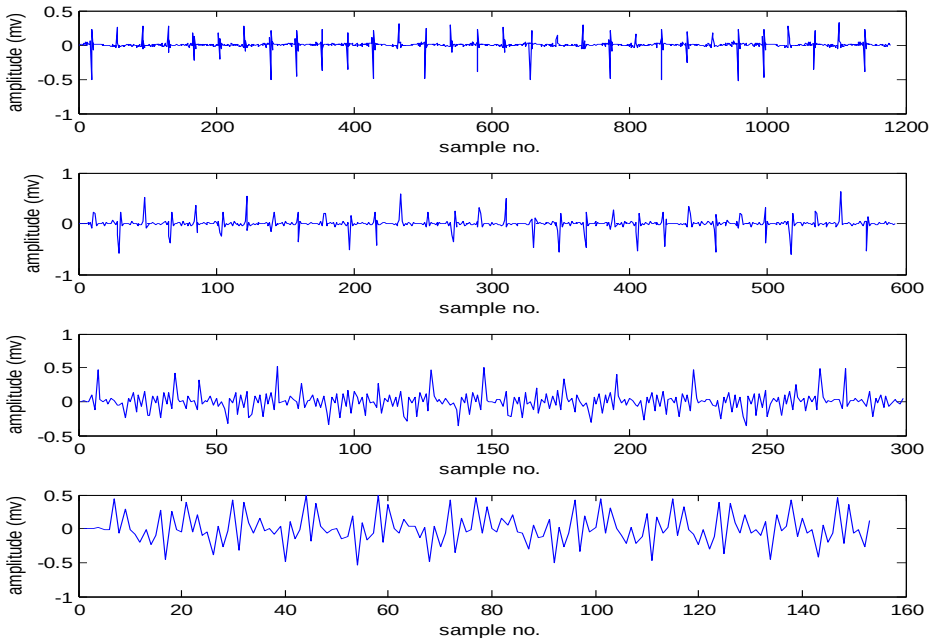

Fig.5 Decomposition of ECG signal

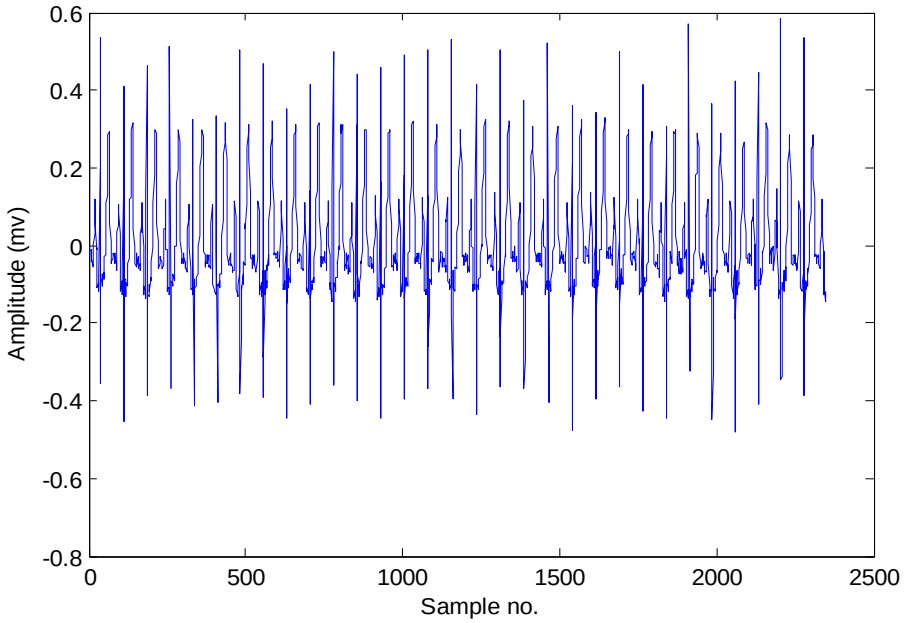

Fig.6 Reconstruction of ECG Signal

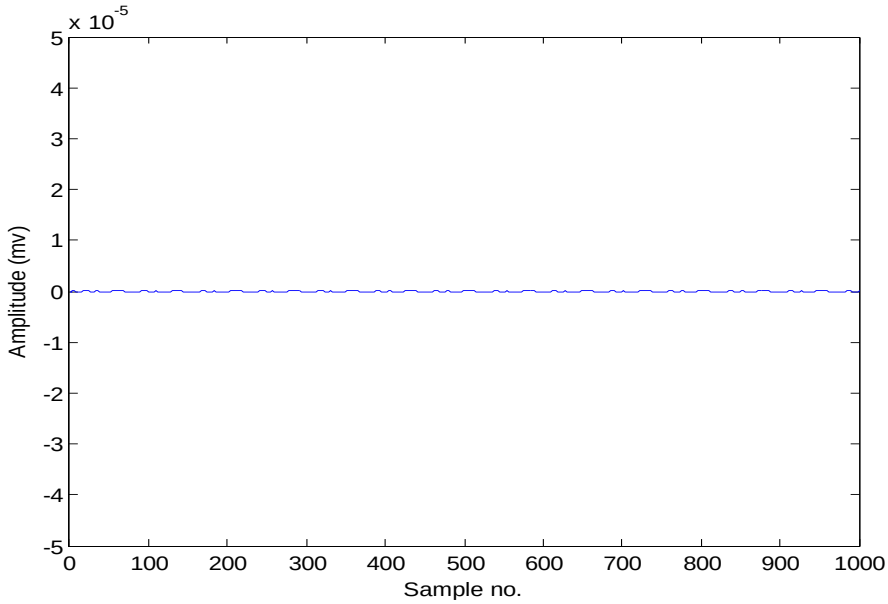

Fig.7 Error of ECG Signal

Table I

Wavelet Family	**Compression Ratio (CR)**	**Percent of root mean square difference (PRD)**
Db3	4.31	2.31
Db4	**5.00**	**1.99**
Sym2	1.02	9.78
Sym3	2.83	3.52

V. CONCLUSIONS

Wavelet transform is a powerful tool for signal compression and decompression. The proposed wavelet based compression algorithm has been tested for the following parameter. The use of daubechies wavelet and symlet wavelet (db2, db3, db4, sym1, sym2). The evaluated compression ratio and percent root mean square difference. The daubechies wavelet high compression ratio and low PRD value, and symlet wavelet is low compression ratio and high PRD value.

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