An Efficient Lossless Algorithm for EEG Signal Compression using Wavelet Transform

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ABSTRACT:

Transmission of biomedical signals through communication channels is being used increasingly in the clinical practice. This technique requires to deal with large volumes of information. The electroencephalographic (EEG) signal is an example of this situation. In the EEG, various channels are recorded during several hours, resulting in a great demand of storage capacity or channel bandwidth. This situation demands the use of efficient data compression systems. The objective of this work is to develop an efficient algorithm for EEG lossless compression. In this algorithm, the EEG signal is segmented and then decomposed through Wavelet Packets (WP). Extensive experimental tests were made by applying the algorithm to EEG records and measuring the compression rate (CR). The WP transform showed a high robustness, allowing a reasonably low distortion after the compression and decompression process, for CR typically in the range. The algorithm has relatively low computational cost, making it appropriate for practical applications.

1. INTRODUCTION:

Electroencephalography is the bio-signal which deals with recording the electrical activity of the human brain. It can produce the signals of up to 256 channels of up to 32 bps each, and it is sampled at the frequency of 1000Hz [5]. The EEG is used in the evaluation of brain disorders and it is used to find the brain damage. It has a high temporal resolution but poor spatial resolution. It can be efficiently stored and also transmit the huge amount of EEG signal by using the compression techniques. EEG compression has two types. They are lossy compression and lossless compression.

In the medical applications, transmitting the large amount of data through the compressed form. An excellent way to determine the performance by lossless EEG compression techniques.

Lossless data compression techniques allow perfect reconstruction of the original waveform; they yield the high compression ratios. There is some kind of quantization of the input data which leads to compression ratio. The lossless compression has the effective and economic data storage along with real time transmission of the signals. The most efficient data compression technique is the lossless data compression techniques. The efficient compression algorithms are required for the fast transmission of signals. So the signals are compressed before transmission with better accuracy.

The Wavelet Transform is the tool to find signal compression application. In Wavelet Transform analysis, the given equation for wavelet mentioned below.

A signal s (t) can be described by a linear decomposition method as,

$$S(t) = \sum_{j,k} c_{j,k}(t) \qquad (1)$$

Where j, k ∈ Z are integer indexes, aj,k are the wavelet Coefficients of the expansion, and cj, k is a set of wavelet Functions in it.

The paper is organized as follows: Section II discusses about the methodology, applied; detailing the clinical data used for the study and various data pre-processing, feature extraction techniques. Section III, the evaluation procedure and the obtained experimental results are presented. Finally, further discussion and conclusions are included in Section IV.

2. MATERIALS AND METHODS:

In this work, EEG data sets are analyzed by wavelet transform to decompose the signal in order to extract five physiological EEG bands, delta (0–4Hz), theta (4–8Hz), alpha (8–13 Hz), beta (13–30 Hz), and gamma (30–60 Hz).