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New proposed work for Epilepsy Seizure Detection Using Wavelet Based by Artifact Reduction

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Abstract: This **paper presents a method to remove artifacts from scalp EEG recordings to diagnosis/ detect seizure in epilepsy patients. Epilepsy is a neurological disorder in which the nerves in the brain communicate abnormally with each other. The proposed method is primarily based on stationary wavelet transform and takes the spectral band of seizure activities into account to remove artifacts in seizures. The EEG features responsible for the detection of seizures from non seizure epochs have been found to be easily distinguishable after artifacts are removed and consequently the false alarms in seizure detection are reduced. The proposed algorithm is based on the stationary wavelet transform (SWT) that takes the spectral band of seizure activities into account to separate artifacts from seizures. The reason of choosing wavelet transform over other methods (e.g. BSS, EMD, Adaptive Filtering, etc.) is its ability to decompose single-channel EEG data into different frequency band. In addition, the choice of SWT over discrete wavelet transform (DWT) is the factor that SWT is translational invariant since it involves up sampling of the filter coefficients instead of down sampling unlike in DWT**

Keywords**: Artifact, Scalp EEG, Epilepsy, Seizure detection, Stationary Wavelet Transform**

I. INTRODUCTION

Epilepsy is a neurological disorder in which the nerves of the brain communicate abnormally with each other. Epilepsy occurs when a surge of electrical signals from one cluster of nerve cells called neurons, temporarily overwhelm other neurons in the brain. The occurrence of seizure is uncertain which is the cause of disability associated with epilepsy [1]. To reduce this uncertainty of epilepsy, a recording system that provides early as well as accurate seizure detection with immediate warning.. One way to achieve that is to use the long-term EEG recording to detect the characteristics of EEG waveforms during seizures. The prolonged EEG recording is not only can increase the chance of detecting an ictal event (seizure) or an interical epileptic discharge, but it is also useful in the diagnosis of non-epileptic paroxysmal disorders compared to a routine EEG. Unfortunately, EEG recordings are contaminated by different forms of artifacts such as artifacts due to pop-up, motio artifacts, ocular artifacts and EMG artifacts from muscle activity that reduces the accuracy of recorded EEG signal. Thus, in order to correctly diagnosis the epilepsy, it is extremely important to remove such artifacts, prior to seizure detection The proposed algorithm is based on the stationary wavelet transform (SWT) that takes the spectral band of seizure activities into account to separate artifacts from seizures. The reason of choosing wavelet transform over other methods (e.g. BSS, EMD, Adaptive Filtering, etc.) is its ability to decompose single-channel EEG data into different frequency band. In addition, the choice of SWT over discrete wavelet transform (DWT) is the factor that SWT is translational invariant since it involves up sampling of the filter coefficients instead of down sampling unlike in DWT[11]. The proposed method is evaluated for EEG data where data consist of epileptic seizures and artifacts. The algorithms remove artifacts as much as possible without distorting the signal of interest.

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II. RELATED WORK

a. Methodology

The proposed methodology is shown in figure 1. The proposed method diagnose the artifacts in the seizure waveform

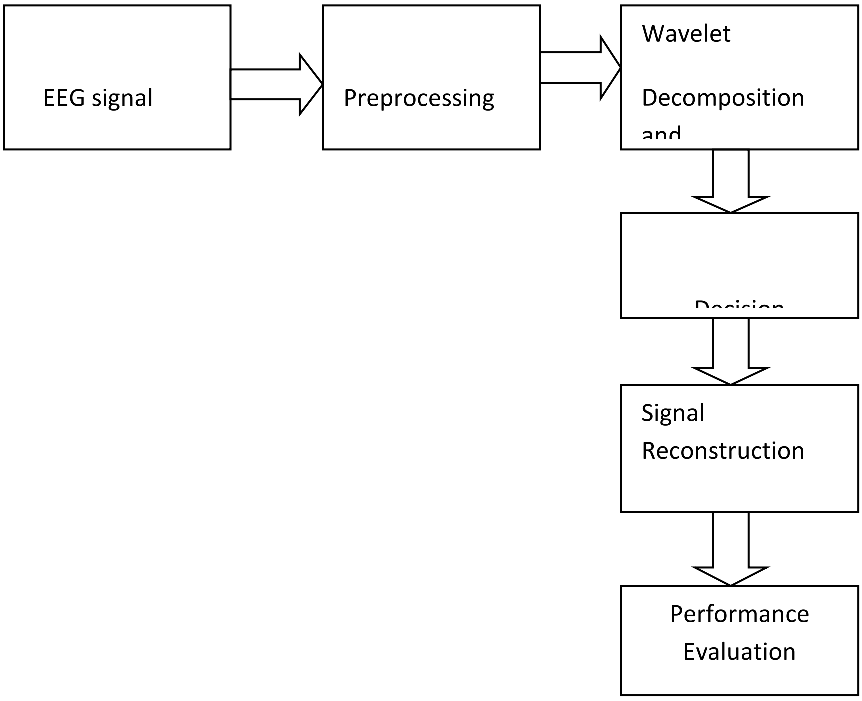

Fig 1: Methodology of proposed system

A. EEG signal

This stage generates a reference seizure epoch of length from an available seizure type specific seizure database. For example, the neonatal seizure events can be simulated from a free online database. On the other hand, if a seizure type specific database (epilepsy patient database) is available that the seizure events are labeled by the clinicians, then we can also use such type of database to generate the reference seizure. However, some preprocessing steps are necessary before starting to use such database

B. Preprocessing

Here, we have use preprocessing to remove the noise or unwanted spikes from the input signal, In the In the preprocessing the signal is firstly divided into non-overlapping epochs. The choice of epoch duration plays an important role in both of artifact removal and amount of distortion in the signal(i.e. seizure events). let xraw(n) denote the sampled raw EEG signal which is sampled at fs Hz where n is the discrete-time index. Then, the jth epoch is given by

$$xj = \begin{pmatrix} xraw\,(jN-1) \\ xraw\,(jN-2) \\ xraw\,(jN-N) \end{pmatrix}$$

'N' will determine the minimum time delay for seizure detection after its onset. If N is too low ((N/fs) < 1 sec) then such epoch may not represent accurate seizure waveform. When N is too high ((N/fs) > 5 sec) then there is high chance to miss lots of artifacts to be detect, so that artifacts are removes in lower amount. Hence we find (N/fs) = 3 sec to be optimum after trying different values

C. Wavelet decomposition and denoising

In the Wavelet decomposition the unwanted artifacts are removed by applying threshold is a familiar denoising process in biomedical signals. Usually, the denoising process refers to removing high frequency noise by thresholding the coefficients after wavelet decomposition. However by using the denoising term, we refer to removing artifactual components from neural signals in the wavelet domain whether it is high-frequency or low-frequency artifacts. The objective of this stage is to decompose and analyze the raw epoch with a reasonable time-scale resolution in wavelet domain for possible identification of artifactual component.

D. Decision

The Decision is the most important stage of the artifact removal algorithm. Depending upon this stage, we can take decision whether an epoch is to be detected is artifactual or seizure. In addition, if there is possibility for an epoch to be artifactual as well as seizure, then particular epoch that denoised to remove artifacts, is also decided in this stage.

E. Reconstruction

In the final stage of reconstruction, based on the decision stage, we apply inverse SWT to reconstruct the EEG epochs. Thus a new sequence of reconstructed data is obtained.

F. Performance Evaluation

The performance of the proposed algorithm has been evaluated in terms of amount of artifact reduction as well as amount of distortion that brings into the signal of interest, specially to the seizure events. several efficiency metrics have been calculated in time as well as in spectral domain to quantify such evaluation. From the input EEG signal we have calculate following parameters:

1) ΔSNR: Assuming the signals have zero mean, then ΔSNR is the difference in SNR before and after artifac Removal

2) ΔCor: Correlation is the measure of similarity between two time series in time domain.

3) ΔCoh: Coherence is the measure of similarity between two time series in frequency domain.

4) SNDR: we have calculate signal to noise ratio in frequency domain.

5) SNRart: Artifact SNR is calculated considering artifact as signal and reference neural signal as noise.

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III. CONCLUSION

The purpose of this research is to develop an artifact removal method in order to make the seizure analysis process easier for the clinicians and also to improve the performance of the available automated seizure detection algorithm.

REFERENCES

[1] R. S. Fisher, B. G. Vickrey, P. Gibson, B. Hermann, P. Penovich,A. Scherer, and S. Walker, "The impact of epilepsy from the patients perspective i. descriptions and subjective perceptions," *Epilepsy Research,* vol. 41, no. 1, pp. 39 – 51, 2000.

[2] S. F. S. O. Regan and W. Marnane, "Automatic detection of eeg artefacts arising from head movements using eeg and gyroscope signals," *Medical Engineering and Physics, vol. 35, pp. 867–874, 2013.*

[3] A. Bertrand, V. Mihajlovic, B. Grundlehner, C. Van Hoof, and M. Moonen, "Motion artifact reduction in eeg recordings using multi-channel contact impedance measurements," in *Biomedical Circuits and Systems Conference (BioCAS), 2013 IEEE, Oct 2013, pp. 258–261.*

[4] J. T. Gwin, K. Gramann, S. Makeig, and D. P. Ferris, "Removal of movement artifact from high-density eeg recorded during walking and running," *Journal of Neurophysiology, vol. 103, no. 6, pp. 3526–3534,* 2010.

[5] X. Yong, M. Fatourechi, R. Ward, and G. Birch, "Automatic artefact removal in a self-paced hybrid brain- computer interface system," *Journal of NeuroEngineering and Rehabilitation, vol. 9, no. 1, p. 50*

[6] B. S. Raghavendra and D. N. Dutt, "Wavelet enhanced cca for minimization of ocular and muscle artifacts in eeg," vol. 5, no. 9, pp. 846 –851, 2011.

[7] A. Flexer, H. Bauer, J. Pripfl, and G. Dorffner, "Using ICA for removal of ocular artifacts in EEG recorded from blind subjects," *Neural Networks,* vol. 18, no. 7, pp. 998 – 1005, 2005.

[8] N. P. Castellanos and V. A. Makarov, "Recovering EEG brain signals: Artifact suppression with wavelet enhanced independent component analysis," *Journal of Neuroscience Methods*, vol. 158, no. 2, pp. 300 – 312, 2006.

[9] C. Zhao and T. Qiu, "An automatic ocular artifacts removal method based on wavelet-enhanced canonical correlation analysis," in *Engineering in Medicine and Biology Society,EMBC, 2011 Annual International Conference of the IEEE*, 2011, pp. 4191–4194.

[10] K. Sweeney. PhD Thesis, National University of Ireland Maynooth, 2013.

[11] H. Guo and C. Burrus, "Convolution using the undecimated discrete wavelet transform," in *Acoustics, Speech, and Signal Processing, 1996. ICASSP-96. Conference Proceedings., 1996 IEEE International Conference on*, vol. 3, 1996, pp. 1291–1294 vol. 3.

[12] C. Guerrero-Mosquera and A. Navia-Va zquez, "Automatic removalof ocular artefacts using adaptive filtering and independent component analysis for electroencephalogram data," *Signal Processing, IET*, vol. 6, no. 2, pp. 99–106, 2012.

[13] Z. Wang, P. Xu, T. Liu, Y. Tian, X. Lei, and D. Yao, "Robust removal of ocular artifacts by combining independent component analysis and system identification," *Biomedical Signal Processing and Control*, vol. 10, pp. 250–259, 2014.

[14] M. K. I. Molla, M. R. Islam, T. Tanaka, and T. M. Rutkowski, "Artifact suppression from EEG signals using data adaptive time domain filtering," *Neurocomputing,* vol. 97, no. 0, pp. 297 – 308, 2012.

[15] M. K. I. Molla, M. R. Islam, T. Tanaka, and T. M. Rutkowski, "Artifact suppression from EEG signals using data adaptive time domain filtering," *Neurocomputing*, vol. 97, no. 0, pp. 297 – 308, 2