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EEG Ocular Artifact Elimination by Extraction of ICA Component

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ABSTRACT

Electroencephalography (EEG) is a method to define the ailments and to classify the activity on specific location by examining the brain signals. An EEG recording generally contains numerous artifacts. Elimination of Artifact is a significant concern while dealing with recordings of EEG. This paper offers an innovative method grounded on Independent Component Analysis (ICA) in EEGLAB toolbox of MATLAB to reject eye movement artifacts for elimination of artifacts from the EEG signals. The signals obtained from eye blinks and movements are of more magnitude than generated brain signals and this is the main cause of artifacts in EEG data. The result shows that the offered method is appropriate for removal of eye movement's artifacts and ideology of this technique can be extended to any other type of artifacts as well. The method is steady, easy to apply and offers a little computational cost.

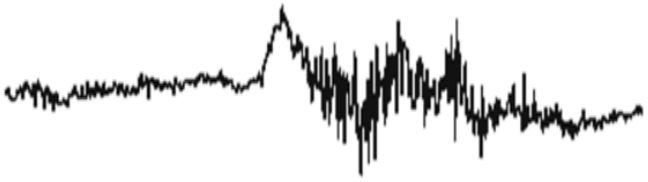
Keywords: Electroencephalography (EEG), artifact, Independent Component Analysis (ICA), EEGLAB, MATLAB

I. INTRODUCTION

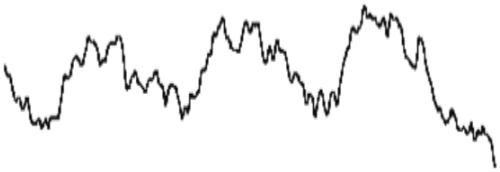
The electroencephalogram is a multi-channel indicator of brain activity which can imitate brain states related to the cerebral condition of an individual. EEG is an extensively used method for examining brain functioning of human. Artifacts are the unsolicited noise or certain disruption produced during recording of the brain signals. A main difficult is the contamination of EEG signal by numerous physiological and non-biological artifacts like eye blinks, movements, activity of muscle, heartbeat, line noise, high electrode impedance and intrusion from electric devices. (T. Raduntz et al., 2015). These artifacts signals are shown in Fig 1.The existence of electrical artifacts produced by eye blinks and eye movement's contamination produce a signal called Electrooculogram (Carlos Guerrero-Mosquera et al., 2009). Out of various techniques used to eliminate artifacts in EEG signals, independent component analysis (ICA) is used in this paper.

a) Eye Blink

b) Muscle Contradiction



c) HeartPulse



d) Eye Movement

Figure 1: Various types of artifact signals [P Bhuvaneswari et al., 2012]

The remainder of this paper is organized as follows: Section II presents the material and method of the designed system used for removal of artifact in EEG signals in MATLAB. Section III gives a detailed discussion on the results obtained. The final section concludes and describes the future scope of this work.

II. METHODS AND MATERIAL

EEG signal is taken from databases having 32 channels per frame having sampling rate of 128Hz. EEGLAB toolbox of MATLAB is used to eliminate the EEG artifacts. Basic FIR filter with lower pass band frequency of 1 Hz and higher pass band frequency of 40 Hz is used to eliminate the unwanted frequency signals. Then channel is rejected by given different threshold values and find out the noisy channel and plot the signal in MATLAB. Figure2 shows the EEG signals along with EOG artifacts at various nodes.

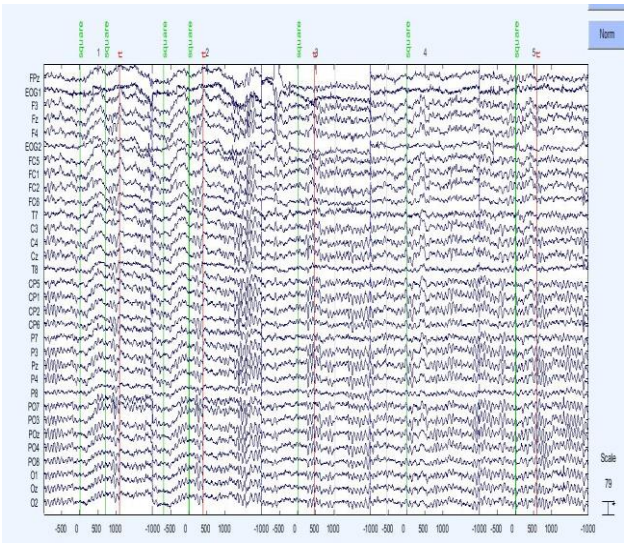


Figure 1. EEG signals at various nodes

III. RESULTS AND DISCUSSION

After obtaining EEG signals, when Z-score threshold of value 5 is applied to electrode2 of obtained EEG signals, signals obtained are shown in fig.3

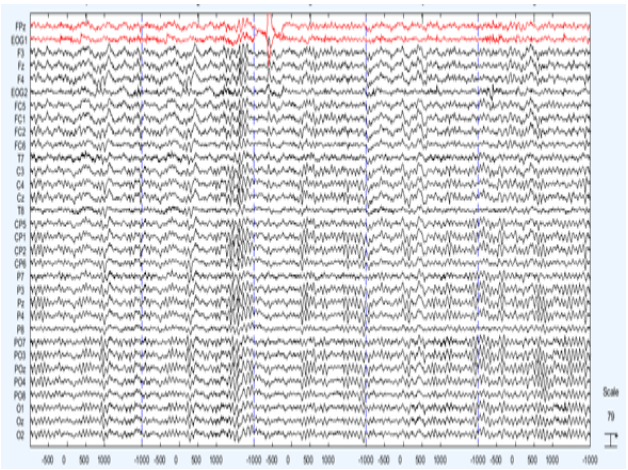


Figure 3. Signals after applying threshold5 at electrode2

These 32 EEG data epochs are obtained at 32 channels as shown in Fig4. By viewing & analysing the properties of these epochs in component properties, it was found that three components (3,11 and 28)are responsible for ocular artifact as shown in Fig5.

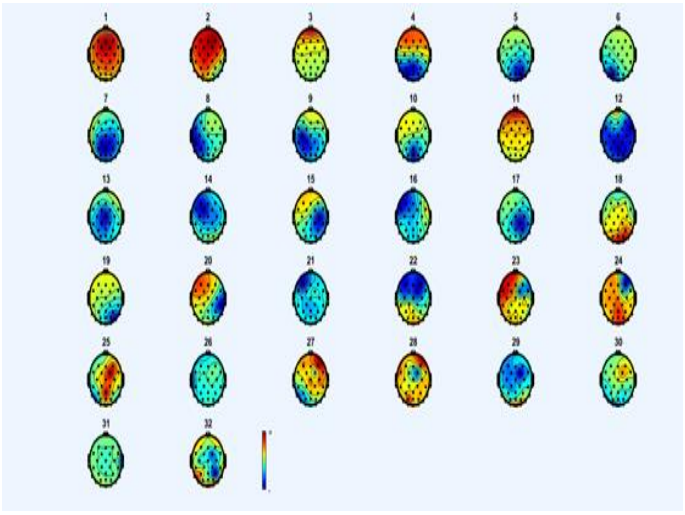


Figure 4. EEG data epochs

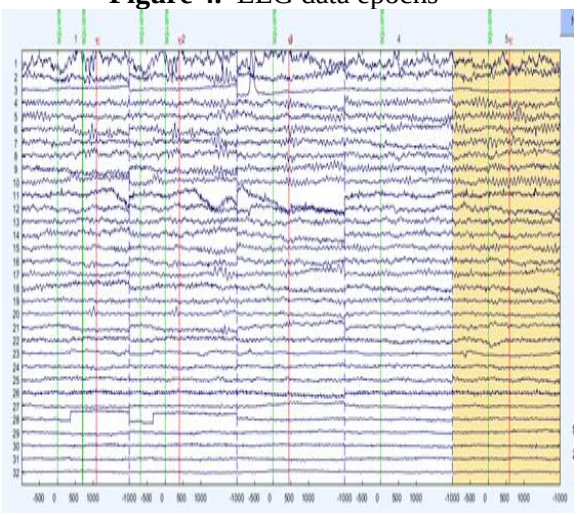


Figure 5. EEG plot of component analysis

These 3 components which are responsible for ocular artifacts by component rejection using ICA and left epochs are shown in Fig6.

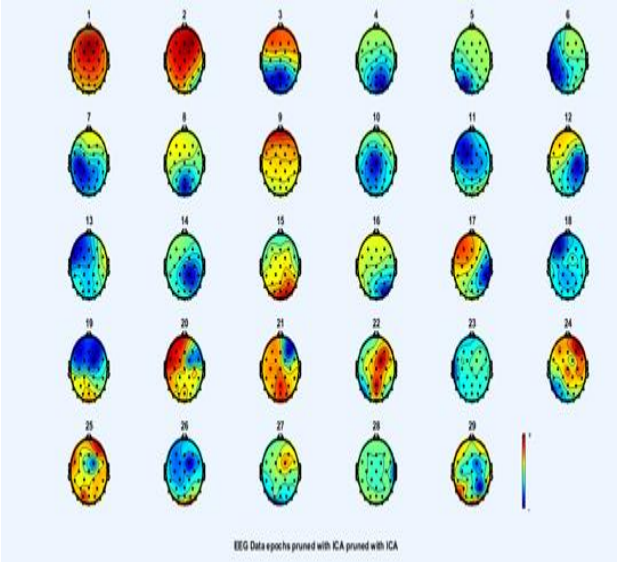


Figure 6. EEG data epochs pruned with ICA

After that ERP component of EEG Data epochs are analysed Fig7 shows the largest ERP components of EEG Data Epochs.

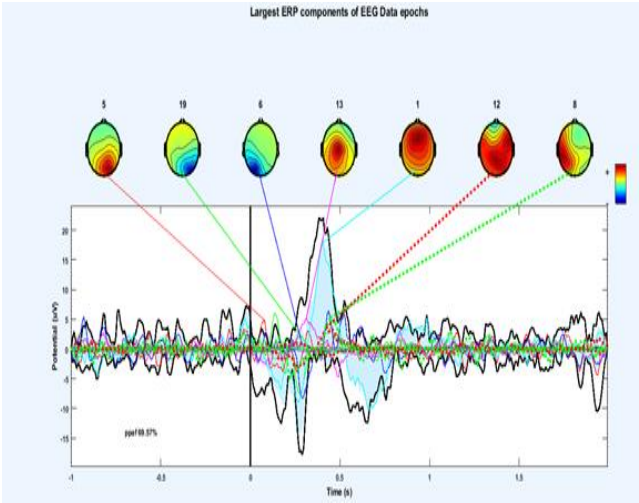


Figure 7 : Largest ERP components of EEG Data epochs

IV. CONCLUSION

Electroencephalography is unique technique to define the disorders and to recognize the activity on a specific location. The signals of EEG are contaminated by artifacts and can be recognized and eliminated using numerous techniques. The result indicates that ICA is extensively used technique to eliminate ocular artifacts with high precision for artifact recognition and elimination. In future this technique can be used to eliminate other types of artifacts in EEG signal.

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