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A suitable approach in extracting non event related potential sources from brain of disabled patients

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Abstract

Brain is the most important, astonishing and complicated part of human body which is responsible for controlling and functioning of all other human organs. The physical movements and thinking capability (Cognition) of humans depend on the brain activity. Based on certain changes that occur within the brain, electric fields will be generated within the brain. Analyzing brain signals plays vital role in diagnosis and treatment of brain disorders. Brain signals are obtained from electrodes of Electroencephalogram (EEG) or Magneto encephalogram (EMG). These are linear mixture of evoked potentials (EVP) of large number of neurons due to variations in conductive and geometric properties in the layers of 3 layer head model or 4 layer head model. Earlier work[1-5] considered processing these mixed signals for analyzing brain functioning of brain disabled patients. But working on the source signals gives an authoritative result. Hence there is a need to separate the source signals from the measured (electrode) signals. This work will suggest a suitable approach in extracting source signals of disabled patients while they were used as subjects under experiment of retrieving event related potentials (ERP). This work retrieved the signals of non target trails i.e., non event related potentials (NERP) and extracted original source signals by the best Gaussian estimate and the algorithm proposed.

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Keywords: Electroencephalogram (EEG);Magneto encephalogram (EMG);Non Gaussianity;Evoked potentials (EVP);Non Event Related Potentials (NERP).

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1. Introduction

Large part of the brain is the cerebrum, consisting of huge number of Neurons. Cerebrum is divided almost equally into two halves. The outer portion is the cerebral cortex which is a folded structure varying in thickness from about 2 to 5 mm. Total surface area of cerebrum is roughly 1600 to 4000 cm^2. Brain is collection of huge number of Neurons. Each neuron is an interconnecting segment in the network of the nervous system. Since brain controls overall functioning of mind and body, brain disorders have deep impact on pleasantness of human life. Communication between humans is affected severely with these brain disorders. Bain disorders cause different diseases. Some of them are briefed here. Cerebral Palsy (CP) is disease caused due to lack of oxygen to brain at the time of delivery of child. CP is a group of non progressive disorders of movement and osture caused by abnormal development of, or damage to, motor control centers of the brain[1]. CP occurs in 1.4-3.0 per 1000 live births. Major clinical features of CP are spasticity of extremities, extra pyramidal movements, dyskinesis and ataxia [2]. Lou Gehrig's disease is a disease that is known to lead to the locked-in syndrome and is otherwise called as amyotrophic lateral sclerosis (ALS) disease[3]. These patients are fully conscious and aware of what is happening in their environment but are not able to communicate or move. Other kinds of brain disorder diseases are lack of learning, seizures[4], Attention Deficit/Hyperactivity Disorder ADHD[5] etc., analyzing the functioning of brain can help working on solutions to the problems mentioned above. The studies of the electrical signals produced by the brain are addressed both to the brain functions and to the status of the full body. By applying digital signal processing methods[6] to the original brain signals extracted from recordings like EEG or MEG rather than electrode signals directly, it is possible to obtain patterns for diagnosis and treatment of brain disorders.

2. Brain signals

Potential generation from brain is fundamentally due to two sources. First is action potential which occurs due to membrane permeability variations and depolarization. This depolarization causes excitatory post synaptic potential (EPSP). Second is due to electrical activity in synapses which causes hyper polarization and produces inhibitory post synaptic potential (IPSP). The combination of this electrical potential of groups of neurons can be measured outside the skull, which is done by EEG. EEG gives in the potential difference between two points on the scalp. Exact location of the activity can't be estimated since there is some tissue and even the skull itself between the neurons and the electrodes. For EEG measurements an array of electrodes is placed on the scalp. The electrodes are placed according to the international 10-20 system[7], as is depicted in fig. 1.

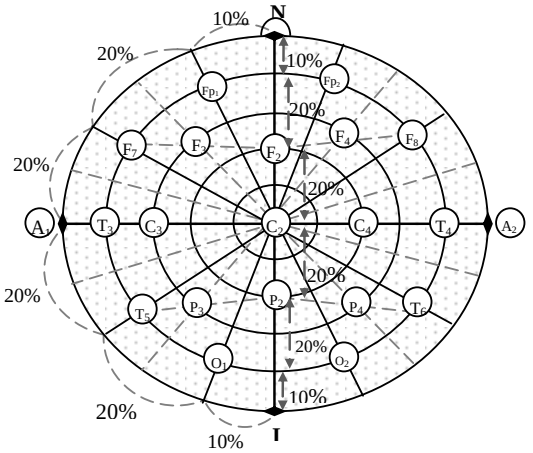

Fig. 1. Distance between electrodes of 10-20 system

The 10-20 system is an internationally adopted procedure to describe the placement of sensors on brain scalp as a standard for better comparisons between different measurements. 10 and 20 refer to distances between adjacent