T.C.
FATIH UNIVERSITY
INSTITUTE OF BIOMEDICAL ENGINEERING

ANALYZING of ELECTROENCEPHALOGRAPHY SIGNALS USING INDEPENDENT COMPONENT ANALYSIS

FATMA ÖZSOY

MSc THESIS
BIOMEDICAL ENGINEERING PROGRAMME

İSTANBUL, OCTOBER / 2014

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THESIS ADVISOR
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T.C.
FATİH ÜNİVESİTESİ
BİYOMEDİKAL MÜHENDİSLİK ENSTİTÜSÜ

ELEKTROENSEFALOGRAFİ SİNYALLERİNİN BAĞIMSIZ BİLEŞENLER ANALİZİ YÖNTEMİ İLE ANALİZİ

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To my mother,

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ABBREVIATIONS

App : Appendix
EEG : Electroencephalogram
ICA : Independent Component Analysis
Max : Maximum
Min : Minimum
Std : Standart Deviation

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SUMMARY

Analyzing Of Electroencephalography Signals Using Independent Component Analyzing Method

Fatma ÖZSOY

Biomedical Engineering Programme

MSc. Thesis

Advisor: Assist. Prof. Dr. Şükrü OKKESİM

Epilepsy is a serious disorder a central nervous system that characterized by recurrent seizures. A seizure is a sudden, absent aberration in the brain's electrical activity. Patients suffer from repetitive seizures that occur at unpredictable times and usually without notifying.

Electrical activity in various areas of the brain can be measured through the placement of electrodes on the scalp. This neurophysiological data is broadly referred to as EEG, and is often recorded for diagnostic purposes. According to EEG data seizures can partial or generalized. Detecting of seizure, and non-seizure activity of EEG data important for understanding the behavior of epilepsy.

Independent Component Analysis(ICA) was used to extract independent signals from EEG signal. We used independent component analysis and calculate seizure and non-seizure activity for obtained epileptic source in the brain.

Keywords: Epilepsy, EEG, Seizure, Independent Component Analysis

ÖZET

ELEKTROENSEFALOGRAFİ SİNYALLERİNİN BAĞIMSIZ BİLEŞENLER ANALİZİ YÖNTEMİ KULLANILARAK ANALİZ EDİLMESİ

Fatma ÖZSOY

Biyomedikal Mühendisliği Programı

Yüksek Lisans

Danışman: Yrd. Doç. Dr. Şükrü OKKESİM

Epilepsi, tekrarlayan nöbetlerin görüldüğü sıklıkla rastlanan bir merkezi sinir sistemi rahatsızlığıdır. Nöbet beyin hücrelerinde geçici anormal elektrik yayılması sonucu ortaya çıkan klinik bulgudur. Hastalar bilinmedik zamanlarda tekrarlayan nöbetlerden muzdariplerdir.

Elektroensefalografi beynin elektriksel aktivitesini yüzey elektrotlarıyla kafa derisi üzerinden ölçer. Bu nörofizyolojik bilgiler genellikle teşhis amaçlı olarak kayıt edilir. EEG datalarına göre epilepsi parsiyel veya jenaralize nöbet olabilir. Parsiyel veya jenaralize nöbetin tespiti epilepsi hastalığının tespitinde öenmlidir.

Bağımsız bileşenler analizi EEG sinyalini oluşturan birbirinden bağımsız bileşenleri ayırmak için kullanılır. Çalışmamızdaki amaç nöbet öncesi ve nöbet esnasındaki EEG datalarını bağımsız bileşenler analizini kullanarak hesaplayarak beyindeki epileptik nöbetlere sebep olan kaynakları bulmaktır.

Anahtar kelimeler: Bağımsız Bileşenler Analizi, Elektroensefalografi, Epilepsi,Nöbet

CHAPTER 1

INTRODUCTION

1.1 Purpose of the Thesis

Epilepsy is an important defect of the central nervous tract, that prepare those effected to relapse attacaks. Approximately fifty millions of people worldwide have falling sickness, and approximately 80% of falling sickness happens in rising countries [1].

An attack is a peracute impairment of neuronal efficacy of the brain that is clinically issued by reflex change in behavior, movement, precision, or conciousness [2]. Two-thirds of impressed persons have attacks that are controlled by antiepileptic drugs. Other 7%-8% can be treated by falling sickness operation. So about 25% of persons with falling sickness, attacks cannot be controlled by any available cure [3].

Electrical efficacy in multiple fields of the brain can be measured through the laying of electrodes on the skull, on the face of the brain or within its deepness. This nervous tract physiology knowledge is broadly referred to as EEG, and is often saved for diagnostic goals. A lot of studies have specified that EEG pulses do have valuable knowledge that, if correctly analyzed, could help in the estimate of attacks in epileptic sick persons before their occurrence [4].

A goal of actual investigations to develop attack-triggered diagnostic, curative and alerting tracts. [5]. Distinct component analysis (ICA) is a novel method that can separate statistically distinct agents from complicated pulses [6].

The recently improved ICA method is improved for estimating underlying components of (multidimensional) statistical data [7].

Distinct componenet analysis (ICA) is recently improved method in which the goal is to find a linear simile of nongaussian information so that the elements are statistically

distinct or as distinct as possible. So a simile seems to capture the base presence of the information in a lot of applications, including property ejecting and pulse seperation [8]

Our goal is, analyzing about child ilnesses EEG information and property ejecting for find attack origin on the brain using distinct component analysis (ICA) .

CHAPTER 2

2.1 Brain

The human brain is one of the most complicated and imposing organs in the human body. The brain is the control centre for all the body's functions .This organ allows us to think, move, feel, see, hear, taste and smell .It controls our body parts, receives, analyzes knowledge.The brain produces electrical pulses, which together with chemical reactions, let the parts of the body comminicate.Neurals send these pulses throughout the body. Every parts of the brain are responsible for controlling various body functions. One part of brain harmed, other parts of brain could not perform activities .For example the occiputal lobe involves the base center for operatesing visual knowledge. If the occiut lobe on each sides of the brain is harmed, people cannot see, despite the eyes themselves are functioning normally. This defect is called cortical blindless.

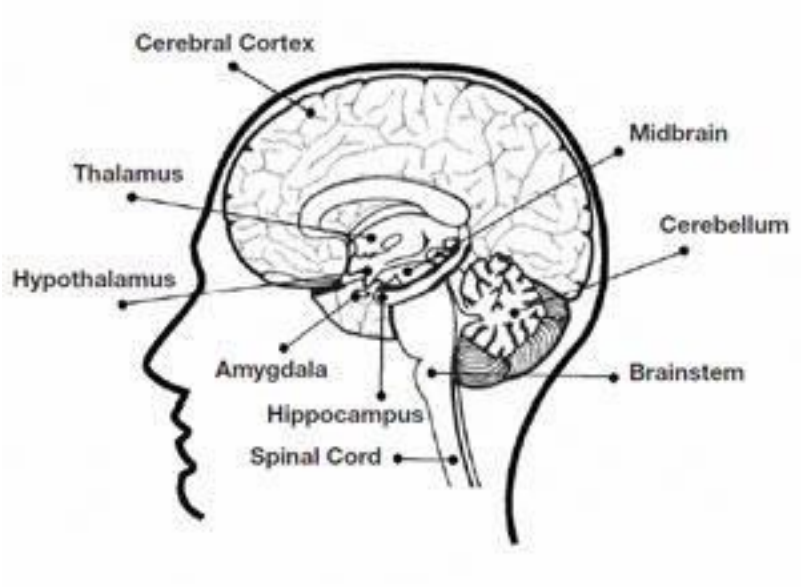

Figure 2.1 Major Regions Of the Brain[9]

The human brain is a complicated presence that is composed of two big classes of individual cells: neural cells (or neurons) and neuralgic cells (or glial cells). Neurons operates and transmit knowledge. The usual constructional propertys of a neuron has a cell body (or soma), anywhere from some to some hundred branching dendrites that are diverticulums from the soma, and a generally longer extension known as the neurite with one or some synaptic terminals at its end. The knowledge that is operated and delivered in the brain takes the form of various brief electrochemical events, with a typical duration of less than two milliseconds, called action potentials or neural pulses. These pulses most often arise from near the place at which the neurite and soma are joined and then move at speeds of till 130 meters for second along the neurite to the synaptic boundaries [10]

2.1.2 Action Potential

The action potential is either an immediate increase or a decrease in the electrical cell membrane potential for a short moment. The action potential occurs caused by ion exchange which passes through the nerve cell membrane and it is a temporary change in the cell membrane transferred along the axon. It is generally started in the cell body and continues in a normal direction. The cell membrane is "depolarized" by producing a vertical attack, or it becomes positive. After the vertical attack, the cell membrane is repolarized, or it becomes negative. The action potential of most nerve cells continues 5-10 ms. The velocity of the action potential changes between 1-100m/s. the action potentials can be started by lots of different types of stimulus (chemical, electrical, optical, baric, tactual). For example, the nerve cells in the central neurosystem are activated chemically. In order for this stimulu to create an action potential, it should reach the threshold. Otherwise, it leads only to a local electrical defect and the action potential does not occur. Only when the stimulu reaches the threshold, an action potential is created and it starts to move from the nerve cell. The sharp point of the action potential occurs by opening of the Na channels. The Na pomp produces both Na and K gradients. Each of them is used for producing the action potential.Na is more outside of the cell than the inside. Excitable cells have special Na and K channel gates which can be opened or closed according to the cell membrane voltage. The open Na

channel gates permit positive Na to pour inside the cell. It leads to depolarization and creates a vertical attack [11].

The process;

I. The Na channels are opened when the nerve cell dendrites receive a stimulus and if this opening is able to make the inner potential increase from -90 mV to -60 mV, the process continues.

II. After arriving to the threshold, more Na channels are opened. The Na flow increases the inside of the cell membrane to about 20 mV. This process is called depolarization.

III. Then Na channels are closed and K channels are opened. Because of the fact that K channels open very slowly, the depolarization time gets full. When both channels are opened at the same time, it makes the system neutral and prevents the production of the action potential.

IV. When K channels are opened, the cell membrane repolarizes itself towards the resting potential.

V. Repolarization generally makes the resting potential -90 mV. This is called also as "hyperpolarization." The hyperpolarization prevents the nerve cell to take another stimulus during this stage or at least prevents it to reach the threshold.

Another importance of hyperpolarization is that it guarantees the signal to continue in a mere direction.

VI. After hyperpolarization, Na and K pomps makes the cell membrane turn its resting potential -90mV. In order for a nerve cell to receive another stimulus, it requires only 2 ms. During this stage, the action potential cannot be produced [12].

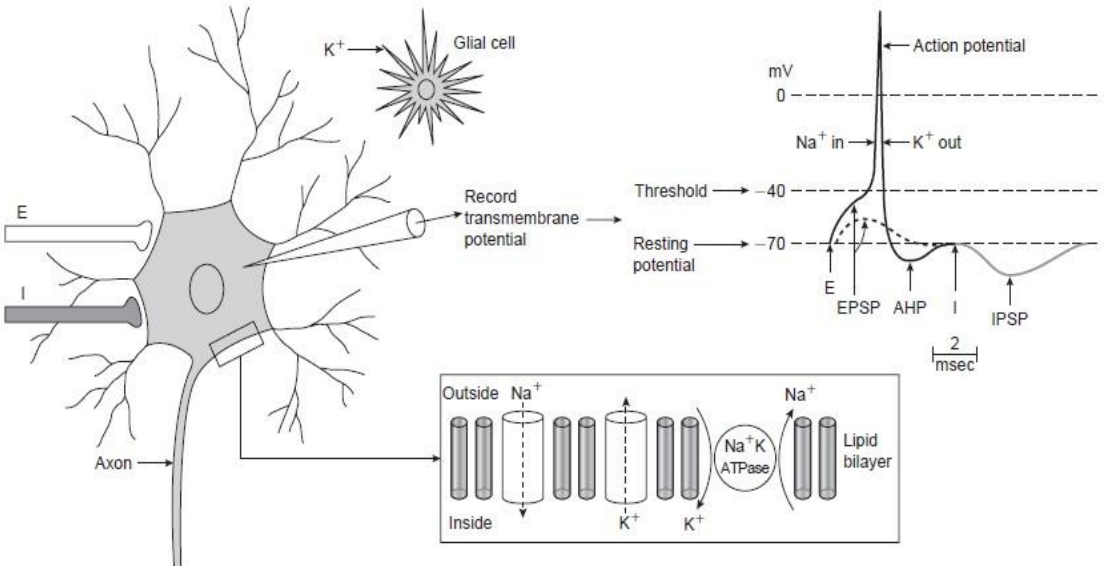

Figure 2.2 Action Potential

2.2 Epilepsy

Epilepsy is a serious disorder a central nervous system.Epilepsy is a clinical condition caused by increased excitability (neuronal hyperexcitability) of the nerve cells in the brain. Epileptic seizure stems from the increased, fast and local electrical discarges in the grey matter and immediate, short term and temporary stereotypical change conditions in the conscious, attitude, emotion, motion and sensation as limited to a specific time clinically are observed. Epilepsy describes the table of going away of the chronically recurrent and non-provoked attacks. So, one single non-provoked attack does not mean the epilepsy [13]. The attacks generally repeat according to some stimulating factors or of its own accord in a specific shape for each patient.

Between the attacks, the patient generally lives a normal life. The attack spaces and types can be extremely different. However, in the same patient, generally, the same or specific types of the attacks show inclination to repeat.

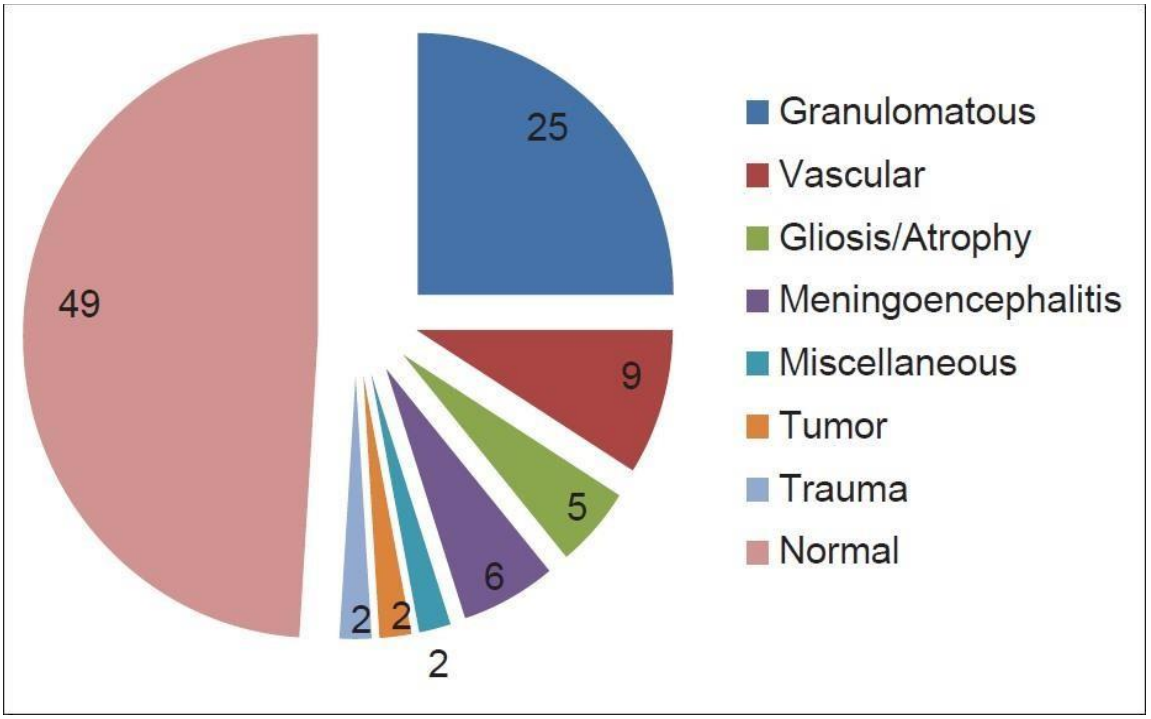

Figure 2.3 Etiology of epilepsy [14]

2.2.1 History of Epilepsy

On the Sacred Disease(first book on epilepsy),wrote by Greek physician Hippocrates around 400 B. C Hippocrates approved that epilepsy was a brain defect, and he refuted the views that attacks were a curse from the gods and that people with epilepsy held prophetic powers. Wrong idea die slowly–a 1494 handbook on witch-hunting, Malleus Malefi carum, written under papal control, used attacks as a characteristic to describe witches. The Malleus fomented a surge of holdfast and torture and the death of approximately 200,000 women. At the beginning of nineteenth century, asylums cared for human with falling sickness and psychiatric defects, but the two groups were resigned because attacks were considered epidemic. At the beginning of twentieth century, some U.S. countries had laws restraining human with falling sickness to marry or become parents, and some countries tolerated sterilization. We have come a long way[15].

2.2.2 The Epidemiology of the Epilepsy

Epilepsy is a common neurological disease all over the world. The prevalence of the epilepsy has been found as 3-22,3/1000 in the studies of different countries. In 1996, the epilepsy prevalence of the 0-16 Turkish children was 8/1000 [16]. The frequency of the epilepsy according to the age is higher in the early years of the life (120/100.000),in 1-10 years 40-50/100.000, from 10 until the end of the adolescence 20/100.000 [17].

It is declared in Germany that in 1999-2000, the frequency of the 0-15 age is 61/100000 [18]. In England, yearly epilepsy incidences in 29 months- 14 year old children was found 66,37100.000 in 2001-2003 [19].The incidence and the prevalence of the epilepsy are higher in developing countries leading to symphtomatic epilepsies. The birth trauma, the cranial trauma and central neuro system infections are among the causes of the epilepsy which can be avoided and it is known that they increase the epilepsy incidences in developing countries .In a work conducted by Kenya people, the yearly incidences are declared as187/100.000 in 6-12 children [20] .

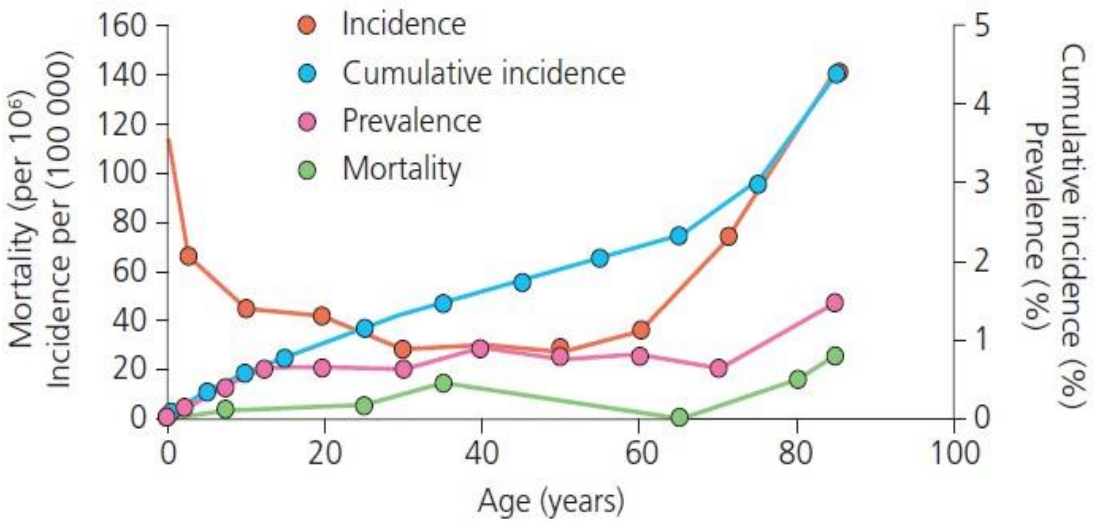

Figure 2.4 Incidence, cumulative incidence, prevalence and mortality for epilepsy in Rochester, Minnesota, 1935–1984 **[21]**

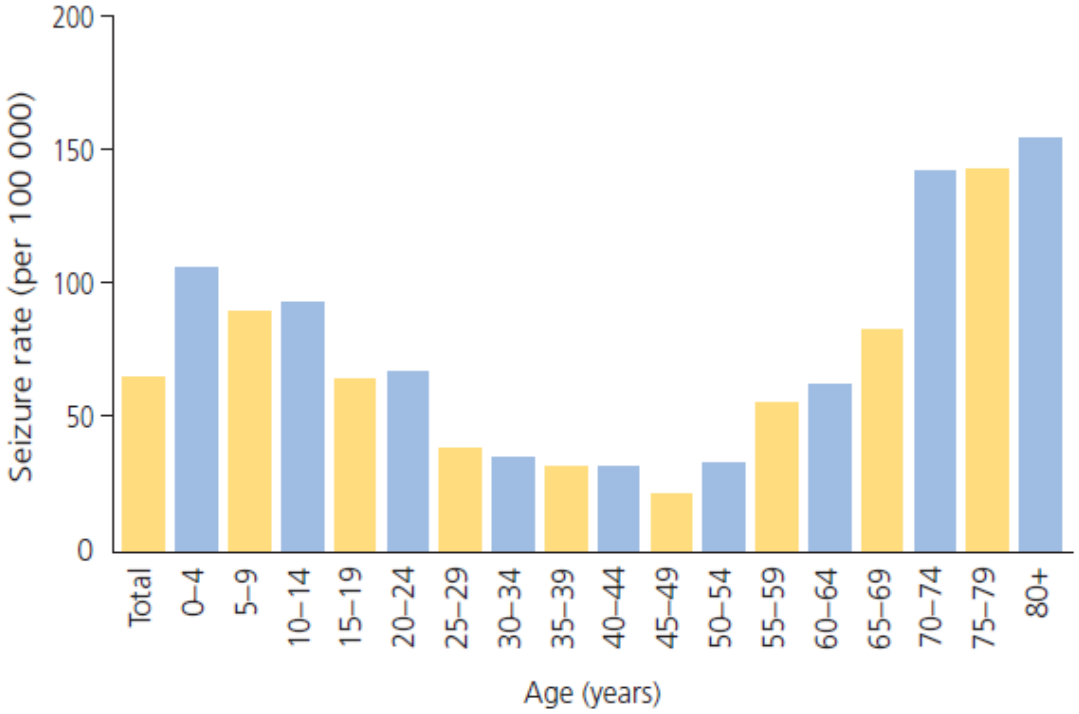

Figure 2.5 Incidence of epilepsy in relation to age **[21]**

2.2.3 3 Epileptic Seizure

An attack is sudden impairment of the neuronal efficacy of the brain that is clinically issued by an reflex change in behavior, movement, precision, or conciousness [2]. Human with falling sickness, affected from recurring attacks that occur at unforeseen moments and often without alarm. Attacks can result in a lapse of attention or a whole-body convulsion. Frequent attacks increase an individaul's risk of sustaining physical injuries and may even result in death [22].

The attacks generally repeat according to some stimulating factors or of its own accord in a specific shape for each patient. Between the attacks, the patient generally lives a normal life. The attack spaces and types can be extremely different. However, in the same patient, generally, the same or specific types of the attacks show inclination to repeat[23].

2.2.4 Classification of Seizure

Neurologists are try to classification the epilepsy in international conferences since 1960.According to EEG data , seizures can classified as generalized or partial.[24]

Partial seizures also known as focal seziures ,in only portion of the brain has irregular functioning.Symptoms and signs depend upon part of the brain that influenced.[25]

Table 2.1 International Classification of Seizure table

I. PARTIAL SEIZURES (seizures beginning locally)
A. Simple partial seizures (consciousness not impaired)
1. With motor symptoms
2. With somatosensory or special sensory symptoms
3. With autonomic symptoms
4. With psychic symptoms
B. Complex partial seizures (with impairment of consciousness)
1. Beginning as simple partial seizures and progressing toimpairment of consciousness
(a) With no other features
(b) With features as in A 1–4
(c) With automatisms
2. With impairment of consciousness at onset
(a) With no other features
(b) With features as in A 1–4
(c) With automatisms
C. Partial seizures secondary generalized
II. GENERALIZED SEIZURES (bilaterally symmetrical and without local onset)
A. 1. Absence seizures
A. 2. Atypical absence seizures
B. Myoclonic seizures
C. Clonic seizures
D. Tonic seizures
E. Tonic-clonic seizures
F. Atonic seizures
III. UNCLASSIFIED EPILEPTIC SEIZURES (inadequate or incomplete data)

2.2.5 5 Childhood Epilepsy

There are a lot of more disturbed seizures in neonates and infants than in adults. Their causes may include trauma, hypoxic-ischemic encephalopathy, high blood pressure, metabolic aberrances (amino acid disturbances, hypocalcemia, hypoglycemia, and electrolyte imbalance), infections, drug shrink, pyridoxine dependency, and toxin [26].

Similarly, a genetic leaning to epilepsy may be clarified in infancy. Genetic elements may include congenital encephalic malformations and domestic attacks such as neurocutaneous symptom complex, genetic symptom complex, and good natured tumor domestic epilepsy [27]

Additionally, several difficult attack syndromes happen in early infancy or childhood and not later on.

2.3 Electroencephalography(EEG)

EEG is non-invasive method that measures electrical activity of the brain using surface electrodes [28]. The EEG is carried out by means of an electro gel, with a conductive matter, and tiny electrodes sticked on to the hairy head. The potential differences between these two electrodes are recorded in a computer and the result is commented by an expert and the required information is given to the patient. In the examination of the record, the diagnosis of the disease can be carried out comparisons between the normal and the results of the time and frequency axis [29]

2.3.1 History of EEG

In 1929, a German psychiatrist called Hans Berger, who worked in the city of Jena, declared to the world that it was possible to record the feeble electric actuals generated on the brain, without opening the skull, and to tell them graphically onto a strip of paper. Berger called this new form of recording as the electroencephalogram (EEG) that this efficacy changed pursuant to the functional case of the brain, such as in sleep, anesthesia, oxygen deficiency (lack of oxygen) and in certain nervous ilnesses, such as in epilepsy [30].

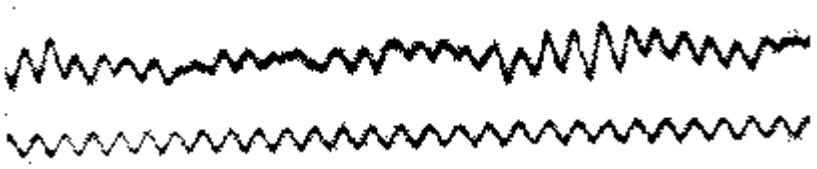

Figure 2.6 First EEG by Hans Berger[31]

2.3.2 EEG Recording

EEG records the immediate electrical activity from the cerebral cortex. The EEG signs are not periodical. The amplitude, phase and the frequencies constantly change. Therefore, in order to derive a meaningful data, the measurements should be considerably long. The routine EEG recordings generally last 20 minutes. 1 minute of this is hyperventilation (deep breath) and 1 minute is optical stimulation (photic stimulation). During the photic stimulation, firstly, a low frequency photic stimulation is given for a specific time. Then resting occurs as long as this time. The same process is repeated by increasing the frequencies. It lasts generally 10 seconds. In order for patient not to react any outsider leading to corrupted signs, the environment should be voiceless and dim. Because the patient should not be exposed to any sensational stimulus during the recording. If possible, the electronic devices should be avoided. Because, the magnetic waves from these devices can lead to the data of EEG to be noisy. In EEG recording, generally 10-20 electrode system is used. In this system, the electrodes should be placed at 10-20% spaces between the nasion and the inion. According to this system, even though 75 electrode areas are detected, in clinical applications generally 8-32 number of electrodes are seen enough [32]. The placements of the electrodes are as below [26].

While recording the EEG, 0.5 mm solder or silver-silver chloride disc electrodes should be attacted to hairy skin by colloide or sticker paste material. In the EEG there are either 8-24 or more increasing units which can get records from several places simultaneously. The increased rhythms of the brain are strong enough to move a pen. The standard velocity of the flow is 3 cm-s. on the paper, 0.5-30 Hz brain activity waves are drawen. These waves are generally processed digitally and transferred to a monitor. This EEG graphic is actually time against voltage graphic. The received data are generally recorded as parallel wavy striped. Every channel symbolizes the electrical potential between two electrodes. A mutual or soil electrode can be used as a mere record point. The channels are regulated generally to be seen as standard montages comparing the received activity from the other hemisphere of the cerebral cortex. The traditional EEG pen tecnique slowly leaves its place to the digital EEG. İn the digital EEG the numbered wave forms are displayed on the monitor. The abundant number of the channels make

the results to be commented easily. The digital EEG provides also the redeposit and revaluation . the block associated with the EEG record the standard EEG consists of lots of records of either 150-300 or more which are all 10 seconds. In order to prevent the movement or artefacts-defective signals-effects occurred in the patient during recording process, there are some precautions. Moreover, in order for the records to be correct, the patient should not take sedative drugs or should not stay hungry for a while. The opening of the eyes under bright sun and then closing make differences [33].

The routine EEG is the most important laboratory method for diagnosing the epilepsy. It is tried to detect the asymmetry or slowing and epileptiform discharges (thorn, sharp and thorn-sharp discharges) apparent in the bottom activity. It gives information about the electroclinical syndromes. It helps to answer whether the patient is epilepsy or not, if yes, what its type is. If the lateralization of the detected anomally, it is precious for the localization. However, it does not always mean to have epilepsy to see epileptiform anomally. Instead, it should be kept in mind that a normal EEG does not exclude the diagnosis of the epilepsy.

2.3.3 EEG Waves

The brain activity and the frequency of the EEG signs are related closely. The frequency and activity the increase together. In the clinical analysis of the EEG signs are between 0,5-30 Hz. The signs are called as gama on this band. They are used scarcely. Because they have very little amplitudes [34].

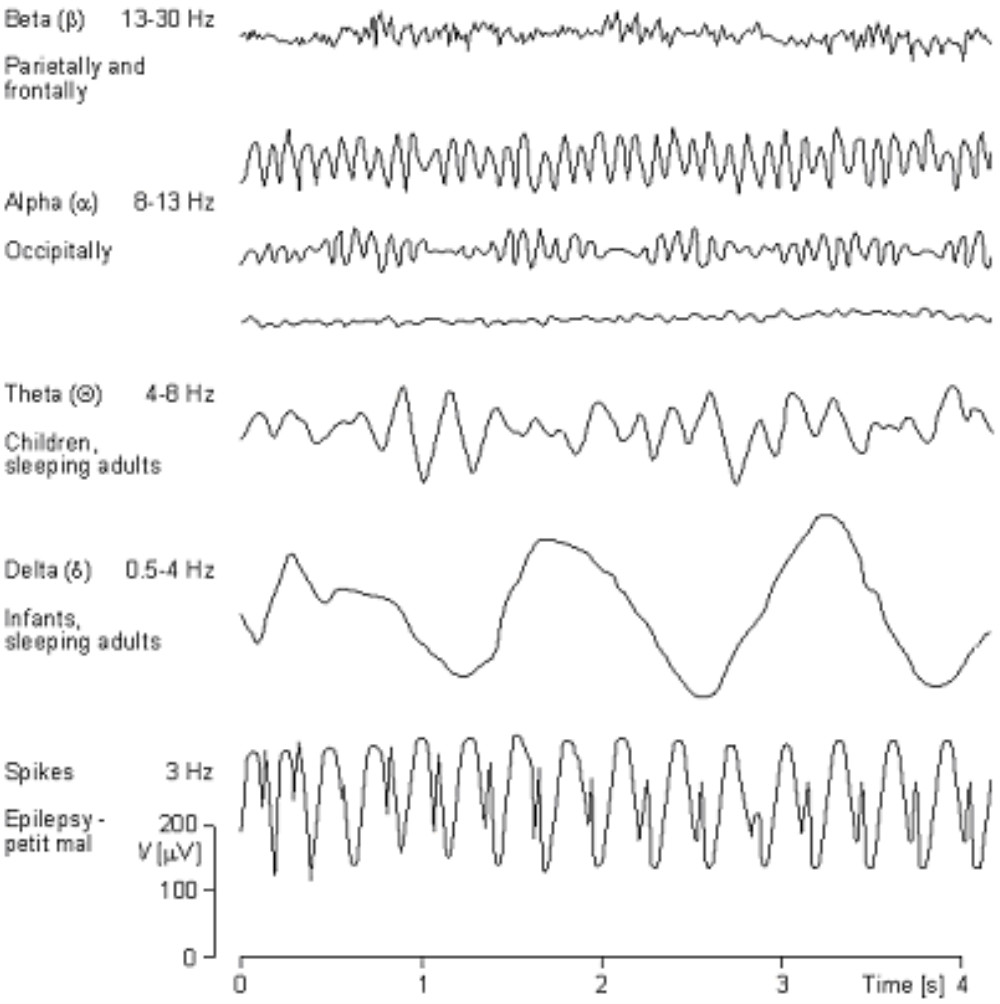

Figure 2.7 EEG waves

CHAPTER 3

3.1 Material

Table 3.1 Subjects

Patient	Gender	Age	Patient	Gender	Age
chb01	F	11	chb13	F	3
chb02	M	11	chb14	F	9
chb03	F	14	chb15	M	16
chb04	M	22	chb16	F	7
chb05	F	7	chb17	F	12
chb06	F	1,5	chb18	F	18
chb07	F	14,5	chb19	F	19
chb08	M	3,5	chb20	F	6
chb09	F	10	chb21	F	13
chb10	M	3	chb22	F	9
chb11	F	12	chb23	F	6
chb12	F	2			

Used EEG signals in this study were provided from open source database [35] which data collected at Children Hospital's Boston. It contain EEG signals which collected from Pediatric subjects with unyielding seizures. For characterizing their seizures and checking necessity for surgery intervention, the subjects withdrawal from anti-seizure medication and monitored for several days

23 different pediatric EEG signal package collected from 22 pediatric patients. Each Signals package represent with numbers. The data packet 21 obtained from the same patient numbered data packet 1 but 1.5 year later. The ages range from 1,5 to 22 (5 male subjects from 3to 22 and 17 female subjects from 1,5 to 19) with 9.98 average age and 5.67 standard deviation.

3.1.2 EEG Signals

From 9 to 42 edf files included in each data package or case (chb01, chb02, etc.) from single subject. The 10 or less second gap during non-measuring time had been occurred due to the Hardware limitations. In some cases this gap were much more than 10 seconds. For privacy of the subject protection, Protected Health Information (PHI) had been replaced with related information without losing their meaning in edf files. Recorded dates had been replaced but the time relationship in each case were not changed.

Generally edf files contain 1 hour EEG signals, but in some cases like chb10 contain 2 hours EEG signals and chb04, chb07, chb09 and chb23 contains 4 hours EEG signals. Generally in this cases seizures were too short.

Signals collected with 256 Hz sample rate with 16-bit resolution. Expect a few cases with 24 and 26 channels, most recordings contain 23 channels. This source contained total 664 edf recorded files and 129 edf files contain between from one and four seizures. The Standardized International 10-20 EEG System and Nomenclature had been used.

The Standardized International 10-20 System of EEG electrode position:

Spontaneous EEG recordings generally the internationally standardized 10-20 system is usually used. The electrodes are placed on the surface of scalp in this system as shown in Fig-3.1A, 3.1B and 3.1C.

Reference points: Nasion and Inion used for determining reference points. In the transverse and median planes, from this reference points the skull perimeters are measured. So these perimeter divided into 10% and 20% intervals for Electrode locations. Other three electrodes also placed equidistant from the points like in Fig-3.1B.

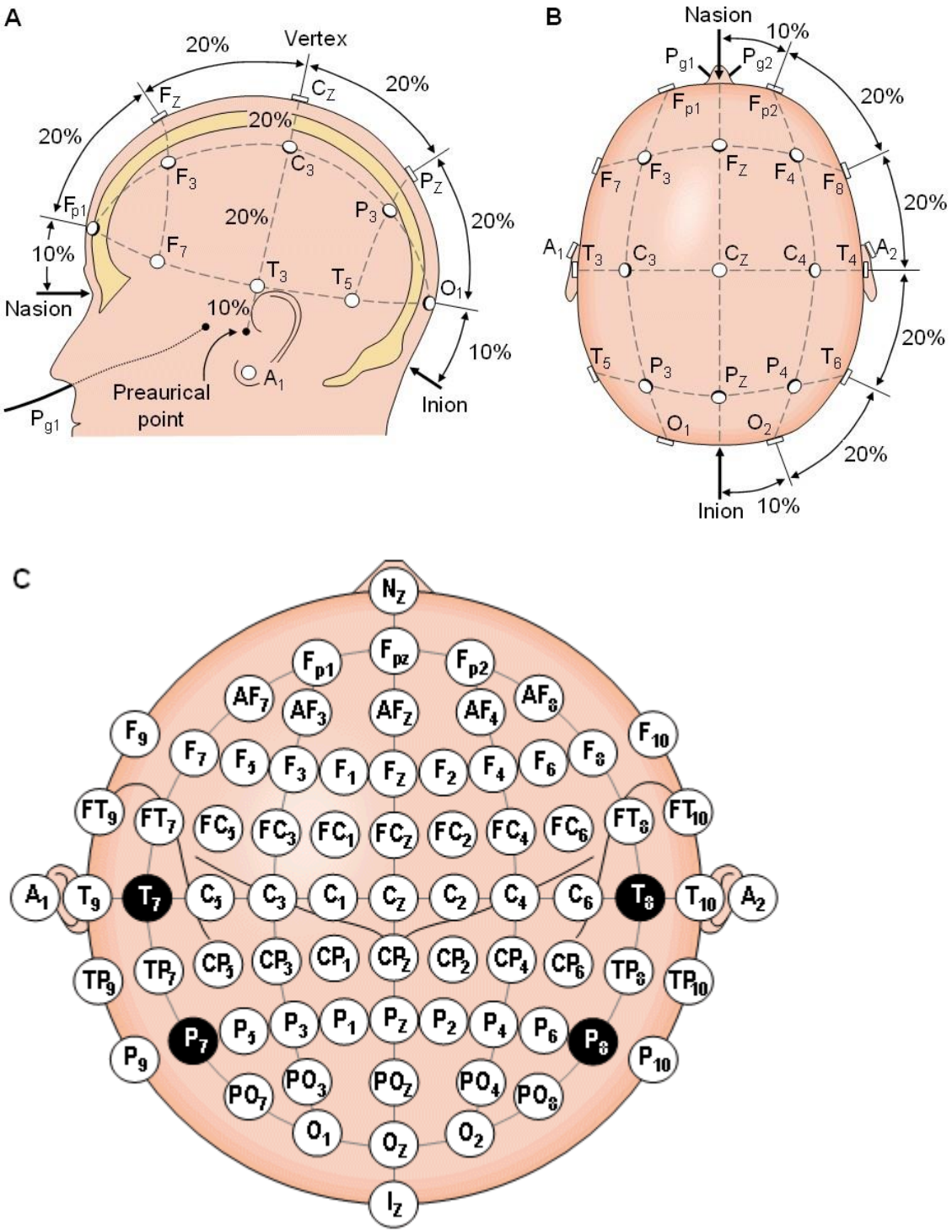

Figure 3.1. The international 10-20 system seen from (A) left and (B) above the head. A = Ear lobe, C = central, Pg = nasopharyngeal, P = parietal, F = frontal, Fp = frontal polar, O = occipital. (C) Location and nomenclature of the intermediate 10% electrodes, as standardized by the American Electroencephalographic Society[36]

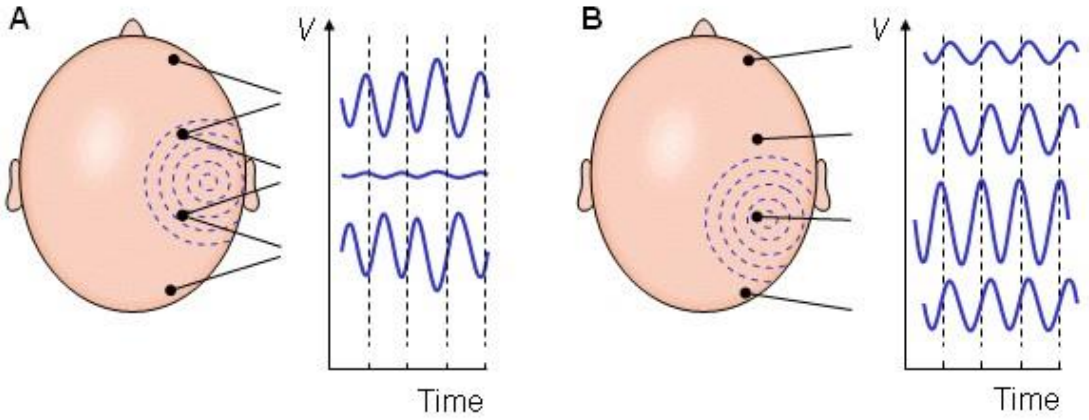

Figure 3.2. (A) Bipolar and (B) unipolar measurements. Note that the waveform of the EEG depends on the measurement location[37]

In the EEG measurement, 2 kinds of measurements: Bipolar or Unipolar electrodes can be used. Bipolar: the potential difference among two pair of electrodes is measured As Shown in Fig-3.2A. Unipolar: the potential difference between each electrode and neutral electrode (Reference) or Potential difference between each electrode and average value of all electrodes as shown in Fig-3.2B. In this recordings first method-Bipolar measurement had been used.

3.2 Method

3.2.1 Independent Component Analysis

Independent component analysis (ICA) is a multiple statistical method which seks to uncover disguised variables in high-dimensional data [38]. The standart example of distinct component analysis coctail party problem: In a room where some people are talking at the same moment, specify what every person is saying by listening to the triturate of sounds.Most people are able to do that by just listening and focusing on a spesific speaker.

To rigorously describe ICA [39], we can use a statistical "latent variables" model. Assume that we observe *n* linear mixtures $x_1, \ldots, x_n$ of *n* independent components

$x_k = a_{k1} s_1 + a_{k2} s_2 + \ldots + a_{kn} s_n$, for all k. (3.1)[40]

We have now dropped the moment list t; in the ICA model, we presume that each triturate x_k alongside every independent component s_k is a random variable, instead of a proper time signal. The observed values x_k(t), e.g., the microphone signals in the cocktail party problem, are then a sample of this random variable.

It is proper to use horizontal vertical surface-matrix formula instead of the sums like in the previous equation. Let us denote by

x the random vector whose elements are the mixtures $x_1, \ldots, x_n$, and likewise by **s** the random vector with elements $s_1, \ldots, s_n$. Let us denote by **A** the matrix with elements a_{ik} Generally, bold lower case letters indicate vectors and bold upper-case letters denote matrices. All vectors are understood as column vectors; thus $\mathbf{x}^T$, or the transpose of **x**, is a row vector. Using this vector-matrix notation, the above mixing model is written as

x=As (3.2)

Some moments we require the columns of matrix **A**; denoting them by $\mathbf{a}_k$ the model can also be shown as

$$x = \sum_{i=1}^{n} a_i s_i \quad (3.3)$$

The statistical model in Eq. 4 is called independent component analysis, or ICA model. The ICA model is a producer model, which means that it describes how the observed data are generated by a operates of mixing the components s_i The distinct components are hidden factors, meaning that they cannot be directly analysed.

Also the mixing matrix is assumed to be unknown. All we observe is the random vector **x**, and we must estimate both **A** and **s** using it. This must be done under as general assumptions as possible [8]

$$s=Wx, \tag{3.4}$$

CHAPTER 4

RESULT

In this chapter, results of analyzing non-seziure and seizure condition of EEG signals will be explained. For signal processing, algorithms in MATLAB® (v. 7.8.0 R2011a) software was used for signal processing .The differences between Non-seizure and Seizures were detailed shortly.

The first signal obtained from the 14 years old female patient coded as Chb03_04 between 2192-2195 seconds seizure and non-seizure EEG signal.

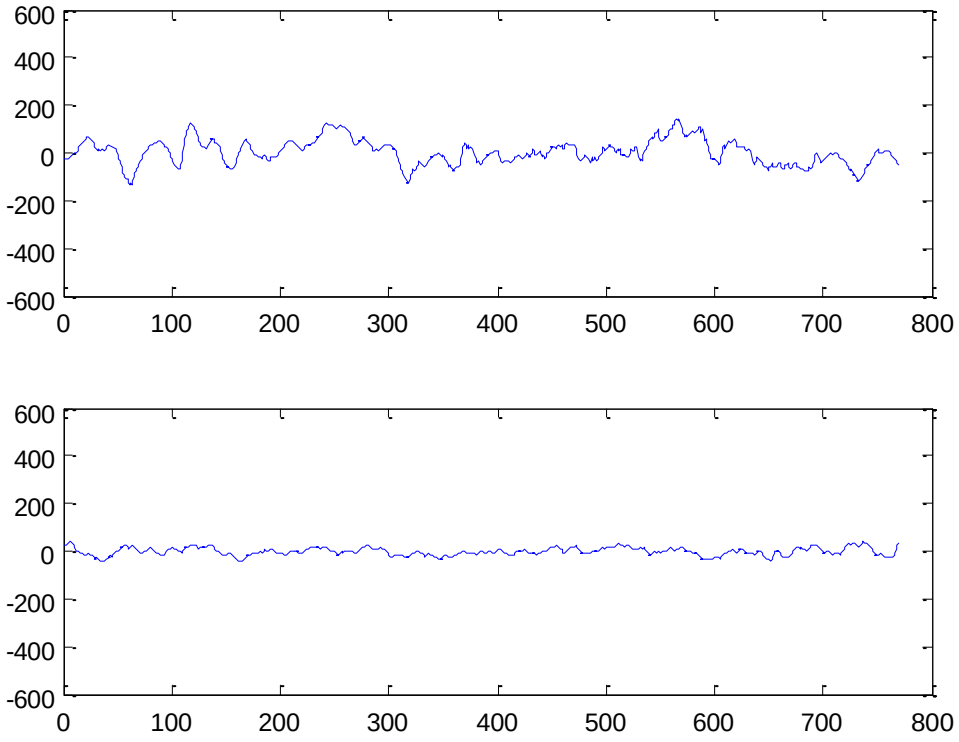

Figure 4.1 Seizure and non seizure part for 3 second

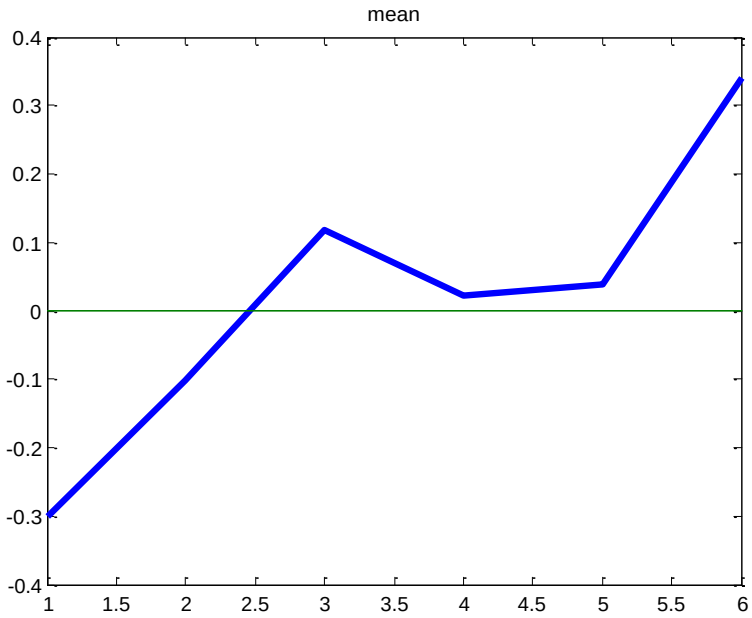

Figure 4.2 chb01 patient's mean ICA during seizure and non-seizure activity

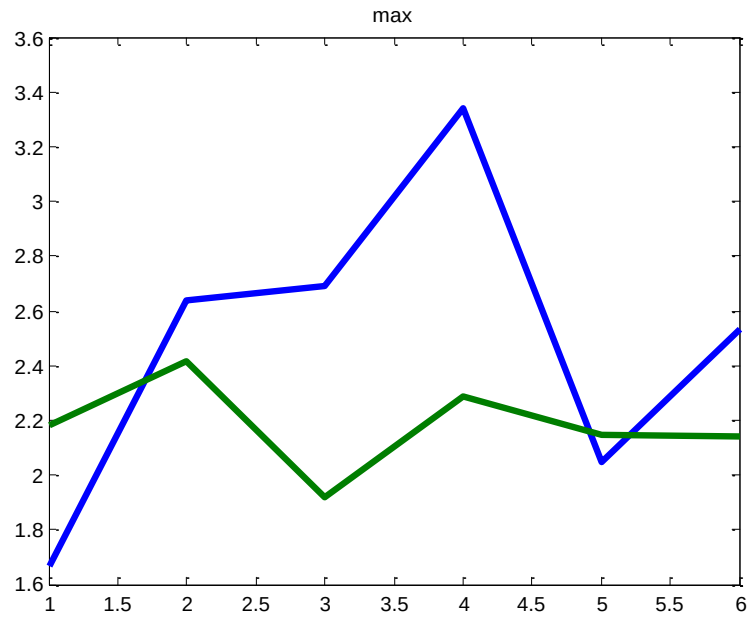

Figure 4.3 chb01 patient's max ICA during seizure and non-seizure activity

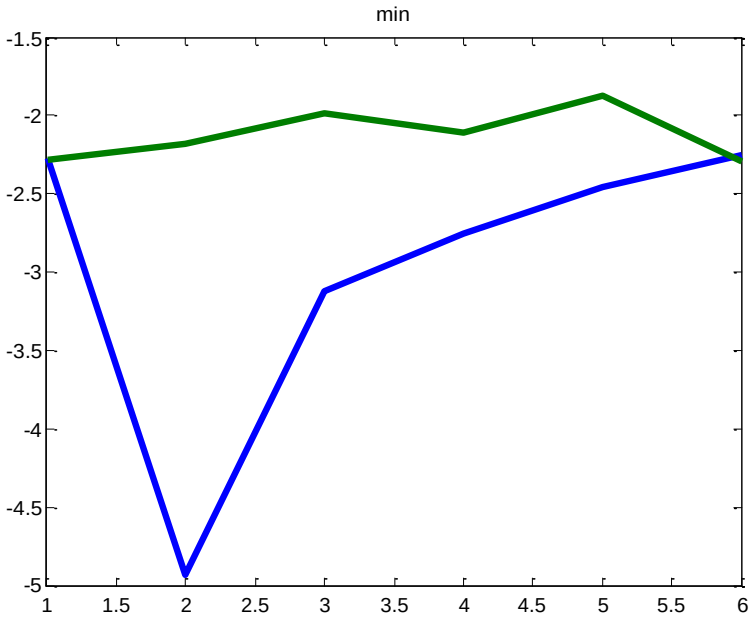

Figure 4.4 chb01 patient's min ICA during seizure and non-seizure activity

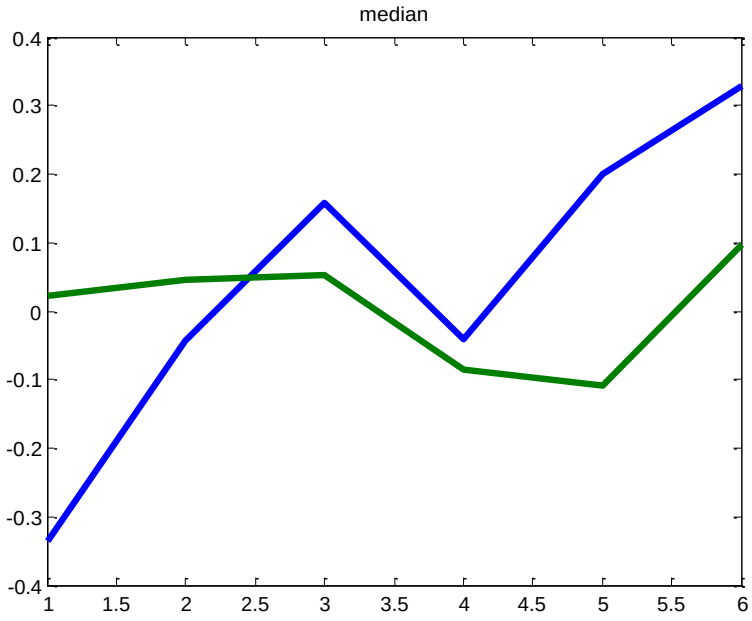

Figure 4.5 chb01 patient's median ICA during seizure and non-seizure activity

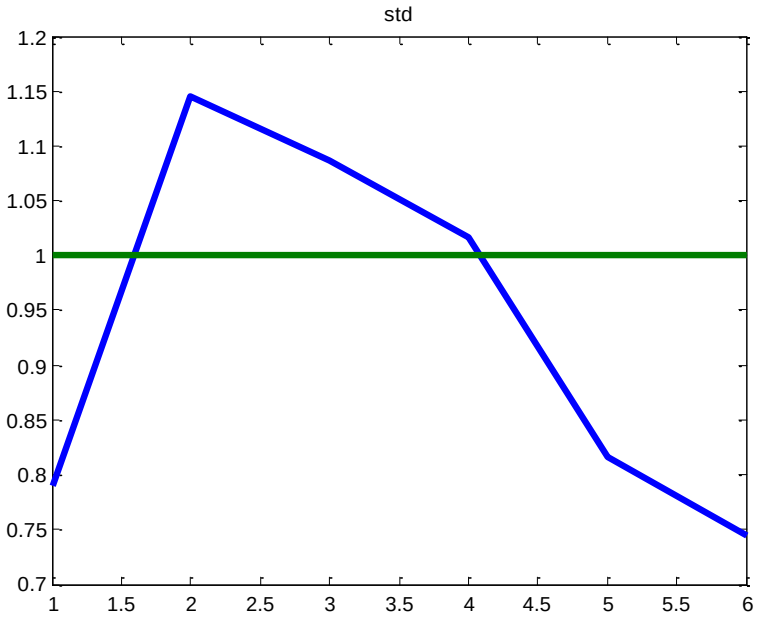

Figure 4.6 chb01 patient's std ICA during seizure and non-seizure activity

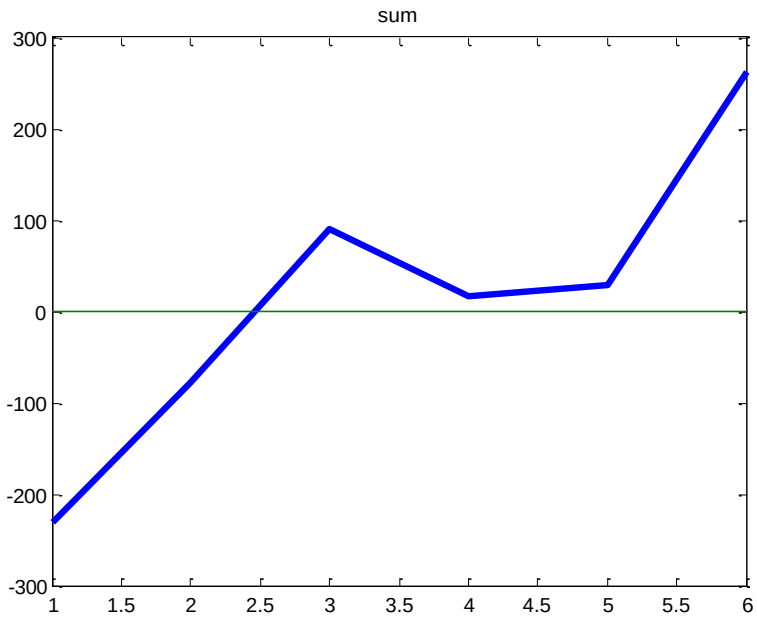

Figure 4.7 chb01 patient's sum ICA during seizure and non-seizure activity

As briefly explained in Chapter 3, the signals had been collected from 23 different channels from different parts of brain. Some of these channels could easily effected from noise and some of them did not much. Shoeb and et all[22] examined three different regions of brain's channels to finding the most sensitive to the seizure:

Frontal Central Channels:
FP2-F4. Channel Number: 9;
F4-C4. Channel Number: 10;
The right frontal and posterior channels
FP2-F8. Channel number: 13;
F8-T8. Channel Number 14;
T8-P8. Channel Number 15;
P8-O2. Channel number 16;
The Central Channel
FZ-CZ. Channel number 17;

Found that the most prominent activity region among them was frontal central channels, second one was central channels and third one was central and posterior channels.

Channel 1: (Frontal Channel)
Channel 10: F4-C4 (Frontal Central)
Channel 13: FP2-F8 (The right frontal and posterior)
Channel 17: FZ-CZ (The Central Channel)

Channel23:(OccipitalChannel)

Table 4.1 Study subject's mean ICA values of signal strenght data during seizure and non-seizure activity

(Ch:1,5,9,13 is frontal, ch:13, 14, 15, 16 is right temporal, ch:4,812,16 is occipital ch:2,3,19,20 left temporal, ch:6,7,10,11 is parietral)

	mean									
	ch:1,5,9,13		ch:13,14,15,16		ch:4,8,12,16		ch:2,3,19,20		ch:6,7,10,11	
	normal	seizure	normal	seizure	normal	seizure	normal	seizure	normal	seizure
chb01_03	-0,0257794	7,62E-17	-0,12204	1,07E-17	0,158339	1,54E-16	-0,22739	3,38E-09	0,155926525	5,76E-17
chb02_19	0,0514755	1,25E-16	0,020173	8,55E-18	0,026264	1,27E-16	0,075406	7,72E-09	0,023152999	7,16E-17
chb03_35	2,0475181	7,35E-15	-52,594	-3,2387	-0,0789	1,22E-16	-0,09727	-5,11E-10	0,045514091	8,59E-16
chb04_08	1,1173219	5,79E-17	0,569958	-7,60E-17	0,038189	7,44E-17	-0,45849	-2,29E-09	-0,04763086	-5,20E-18
chb05_22	0,1183219	6,79E-17	0,264458	-8,60E-17	0,050189	5,44E-17	-0,09249	-5,29E-09	-0,04385086	-5,15E-18
chb06_04	0,1673519	1,79E-17	0,124458	-6,60E-17	0,048933	7,26E-17	-0,38549	-2,29E-09	-0,05763086	-5,25E-18
chb07_13	-0,0349837	7,75E-17	-0,22304	1,08E-17	0,234539	1,60E-16	-0,29359	2,37E-09	0,055926525	5,56E-17
chb08_21	-0,3180618	3,81E-16	1,640408	8,55E-16	0,894511	-1,32E-17	-1,03964	-1,34E-10	0,226817961	-1,38E-17
chb09_08	0,1263219	3,79E-17	0,194582	-8,72E-17	0,043989	1,49E-17	-0,18949	-4,30E-09	-0,04385086	-3,15E-18
chb10_12	0,0408694	1,03E-17	0,112754	-3,47E-17	0,046815	1,10E-17	-0,13258	1,36E-10	-0,01026739	-1,40E-16
chb11_82	0,0328794	1,03E-17	0,118345	-3,12E-17	0,032205	1,03E-17	-0,23195	6,93E-09	0,025314018	4,21E-17
chb12_11	2,0219851	6,34E-15	0,021453	2,54E-15	-0,0721	1,23E-16	-0,08521	-4,14E-10	0,031514242	8,66E-15
chb13_19	0,1934619	1,37E-17	0,158758	-5,60E-17	0,189954	-2,98E-18	-0,38549	-2,29E-09	-0,05763086	-5,25E-18
chb14_11	0,0237123	1,06E-17	0,125133	-2,15E-17	0,027496	9,10E-17	-0,14146	1,20E-10	-0,01085788	-1,60E-16
chb15_20	-0,2276134	2,33E-16	1,640408	-3,14E-15	0,894511	-1,32E-17	-1,03964	-1,34E-10	0,226817961	-1,38E-17
chb16_10	0,1345319	1,24E-17	0,148458	-4,40E-17	0,054363	3,32E-17	-0,11765	-3,28E-09	-0,05633083	-5,25E-18
chb17b_63	-0,0292374	7,62E-17	-0,12204	1,07E-17	0,158339	1,54E-16	-0,22739	3,38E-09	0,155926525	5,76E-17
chb18_29	0,0316494	1,12E-17	0,061152	-1,15E-17	0,023615	6,10E-17	-0,1275	2,20E-10	-0,01011388	-1,43E-16
chb19_28	0,0408694	1,03E-16	0,119864	-3,46E-17	0,028495	1,24E-16	-0,23868	1,35E-10	0,092365442	-1,33E-16
chb20_13	-0,2703463	2,32E-16	1,632788	1,06E-15	0,258111	-1,22E-17	-1,03723	-1,24E-10	0,149717965	-1,37E-17
chb21_19	0,0511565	1,22E-14	0,02431	8,53E-18	0,026264	1,20E-16	0,075411	6,72E-09	0,013458794	4,16E-17
chb22_25	2,0475181	7,35E-15	-52,594	2,53E-15	-0,0789	1,21E-16	-0,09727	-4,11E-10	0,045514825	6,59E-16
chb23_09	1,1173219	5,79E-17	0,569958	-7,60E-17	0,038189	7,31E-17	-0,45849	-2,29E-09	-0,04763085	-5,13E-18
chb24_04	0,0276494	1,10E-17	0,116043	-3,15E-17	0,046815	9,10E-17	-0,14146	1,20E-10	-0,01085788	-1,60E-16

Table 4.2 Study subject's max ICA values of signal strenght data during seizure and non-seizure activity

(Ch:1,5,9,13 is frontal, ch:13, 14, 15, 16 is right temporal, ch:4,812,16 is occipital ch:2,3,19,20 left temporal, ch:6,7,10,11 is parietral)

	max									
	ch:1,5,9,13		ch:13,14,15,16		ch:4,8,12,16		ch:2,3,19,20		ch:6,7,10,11	
	normal	seizure	normal	seizure	normal	seizure	normal	seizure	normal	seizure
chb01_03	1,862907	2,911824483	1,289727014	2,4549	1,950303	2,46E+00	1,957407	3,09782539	1,636275	3,0226
chb02_19	1,990102	3,857884911	1,418839439	2,905239	1,534354	3,002765	1,598676	3,10556978	0,825126	2,595002
chb03_35	27,18327	5,721207256	54,39401148	2,865653	0,68314	3,324328	1,205307	2,5682003	1,856995	3,04648
chb04_08	1,728936	4,15398542	0,630743124	2,12766	1,315986	2,198785	1,267918	3,12226223	0,193763	3,235785
chb05_22	3,964961	2,2190164	10,62191204	2,604172	3,790217	2,782936	9,308427	2,96673575	5,877589	2,714141
chb06_04	1,889765	2,15337042	1,157727034	2,23459	0,6381	2,101527	1,114307	2,1252327	1,726919	2,016776
chb07_13	0.623864	1,154365346	1,120839443	2,120939	1,218956	2,183405	1,168935	3,34016212	0,121463	3,235785
chb08_21	0,459445	1,890965417	6	8	1,942669	1,691066	1,791141	1,87113609	1,138564	2,285568
chb09_08	14,02847	5,650207376	0,543643629	2,12826	0,52104	3,281158	1,127647	2,10920379	1,612025	3,12948
chb10_12	4,937652	2,264230726	5,176919232	2,125478	3,630216	2,782936	3,303877	1,28413574	3,170584	2,13244
chb11_82	1,982602	3,153985421	1,512839369	2,165239	1,254354	3,127765	1,348675	3,20556954	0,125126	2,127095
chb12_11	3,783072	2,139016379	15,12892054	2,126542	3,120957	2,621935	9,128943	2,93474571	4,236599	2,15441
chb13_19	0.126483	1,793096123	1,134539902	1,156099	1,176958	2,026705	1,213935	3,21516591	0,158933	3,153785
chb14_11	1,915351	2,2190164	1,003839437	1,905236	1,534354	3,002765	1,598676	3,10556978	0,825126	2,595002
chb15_20	0,340915	1,712965414	5	9	1,822724	1,771566	1,351121	1,24713892	1,147644	2,213445
chb16_10	4,067964	2,108016313	4,127912024	2,125672	3,470977	2,156936	9,308427	2,96673575	5,109544	2,613095
chb17b_63	1,765209	2,857284916	1,109327025	2,23459	0,647091	2,136521	1,245607	2,1347327	1,681919	2,013786
chb18_29	1,862907	2,762812983	2,226537014	1,4903	1,670101	2,21E+00	1,873401	3,32078308	1,636275	3,19544
chb19_28	1,990102	3,726084935	1,112653943	2,123239	1,520954	3,434765	1,328775	3,34556979	0,639126	2,432002
chb20_13	27,18327	4,612792304	48,33501147	2,028455	0,52104	3,001328	1,127647	2,5682003	1,612025	3,12948
chb21_19	3,964961	2,264076704	9,626780201	2,616134	3,790389	1,432936	8,129827	2,10054575	4,164589	2,20764
chb22_25	0,459445	1,160265417	7	8	1,943088	1,786066	1,184141	1,80813616	1,092565	2,983468
chb23_09	1,394926	3,813409551	0,735743676	2,12526	1,248986	3,199545	1,152917	3,32126312	0,104763	3,23787
chb24_04	1,394926	4,560930512	0,760743645	2,45526	1,144986	3,052663	1,160017	3,10820038	0,197281	3,345671

Table 4.3 Study subject's min ICA values of signal strenght data during seizure and non-seizure activity

(Ch:1,5,9,13 is frontal, ch:13, 14, 15, 16 is right temporal, ch:4,812,16 is occipital ch:2,3,19,20 left temporal, ch:6,7,10,11 is parietral)

	min									
	ch:1,5,9,13		ch:13,14,15,16		ch:4,8,12,16		ch:2,3,19,20		ch:6,7,10,11	
	normal	seizure	normal	seizure	normal	seizure	normal	seizure	normal	seizure
chb01_03	-1,5615313	-2,32081	-1,63287	-3,271617	-3,63028	-2,516935	-1,73066	-2,070071	-2,64115852	-3,003118
chb02_19	-4,3902062	-2,3384	-1,12962	-2,711239	-1,59024	-2,299807	-1,46666	-3,378094	-0,86890342	-2,487257
chb03_35	-26,093587	-3,25293	-3,45459	-2,278234	-1,32983	-4,042386	-0,71265	-2,135959	0,032564023	-3,732979
chb04_08	-0,857627	-4,67369	-0,52312	-3,590969	-1,04736	-2,785096	-0,85851	-2,854794	-0,70697094	-3,272579
chb05_22	-6,0018182	-2,3263	-8,63176	-2,723211	-3,80954	-2,857197	-12,6471	-2,646063	-4,78627819	-2,533565
chb06_04	-1,348142	-2,32876	-1,53897	-3,140346	-3,52727	-2,620941	-3,61621	-2,102757	-4,61396853	-3,175438
chb07_13	-0,6346298	-4,43321	-0,23026	-3,320969	-1,03279	-2,754896	-0,98231	-2,097194	-0,58797013	-2,256906
chb08_21	-1,1720945	-1,91017	-4	-16	-0,96437	-2,170613	-5,38606	-1,843403	-0,63776117	-2,223246
chb09_08	-0,6084263	-3,18965	-0,2762	-3,120967	-0,01536	-2,478091	-0,76381	-1,257794	-0,60927094	-3,129079
chb10_12	-0,723097	-4,52368	-0,52312	-3,237969	-1,04736	-2,613096	-0,87651	-2,923379	-0,89912094	-3,347679
chb11_82	-3,1227962	-2,349	-1,13762	-2,340239	-1,60324	-2,139807	-1,13466	-3,327094	-0,76890094	-2,517298
chb12_11	-0,437657	-5,23459	-0,1433	-3,465508	-1,13436	-2,614096	-0,23671	-2,158495	-0,34787009	-3,387579
chb13_19	-0,378423	-5,56069	-0,50272	-3,590969	-1,0279	-2,615096	-0,49341	-2,459794	-0,67927094	-3,298579
chb14_11	-0,2854669	-3,12769	-0,23982	-2,392669	-3,04839	-3,709096	-0,65651	-2,354758	-1,90569709	-2,198579
chb15_20	-1,732942	-3,32809	-1,23297	-3,340945	-3,36827	-2,367944	-3,23461	-2,238757	-4,23706853	-3,223038
chb16_10	-0,2897962	-1,176	-1,16502	-2,193239	-1,25764	-2,207507	-1,16766	-3,168091	-0,56990095	-2,116298
chb17b_63	-1,1037413	-2,32177	-1,51277	-3,292631	-3,45928	-2,124941	-1,6127	-2,100056	-2,61555854	-3,512678
chb18_29	-3,3917862	-2,3474	-1,0231	-2,541009	-1,01275	-2,232787	-1,44556	-3,146094	-0,82760345	-2,983257
chb19_28	-1,1785319	-2,45081	-1,19887	-2,164617	-3,34028	-2,179939	-1,37666	-2,237671	-2,23985856	-3,337118
chb20_13	-5,0178182	-2,235	-8,63176	-2,653213	-3,72141	-2,692372	-1,38106	-2,349863	-3,1962381	-2,565739
chb21_19	-0,7244223	-4,12789	-0,1972	-3,095467	-0,12766	-2,378091	-0,83482	-1,360794	-0,19827098	-3,477079
chb22_25	-0,7356269	-3,28765	-0,42813	-2,174969	-1,04736	-2,647095	-0,71291	-2,854794	-0,68947094	-2,195579
chb23_09	-0,3896561	-4,23398	-0,2379	-2,446581	-1,15689	-2,123987	-8,22761	-2,121521	-0,16589809	-3,336579
chb24_04	-0,705427	-5,42069	-0,52312	-3,590969	-1,04736	-2,785096	-0,85851	-2,854794	-0,70697094	-3,272579

Table 4.4 Study subject's median ICA values of signal strenght data during seizure and non-seizure activity

(Ch:1,5,9,13 is frontal, ch:13, 14, 15, 16 is right temporal, ch:4,812,16 is occipital ch:2,3,19,20 left temporal, ch:6,7,10,11 is parietral)

	median									
	ch:1,5,9,13		ch:13,14,15,16		ch:4,8,12,16		ch:2,3,19,20		ch:6,7,10,11	
	normal	seizure	normal	seizure	normal	seizure	normal	seizure	normal	seizure
chb01_03	-0,27283	0,007726795	-0,149320311	0,028715	0,032343	0,013444	-0,02735	0,03115595	0,3925	0,124905
chb02_19	-0,01113	0,023004179	0,005259289	-0,04322	0,085493	-0,03048	0,106268	-0,0237004	0,170161	0,050575
chb03_35	-1,63879	0,278665456	-0,555801814	0,182198	-0,05875	-0,04123	-0,08644	0,03713915	0,088303	0,163868
chb04_08	0,023478	-0,026794542	0,123601477	0,025436	0,113711	0,072551	-0,13824	-0,1384421	-0,03485	-0,08213
chb05_22	0,252662	0,129763218	-0,099206388	0,021995	0,066147	0,046338	0,503223	-0,0162891	-0,11312	0,085348
chb06_04	0,053971	-0,037997844	0,153500977	0,025736	0,126513	0,054671	-0,13473	-0,1384347	-0,02945	-0,08263
chb07_13	0,038578	-0,035296342	0,128500477	0,036936	0,108532	0,138858	-0,12923	-0,1494491	-0,04735	-0,14853
chb08_21	-0,31947	-0,333562328	2	0	0,952658	0,188961	-0,8912	0,02023734	0,224793	-0,28788
chb09_08	-0,36793	0,012678356	-0,289300244	0,021572	0,038143	0,017656	-0,02189	0,03592328	0,298479	0,216176
chb10_12	-0,02359	0,043145124	0,005823347	-0,03282	0,067349	-0,0381	0,11826	-0,0154014	0,149165	0,043957
chb11_82	-0,32983	0,005643795	-0,178400324	0,032815	0,043843	0,021544	-0,03535	0,02562395	0,31348	0,234176
chb12_11	-0,02109	0,021045178	0,006029347	-0,04322	0,087343	-0,04786	0,106268	-0,0237004	0,170161	0,050575
chb13_19	-1,63879	0,134635454	-0,435806714	0,163195	-0,03455	-0,04329	-0,07654	0,02983255	0,076324	0,206835
chb14_11	0,032572	-0,034997812	0,084601341	0,034836	0,015711	0,062851	-0,11424	-0,123442	-0,02365	-0,06813
chb15_20	0,021978	-0,034794542	0,123601477	0,025436	0,113711	0,072551	-0,13824	-0,1384421	-0,03485	-0,08213
chb16_10	0,234663	0,158763217	-0,086706385	0,020294	0,034747	0,029363	0,478223	-0,0128491	-0,10912	0,078324
chb17b_63	-0,32783	0,004526285	-0,137320311	0,034215	0,042743	0,026448	-0,02915	0,04317552	0,422405	0,134605
chb18_29	0,257662	0,129763218	-0,087206388	0,024895	0,053147	0,037438	0,476393	-0,0148891	-0,01112	0,083435
chb19_28	0,053212	-0,028594842	0,148534046	0,034723	0,123789	0,05377	-0,12374	-0,1354334	-0,02935	-0,07153
chb20_13	-0,31453	0,004379576	-0,165400244	0,031712	0,042143	0,019454	-0,03229	0,02392394	0,298479	0,216176
chb21_19	-0,02109	0,021045178	0,006029347	-0,03152	0,087345	-0,04786	0,213258	-0,0236014	0,185161	0,053757
chb22_25	-1,57478	0,134635454	-0,412806714	0,150195	-0,03238	-0,03929	-0,07345	0,02126276	0,076324	0,213835
chb23_09	0,027572	-0,025897823	0,098601387	0,023736	0,015711	0,062851	-0,11424	-0,123442	-0,02365	-0,06813
chb24_04	0,046978	-0,035297842	0,109500477	0,036936	0,114561	0,090851	-0,14124	-0,1224421	-0,03695	-0,09253

Table 4.5 Study subject's std ICA values of signal strenght data during seizure and non-seizure activity

(Ch:1,5,9,13 is frontal, ch:13, 14, 15, 16 is right temporal, ch:4,812,16 is occipital ch:2,3,19,20 left temporal, ch:6,7,10,11 is parietral)

	std									
	ch:1,5,9,13		ch:13,14,15,16		ch:4,8,12,16		ch:2,3,19,20		ch:6,7,10,11	
	normal	seizure	normal	seizure	normal	seizure	normal	seizure	normal	seizure
chb01_03	0,5805168	1	0,472181	1	0,879757	1	0,627258	0,899121	0,866759964	1
chb02_19	0,7728604	1	0,419213	1	0,318446	1	0,384871	0,880879	0,304284407	1
chb03_35	9,9341608	1	20,97222	1	0,331204	1	0,347939	0,873262	0,697376242	1
chb04_08	7,923116	1	0,327213	1	0,237475	1	0,201234	0,910702	0,234953845	1
chb05_22	1,5203452	1	3,199727	1	1,112946	1	3,615305	0,865745	1,291359146	1
chb06_04	0,117409	1	0,434923	1	0,32638	1	0,638253	0,759121	0,789759964	1
chb07_13	7,9926402	1	18,39862	1	1,834846	1	0,325673	0,834202	0,385171848	1
chb08_21	0,304405	1	1,561691	3,137834	0,41949	1	1,161607	0,878139	0,383396867	1
chb09_08	0,2164051	1	0,446213	1	0,023758	1	0,239506	0,665123	0,525044581	1
chb10_12	0,3975154	1	0,287313	1	0,300487	1	0,493763	0,64808	0,475620067	1
chb11_82	7,2345891	1	27,97398	1	0,218205	1	0,503925	0,945129	0,650359926	1
chb12_11	0,1634424	1	0,398713	2,136321	0,398387	1	0,374871	0,589023	0,362284917	1
chb13_19	0,5728988	1	0,376181	1	0,582757	1	0,340938	0,693263	0,573760735	1
chb14_11	1,4973231	1	0,215213	1	0,269757	1	2,437802	0,348743	1,349759406	1
chb15_20	1,7823452	1	0,23176	1	1,542846	1	0,616224	0,79531	0,825357564	1
chb16_10	0,6728998	1	23,2391	1	0,618757	1	0,489058	0,739121	0,682359964	1
chb17b_63	0,3904405	1	0,419213	1	1,752386	1	0,384871	0,659079	0,391284007	1
chb18_29	0,134679	1	0,348722	3,137834	0,254746	1	0,338938	0,769263	0,839376542	1
chb19_28	0,3194423	1	0,449023	1	0,836757	1	1,349506	0,82322	0,298396321	1
chb20_13	0,519821	1	0,430113	2,139274	0,384901	1	0,428058	0,613121	0,736354581	1
chb21_19	1,5202892	1	0,312671	1	0,657887	1	0,435671	0,739079	0,314284067	1
chb22_25	0,4744012	1	0,345671	1	0,458704	1	0,312938	0,368563	0,743376491	1
chb23_09	1,1203092	1	0,328723	1	1,156046	1	1,139511	0,812694	0,427396864	1
chb24_04	0,4676429	1	0,25109	1	0,354387	1	0,208754	0,909202	0,260153846	1

Table 4.6 Study subject's sum ICA values of signal strenght data during seizure and non-seizure activity

(Ch:1,5,9,13 is frontal, ch:13, 14, 15, 16 is right temporal, ch:4,812,16 is occipital ch:2,3,19,20 left temporal, ch:6,7,10,11 is parietral)

	sum									
	ch:1,5,9,13		ch:13,14,15,16		ch:4,8,12,16		ch:2,3,19,20		ch:6,7,10,11	
	normal	seizure	normal	seizure	normal	seizure	normal	seizure	normal	seizure
chb01_03	8,3599	4,02E-14	-93,85198165	8,22E-15	121,7624	1,19E-13	143,3349	2,59E-06	119,9075	4,43E-14
chb02_19	39,58469	9,59E-14	15,51280782	6,58E-15	20,19732	9,79E-14	57,98747	5,94E-06	17,80466	5,51E-14
chb03_35	0,503768	5,65E-12	-852,4819435	-2,63E-13	-40,4766	9,39E-14	-49,8972	-3,93E-07	23,34873	6,61E-13
chb04_08	0,053473	-0,042597842	-2,13124E+14	3,35E-14	32,00093	5,36E-14	-95,6535	8,29E-08	34,63457	3,14E-14
chb05_22	90,98951	5,22E-14	-88,83865329	2,66E-14	38,59559	5,72E-14	-352,579	-1,76E-06	-36,6281	-4,00E-15
chb06_04	0,032094	-0,029597811	-17,42096638	9,30E-14	28,00036	4,12E-14	-78,7864	9,24E-08	37,6428	4,14E-14
chb07_13	17,34529	3,92E-14	-83,78238165	7,33E-15	119,4593	1,23E-13	1126,335	3,50E-06	115,7235	3,42E-14
chb08_21	-244,59	9,79E-14	1261,473877	-88,1758	687,8789	-2,39E-15	-799,487	-3,45E-08	174,423	-3,55E-15
chb09_08	4,104599	6,03E-14	-72,06248165	7,10E-15	89,42379	1,17E-13	1006,237	3,43E-06	112,7013	3,41E-14
chb10_12	6,23891	3,07E-14	-43,89034165	2,11E-15	65,3484	1,00E-13	103,3128	1,09E-06	89,00121	2,23E-14
chb11_82	17,38589	3,01E-14	-85,85238164	4,24E-15	47,7341	1,10E-13	127,3341	4,51E-06	104,3249	6,63E-14
chb12_11	27,37569	4,34E-14	8,512807819	7,64E-15	13,24977	6,38E-14	36,37032	4,33E-06	13,34896	4,54E-14
chb13_19	13,89377	9,83E-12	-712,4813436	-2,11E-13	-34,4757	9,61E-14	-42,5092	-2,94E-07	21,37873	6,43E-13
chb14_11	0,067303	-0,045127842	-1,134673734	3,15E-14	29,15079	5,14E-14	-91,3403	7,28E-08	31,56907	3,11E-14
chb15_20	7,469511	5,12E-14	-58,52905329	2,79E-14	27,26799	3,36E-14	-379,503	-1,39E-06	-31,2407	-3,11E-15
chb16_10	8,345287	3,01E-14	-73,65408168	6,34E-15	128,1053	1,11E-13	1789,311	3,40E-06	110,7224	1,21E-14
chb17b_63	38,52321	8,01E-14	11,51623882	5,98E-15	16,10902	7,49E-14	54,4343	4,13E-06	14,70366	2,33E-14
chb18_29	0,037898	-0,021609842	-14,31203461	3,24E-14	38,00285	6,99E-14	-79,7864	8,29E-08	34,65097	3,14E-14
chb19_28	-318,257	7,74E-14	1023,403477	-56,1299	439,8783	-3,31E-15	-436,487	-3,13E-08	105,434	-2,37E-15
chb20_13	18,10234	2,38E-14	-74,54038188	6,04E-15	119,4593	1,23E-13	1,126335	1,50E-06	105,7235	2,03E-14
chb21_19	28,52989	9,10E-14	12,21098782	6,23E-15	15,19704	8,20E-14	47,23441	3,02E-06	0,328657	4,50E-14
chb22_25	8,270299	3,02E-14	-83,78238165	7,33E-15	119,4593	1,23E-13	1126,335	3,50E-06	115,7235	3,42E-14
chb23_09	42,52985	8,39E-14	13,52257782	5,33E-15	18,25802	7,54E-14	62,45457	5,84E-06	17,80466	4,35E-14
chb24_04	0,046978	-0,035297842	-19,31266634	3,40E-14	36,00037	6,99E-14	-108,786	9,24E-08	59,64277	5,14E-14

CONCLUSION AND DISCUSSION

Epilepsy is a common neurological disorder and epileptic seizure is the one of the most known disorder in nowadays. Epilepsy affects individuals' life Quality negatively and besides it also influences patient's relatives and family. This change in life quality like randomly movements, become angrier in predictable time else causes decrease in work performance and this costs more than treatment of epilepsy.

Delay in diagnosis of Epilepsy or ignorance of signs and symptoms of illness are important reasons of high prevalence of epilepsy. In this case the researches about epileptic seizures taking important role.

In literature, there are many article proved that epilepsy disorder can be evaluated by EEG signals. Researchers still go on to analyze the normal and during seizure EEG activity. ICA is one of the approach for EEG data analysis.

In this study, the detection of seizure and non-seizure condition had been examined with independent component analysis. Results are given there. But there are min of ICA values normal EEG activity is bigger than during seizure. And max of ICA values of normal EEG is smaller than during seizure.Seizure showed more intense from prefrontal lobe.

Since the signals are provided from open acess source the deeply investigation about details of seizure were not possible.

ICA will apply different epilepsy type and different age group.

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