PSD AND WAVELET ANALYSIS OF SIGNALS FROM A HEALTHY AND EPILEPTIC PATIENT

G. Kulakli and T.C. Akinci

Abstract—This study presents one EEG signal from a healthy person brain wavelet and two EEG signals from epilepsy patient one of them is patient normal brain wavelet ,other is while epileptic seizure. Data are validated for reliability and validity and are obtained from data records at the University Hospital of Bonn, Germany. The data compare using power density spectrum and continuous wavelet transformer.

Keywords—*EEG, wavelet, power spectrum density.*

1. INTRODUCTION

EPILEPSY is one of the top five diseases in the world .It can be seen at any age. Seizures can be a sign of neurological disorder, leading to serious injury and loss of self-esteem. The seizures occur in the nerve cells (neurons) in the brain as a result of abnormally high electrical activity. During the seizure, the brain cannot work properly and sends faulty commands to the body. Except for seizures, the brain usually works normally. There are many different types of epileptic seizures. But the basic thing to keep in mind is that there are two types of seizures: partial (ie, seizures that start limited to a region in the brain) and generalized (those that start as common in the brain). However, the term commonly used herein does not mean a worse and more severe type of seizure. This nomenclature is used to describe epileptic seizures due to different causes.
In ancient times, epileptic crises are often thought to be the attack of evil spirits or the devil. It was thought to be an illness, requiring extermination, exorcism or other religious or social approaches. The EEG method was used in various animals like rabbit, monkey, before humans [5].

1.1. Number of people with epilepsy in WHO regions

N=105, these numbers are only indicative based on the information provided by Atlas respondents which is figure 1. The numbers have not been corrected for nonresponding countries [1].

1.2. What is an EEG?

EEG stands for electroencephalogram. EEG is the main diagnostic method in the diagnosis of epilepsy. The EEG works on the basis of registering the wavering in the electrical movement of the nerve cell within the same group in the brain. The electrodes are glued to the scalp and recorded. This review is not painful or harmful to health. No contact with electricity. In addition to the classical EEG devices, which are developed with the support of technology and connected with computers, telemetric investigations and video-EEG monitoring studies help to better evaluate epilepsy patients.

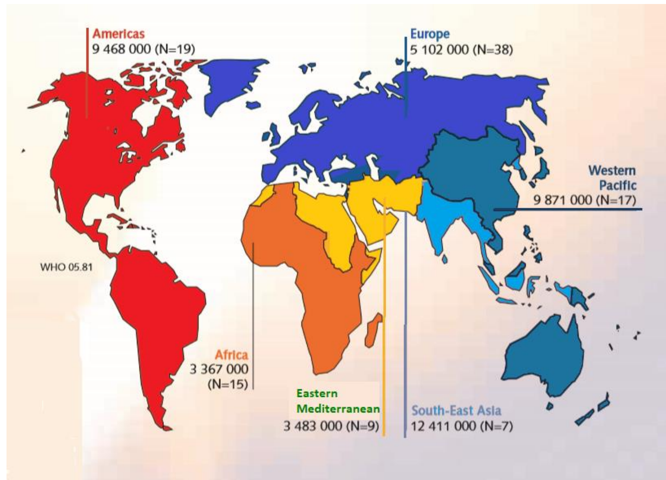

Fig.1. An auto: Number of people with epilepsy in WHO regions [1]

Since EEG examination is a short-term examination, the first examination may not detect any disorder. Short or long-term sleep examinations can be performed in clinically suspicious and recurrent conditions, with more than one EEG examination and even sleep deprivation.

1.3. Brainwaves

Brain waves change according to people's moment of thought or emotion. When slower brain waves are dominant, they correspond to tired, slow, sluggish, or dreamlike situations. However, higher frequencies predominate when over-awake or when our consciousness is open. Brainwave speed is measured in Hertz (Hz). There are six different types of brain waves from low to high frequency;

1.3.1. Infra-low

It is very difficult to detect them. Today there is not much information about the subject. Various research groups define this category.

1.3.2. Delta Waves (0-3 Hz)

This brainwaves are very slow, they has low frequency.
They are generated in deepest meditation and dreamless sleep. Everybody has delta wave in dreamless sleep.

1.3.3. Theta waves (3-8 Hz)

Theta brain waves are most commonly seen in sleep, but it is very easy to catch theta wave in deep meditation. Theta wave is our door to basic cognitive process, engram and discernment. In Theta, our senses are drawn from the outside and focus on the signals coming from inside.

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1.3.4. Alpha waves (8-12 Hz)

Alpha waves to indicate that the brain is restinting. Alpha waves help the general mental coordination, coolness, brain - body completion and learning.

1.3.5. Beta waves(12-38 Hz)

The most common pattern in the normal waking state. They occur when they are solving problems. When we pay attention to the outside world in daily life, Beta brain wave prevails. Beta brain wave is a fast activity that occurs when we are on alert, when our attention is concentrated, when there is, judgment, focused mental activity, problem solving or decision making

1.3.6. Gamma waves (38-42 Hz)

Gamma waves are the quickest of brain waves and relate to equitemporaneous processing of data from other brain areas. Gamma brain waves transmit information quietly and quickly to memory. Gamma brain wave is highly active in cases of superficial love, sacrifice and ın high virtues fire. It is estimated that gamma rhythms change perception and consciousness, and that the presence of more gamma rays is associated with the emergence of expanded consciousness and mental states.

2. EEG SIGNALS AND COMPARISON

The EEG signal from healthy person is plotted by red, EEG signal of healthy data of epilepsy patient plotted by blue, EEG signal at the time of epilepsy is plotted by black at figure 2 and figure 3 as the expansion and translation feature indicates, the master wavelet can form a base with the specified.

$$\boldsymbol{\psi}_{s,u}(\boldsymbol{t}) = \frac{1}{\sqrt{s}}\, \boldsymbol{\psi}\left(\frac{t-u}{s}\right) \tag{2}$$

It is the translation parameter that specifies which region we are interested in *s* is the scaling parameter bigger than zero because of the fact that negative scaling is indescribable. The Multi-resolution feature provides set $\{\psi_{u,s}(t)\}$ is orthonormal. Conceptually, the fundamental coefficient of continuous wavelet transform $\psi_{u,s}(t)$. It is

$$Wf(s,u) = \langle f(t), \boldsymbol{\psi}_{s,u} \rangle$$
$$= \int_{-\infty}^{\infty} f(t), \boldsymbol{\psi}*_{s,u}(t)dt$$
$$= \int_{-\infty}^{\infty} f(t), \boldsymbol{\psi}*_{s,u}\left(\frac{t-u}{s}\right)dt \tag{3}$$

Epilepsy is a common neurological disorder in which the normal activity of the brain is disrupted by excessive discharge of nerve cells.The seizure is the result of a sudden burst of electrical activity in the brain.

When the signals are overlapped, it can be clearly seen that the signals in epileptic seizures are more than the brain signals of the healthy individual or the normal brain signals of the epileptic patient.

Epilepsy seizures are divided into two groups as sequential, partial (focal) and generalized according to the distribution of abnormal electrical activity. Clinical symptoms vary according to the rate and localization of this activity.

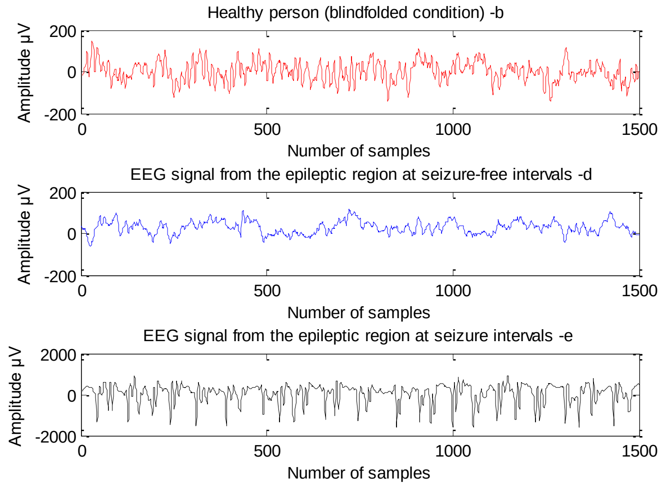

Fig.2. EEG signal of healty person (red),EEG signal of epilepsy patient non epileptic seizure(blue) ,EEG signal from epileptic seizure (black)

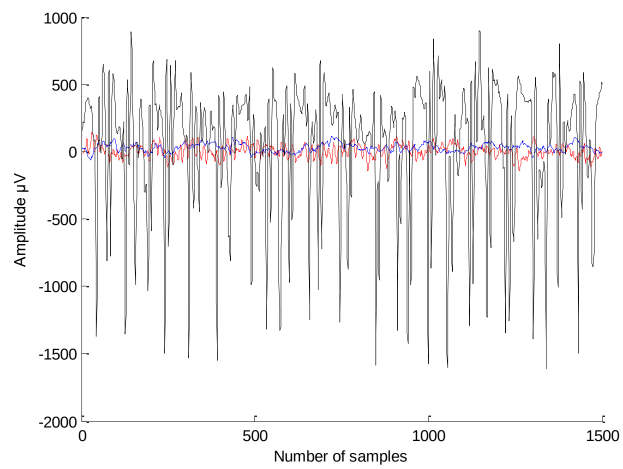

Fig.3. Overlapped signals of EEG signal of healty person (red), EEG signal of epilepsy patient non epileptic seizure(blue), EEG signal from epileptic seizure (black).

3. EEG SIGNALS AND COMPARISON USING POWER SPECTRUM DENSITY

For EEG analysis, there is no need to split the skull and insert the sensor into the brain. In the EEG analysis, electrical data is recorded by sensors placed on the head surface. 10 to 500 electrodes are used for EEG analysis. The electrical signal amplitudes are very small, since it is difficult to analyze the data at this amplitude, the amplifier is used to increase the amplitudes of the signals. Thus, the data is shown as the time-series of the voltage values [10]. The signals can be decomposed into the frequency components contained by the continuous and discontinuous Fourier transform method. The Power spectral density (PSD) of a signal indicates the power that the signal has at each frequency. The spectral energy density of a signal shows how the energy changes depending on the frequency. The definition of energy density is used for changes in the form of pulses where energy is concentrated around a single frequency. For continuous signals in time, the term spectral power density is often used. The concept of power here can be really physical, or the definition set may differ. However, the power spectrum concept is used in both meanings. The mean power over time of the $x(t)$ signal is defined as in the equation 4.

$$P = \lim_{t\to\infty} (\frac{1}{2}) \int_{-\infty}^{\infty} |x(t)^2| dt \qquad (4)$$

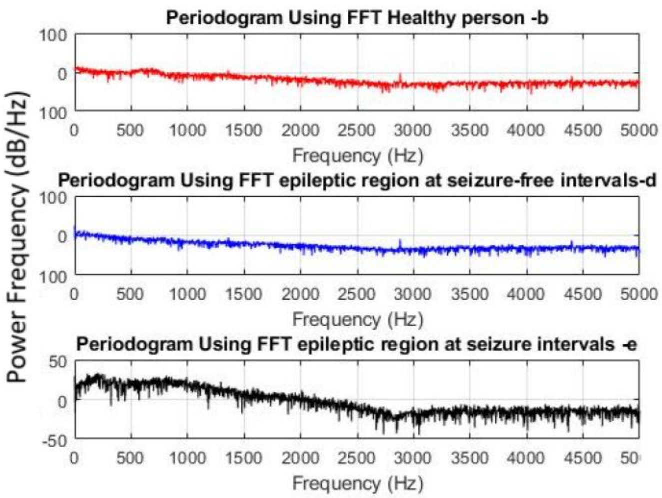

Fig.4. EEG signal's power spectrum density plot of healty person (red),EEG signal of epilepsy patient non epileptic seizure(blue) ,EEG signal from epileptic seizure (black).

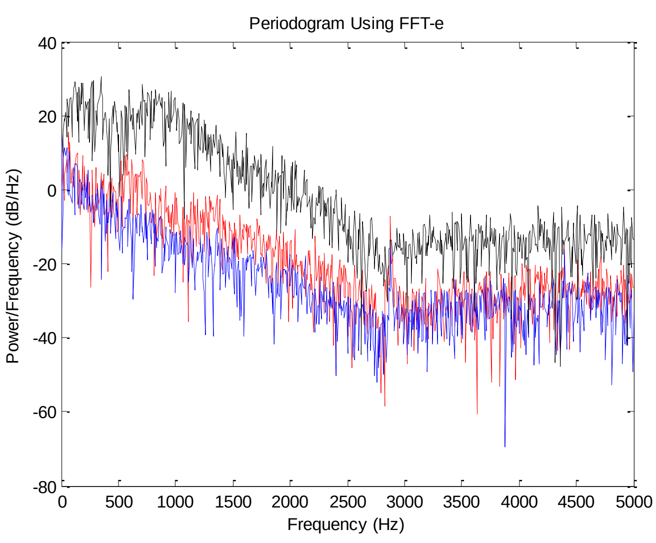

Fig.5. Overlapped EEG signal's power spectrum density plot of person (red),EEG signal of epilepsy patient non epileptic seizure(blue) ,EEG signal from epileptic seizure (black).

It can be observed very clearly at epileptic seizure moment brain signals have more energy than normal time and also it can be observed figure 4 and figure 5.

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BIOGRAPHIES

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