EEG SIGNAL QUANTIFICATION BASED ON MODUL LEVELS

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ABSTRACT

This article proposes a contribution to quantify EEG signals outline. This technique uses two tools for EEG signal characteristics extraction. Our tests were realized on the basis of 32 canals EEG canals using Neuroscan software. EEG example demonstration is referenced CZ and is sampled at 1000HZ. The principal aim of this technique is to reduce the important volume of EEG signal data Without losing any information. EEG signals are quantified on the basis of a whole predefined levels The obtained results show that an EEG alignment can be posted in a quantified form.

KEYWORDS

Signal, EEG, Segmentation, Quantification, FFT, ACP, information, levels

1. INTRODUCTION

Human brain is constituted of a great net of hundred billion of neurons that joining and activities are Present complex process and are not well known whether at the microscopic or macroscopic scale. This huge network is the prop of cerebral activity that rules the functioning of human body. Pyramidal cells of cerebral cortex which big axe is perpendicular at surface and are considered as the elementary generators of EEG [2] activity. The electroencephalography is the electric activity recording of brain using placed electrodes on the scalp surface. This system is used in clinical environment in the frame of Epilepsy treatment and hence it is the only system allowing observing anomalies [3]. EEG signals record the cortical electric activity. Since its discovery in 1929 by Hans Berger, medical practitioners and researchers have employed several methods to analyze EEG signals so that they can describe the cerebral activity. The EEG analysis implicates quantification questions : dominant frequency, similarities, evolution, etc on a great set of signals which priorities vary temporarily and spacially. In addition to the clinical approaches, two types of approaches are thinkable for signals analysis. The non-pragmatic methods that consider the signal as a stochastic signal and the parametric modals that estimate EEG used from a specific modal [4].We tackle this problematic in this paper using a nonparametric method essentially based on the theory of signal treatment that is lately adapted on the EEG signals analysis .Several works in the domain of classification and the extractions of EEG signals characteristics have been realized. We are going to present some works as an illustration.

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Elif Derya U¨beyli (2009) has presented in his presentation an integrated vision of automatic systems of diagnostic combined with spectral analysis techniques in the classification of electocephalogrames.

The document contains detailed information on the illustration and the implementation of automatic systems, diagnostic sysytems and characteristic extraction or the selection on the basis of EEG signals. The principal objective of this article is to guide lectors that aim in developing the diagnostic automatized systems for EEG signals classification.

Ling Guo∗, Daniel Rivero, Juli´an Dorado, Cristian R. Munteanu, Alejandro

Pazos (2011) have presented in their papers a rich review of lit in this domain ,they have quoted the relative works to : l'Epilepsie et l'électroencéphalogramme(EEG), Discrete wavelet transform, Genetic programming, K-nearest neighbor classifier, Previous work of genetic programming application on feature extraction [5].

2. EEG FREQUENCIES

In this section we represent some frequencies that we can observe in the EEG.

- Delta is frequencies scale up to 4 HZ . It has the tendency to be highest in amplitude and the slowest in waves .We normally observe with adults during a show wave sleeps it is also normally précised within babies .
- Theta is the frequency scale of 4HZ at 7 HZ .Theta is normally considered within young children.
- Alpha is the scale frequency of 8 HZ at 12 HZ .Hans Berger named it the first rythmic EEG activity that we considered as being « Alpha waves » .
- Beta is the scale frequency of 12 HZ to 30 HZ .We usually observe from both sides in the symmetric distribution that is obviously frontal.
- Gamma is the frequency scale about 30-100 Hz . Gama rythms are supposed to represent the link between different neurons population thus in a network within the objective to realize a certain cognitive or motrice function.
- Mu gammes 8-13 Hz., is partly double used with other frequencies .It reflects the synchronic unloading of driving neurons in a rest state.

3. PRINCIPAL COMPONENTS ANALYSIS

In most situations we dispose of various observations on each signals constituting the studies signals. So we have to take into account P variables by signals. P is strictly superior to 1. The separated study of each variables gives information but it is insufficient as not taking into consideration bindings between them which most of time constitutes our study objectives. It is the role of multifractional statistics to analyze the whole data taking into consideration the whole variables.

The principle component analysis is a good method to study multidimensional data ,when all observed variables are numeric ,preferably in the same units within the possibility to observe the existing links with these variables. We start within a table of rectangular data ,representing all facts placing individuals (signals)represented by lines and using columns for variables.

4. TREATMENT APPROACH

Our demonstration is going to be beared on a set that is part of EEG sample at 1000hz of 32 Canals treated and analysed by neuroscan and referenced CZ. Figure 1.

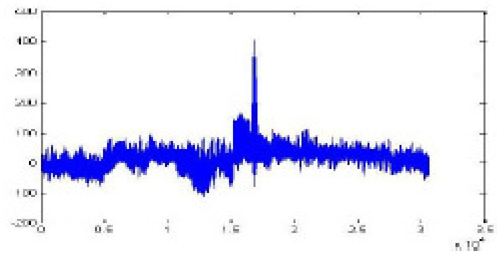

Figure 1 : signal test of canal 1

Signal segmentation : the originated signal will be segmented in a set of fragments. These sets are the results of a sampling .Arbitrary the step was fixed experimentally at 1000 values .
Figure 2 shows the first sample

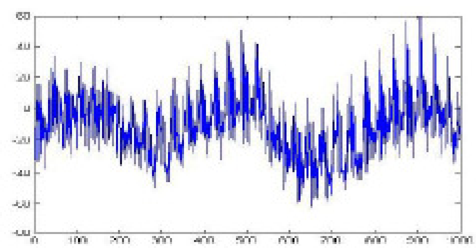

Figure 2 : First signal segment

The convert (transformé) of Fourrier .The segment will be transformed by FFT .The decomposition or the spectral form created by default 1000 sinusoïdes.

Modulus calculation :This step consists in calculating the correspondant modules of different created sinusoïdes figure 3 shows the different modules under signals.

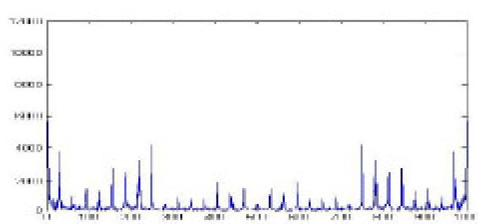

Figure 3 : under signals modules

Modulus quantification .This step aims to quantify the modules by levels. The level is an experimental stage which has been fixed in our case at 900.

La figure 4 shows the modules distribution according to different stages.

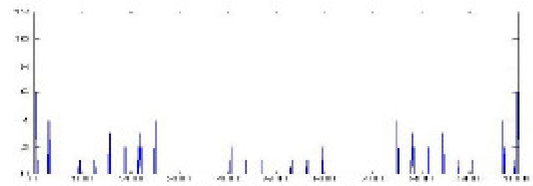

Figure 4 : quantification of moduls

The aim towards these processings is to pull out the principal characteristics so that they could be analysed by ACP method (Analysis by principle componants).To facilitate the treatment we estimate necessary to represent these information using a histogram.

figure 5 shows the relative histogram at the initial fragment

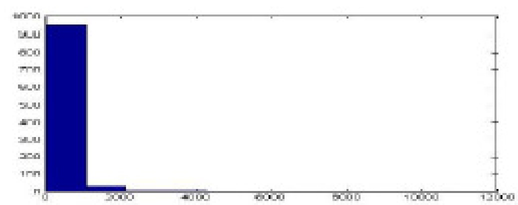

Figure 5 : histogram of the initial fragment

After quantification five variables have been created (variables defining the stage).

- Var 1 : 0 to 200
- Var 2 : 200 to 400
- Var 3 : 400 to 600
- Var 4 : 600 to 800
- Var 5 : 800 to1000.

- Treatment of all segments : the same applied procedure for all segments from 1 to 30504 (the real recording size).

- APC application : The aim within this step is to reduce the pertinent information. The matrix input is defined according to table 1 & 2.

Table 1 : Modules repartition according to stages (1000 to 6000)

-0,16	0,34	0,04	0,05	0,66	0,06	-0,06	-0,29
-0,15	0,12	-0,27	-0,14	0,42	0,13	0,25	0,26
-0,19	- 0,20	-0,18	0,02	0,01	-0,11	-0,04	-0,24
-0,18	- 0,03	-0,05	0,16	-0,12	-0,10	-0,12	0,01
-0,20	- 0,02	0,22	-0,07	-0,07	0,02	0,07	0,33
-0,19	- 0,03	0,10	0,09	-0,11	0,95	-0,05	-0,04
-0,20	- 0,19	0,02	0,13	-0,03	-0,04	0,91	-0,10
-0,22	- 0,31	0,16	0,07	0,30	-0,07	-0,14	0,70
-0,17	0,18	0,01	0,17	0,06	-0,07	-0,03	-0,03
-0,18	- 0,04	0,00	-0,16	-0,13	-0,02	-0,03	-0,02
-0,14	0,18	-0,36	0,08	-0,14	0,00	-0,02	0,12
-0,19	0,18	0,36	-0,08	-0,12	-0,08	0,01	-0,03
-0,17	0,07	0,00	-0,25	-0,04	-0,02	-0,01	-0,02
-0,19	- 0,16	-0,16	0,20	-0,02	-0,03	-0,09	-0,06
-0,17	- 0,05	-0,10	-0,47	0,01	0,00	-0,03	-0,06
-0,16	0,34	0,05	0,15	-0,08	-0,07	0,01	0,06

Table 2 : Modules repartition according to stages (6000 to 12000)

0,16	0,34	0,05	0,15	-0,08	-0,07	0,01	0,06
-0,17	-0,05	-0,10	-0,47	0,01	0,00	-0,03	-0,06
-0,19	-0,16	-0,16	0,20	-0,02	-0,03	-0,09	-0,06
-0,17	0,07	0,00	-0,25	-0,04	-0,02	-0,01	-0,02
-0,19	0,18	0,36	-0,08	-0,12	-0,08	0,01	-0,03
-0,14	0,18	-0,36	0,08	-0,14	0,00	-0,02	0,12
-0,18	-0,04	0,00	-0,16	-0,13	-0,02	-0,03	-0,02
-0,17	0,18	0,01	0,17	0,06	-0,07	-0,03	-0,03
-0,22	-0,31	0,16	0,07	0,30	-0,07	-0,14	-0,30
-0,20	-0,19	0,02	0,13	-0,03	-0,04	-0,09	-0,10
-0,19	-0,03	0,10	0,09	-0,11	-0,05	-0,05	-0,04
-0,20	-0,02	0,22	-0,07	-0,07	-0,06	-0,03	-0,08
-0,18	-0,03	-0,05	0,16	-0,18	-0,03	-0,05	0,02
-0,19	-0,20	-0,18	0,02	-0,02	-0,01	-0,09	-0,07
-0,15	0,12	-0,27	-0,14	-0,05	0,00	-0,02	0,05

5. RESULTS AND DISCUSSION

The obtained results of this study represent 12 signal families that we identify as pertinent data families .This was realized within the application of the ACP method .
figure 6 shows a module stitching of the 31 analysed segments .The used legend shows the different module stages.

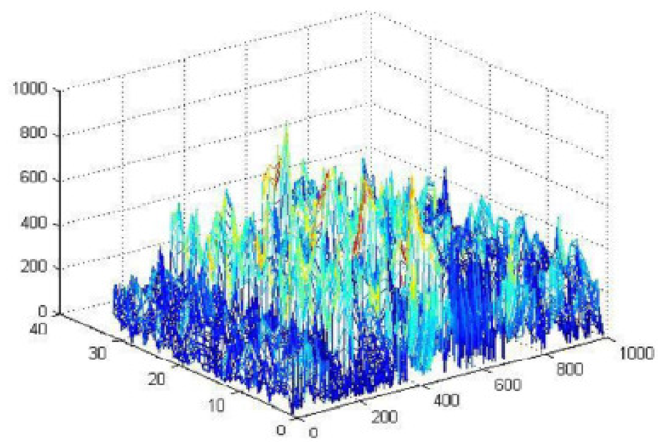

figure 6   31 segment's modules

The resulting segments constitute the PCA brute data .The PCA application shows that 82% of segments occur in the first axe ,16% occur in the second axe ..
figure 6 shows segments (componants) repartition on the new axes.

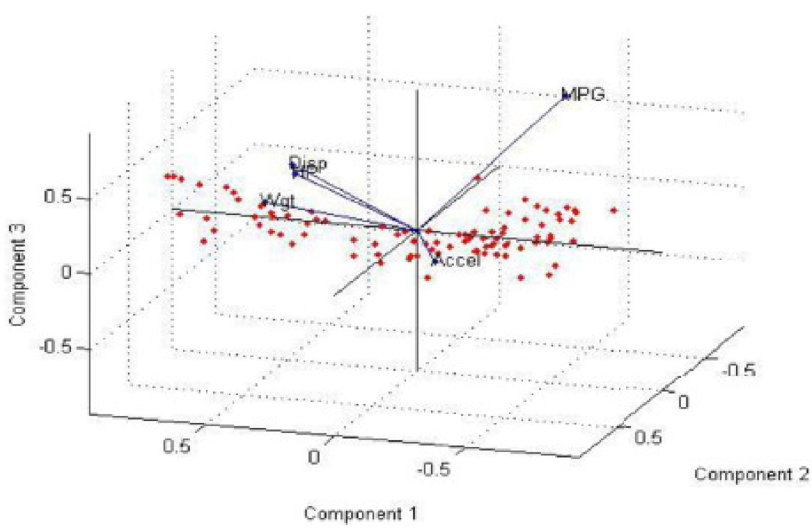

Figure 7 : représentation of the principle componants

According to this representation we can say that the pertinent information is focused on 82% on the whole segments corresponding to frequencies 600 and 800 hz .This technique that allows to represent EEG drawing by graphic and reduced significant.

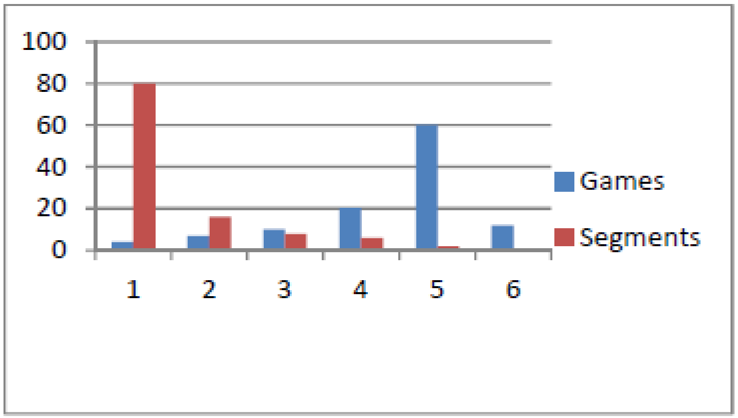

Figure 8 : results graphic

6. CONCLUSION

The Length of EEG recordings more often causes problems of data analysis .This study only based on pertinent data which makes the process quite difficult .Whether in searching the pertinent signal or in analyzing it.

This approach strongly contributes in the EEG data analysis by reducing the information amount to a set of families that will constitute our analysis .The EEG signal quantification on the stage basis enables to determine the dominant frequencies within histograms forms (figures) or other displaying tools.

A brain cartography is supposed to be realized on the basis of findings .The principle aim of this study is to create a simple apace .And mainly a reduced one to be able to analyze its context following in a real time the EEG diagram of 23 seconds which often causes problems related to its complexity from one sense and from another side to the signal length which makes the pertinent information more difficult to be located.

In our previous studies, we centered our researches on the pertinent information using the same techniques Ie Fourrier's convert (transformé de Fourrier) and analysis relying on principal components.

In our case a signal reduction of 30504 recordings in 12 components is an initial result to start researches analysis on pertinent family signals in a future time and in perspectives approach to tackle brain cartography and EEG signal emitting areas.

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