

Analysis of Normal and Epileptic EEG Signal with Filtering Method

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Abstract - EEG signal is measurement of the electrical activity is produced by the neurons network of the brain when brain is formed any mental task. The EEG signal is contains very low frequency components and amplitude so diff. types of noises and artifacts are overlapping with EEG signal like as bottom line wondering, eye blinking, eye movement, breathing etc. EEG signal is complex signal. The doctors and medical researchers are face or interact to great complications to analysis these signals and extract the linear, non-linear information from these biomedical signals. We are filtering the EEG signal by using diff types of filters to remove the unwanted frequency components from the original signal and to extract the features or information about the signal with the assistance of various efficient DSP tools like DFT, FFT, STFT and wavelet transform. Here we are used the FIR band pass Butterworth filter to filter the EEG signal and analysing this filtered signal with the help of FFT. The matlab software tool is used to this work it is easier to mat lab .software because there is programming is not used in MATLAB

Key Words: EEG (Electroencephalography), FFT (Fast Fourier transform), FIR (Finite impulse response), IIR (Infinite impulse response) and MATLAB.

1. INTRODUCTION

Electroencephalography may be a method which is employed to measurement of an electrical activity or signal is nothing but up to voltage level is produced by the brain. When the signals Performs any mental ability work. The EEG produced when the multitudation within the neural population of the brain [1]. The brain signals are adapted from the pin point measurement systems placed on the forehead or in some cases on the cortex of the patient. The captures the result waveform by using any computer component is understood because the EEG signal. The EEG signal is extremely complex signal and analyzing of this signal is additionally complex. Electroencephalogram (EEG) may be a highly difficult signal, containing tons of data about the human brain function and neurological disorders. It is a test wont to indicate brain damage and other problems, Sometimes it's wont to assess cerebral death also. In short, EEG can be considered as a test to detect and indicates the ab- normalities in the electrical activity of the brain.

1.1 In this paper we are focus on the brain wave classification and feature extraction of the EEG signal with the help of the advance digital signal processing techniques that is Fast Fourier transform etc. Its is found that the limit of EEG signal voltage amplitude is 10 to 100uV. Normally the ten to 50uv of the amplitude range is employed . The frequency domain of the Limit of the EEG signal is change from ultraslow to ultrafast frequency Value set. Brain wave frequency bands:- There will be four sorts of brain waves according of the frequency [2]

1.1 Alpha waves:

This brain wave is produced when the person closing the eyes and in relaxed condition it's indicates as a traditional waveform. The frequency range of the alpha waves is 7 to 12Hz. Alpha activity or wave form are generated rhythmically within the occipital a part of brain

1.2 Beta waves:

The beta waves are produced when the person in alert or anxious state it is a dominant rhythm. It is usually generated on frontal and central part of the brain. It is normally rhythm and is noticed in all age of group. The frequency range of Beta wave is 13 to 30Hz.

1.3 Delta waves:

These wave bands are produced when the person in the deep or dream less sleep. The frequency range of the delta wave is 0.5 to 3Hz.

1.4 Theta waves:

The theta wave bands are produced when the person is in the sleep but in dream. The frequency range is 4 to 7Hz. These are slowest waves and appears with closing the eyes and disappears normally with opening of eyes. These are basically produced in adult. There will be the various method of analysis of the EEG signal. As we know that the EEG signal is having the different type of the noisy frequencies and artifacts. There will be most commonly used method power spectral analysis: the power spectrum is

3.2 PRE-PROCESSING/FILTERING

EEG signal consists of the very low range of the frequency components and amplitude the main problem in analysing the EEG signal is detection of the different kind of interference waveforms (artifacts) mixed to the EEG signal during the recording process [3]. Medium of the artifacts in biomedical signals:

- EEG equipment
- External electrical interference to the subject and recording system.
- The leads and electrodes
- The subject's normal electrical activity from eye blinking, eyes movement, muscles, breathing and heart activity etc.

Various types of the filters are available in MATLAB to filter the biomedical signals basically IIR and FIR filter. IIR filters are designed to provide the non-linear phase response and FIR filters are designed to provide the linear phase response IIR filter are not necessary in signal monitoring application. In this bi-directional 2nd order Butterworth filter is used it is a signal processing filter designed to have as flat frequency response as possible to band pass [8]. It is used to extract the different frequency bands such as Delta, Theta, Gamma, Beta, and Alpha. Butterworth band pass filter having cut-off frequency 0.5 to 60 Hz. The IIR filter having the slower response as compare to FIR filter response.

- In this paper FIR band pass filter are used a band pass filter having the band. pass frequency is 8Hz and band stop frequency 12Hz is called alpha frequency band pass filter.

A band pass filter having the band pass frequency 13Hz and band stop frequency is 30Hz is called the beta frequency band pass filter.

- A band pass filter having the band pass frequency 0.5Hz and band stop frequency is 3Hz is called the delta frequency band pass filter.
- A band pass filter having the band pass frequency 4Hz and band stop frequency is 7Hz is called the theta frequency band pass filter.

The amplitude and frequency are extract of each frequency band by using the single tone measurement. For loop is used to execute the program N no. of time.

3.3 FEATURE EXTRACTION

There will be the different methods of the extract the waveforms of the EEG signal. The activity of the brain is divided into frequency bands, named: Delta (0.5–4 Hz), Theta (4–8 Hz), Alpha (8–12 Hz), Beta (12–30 Hz) and Gamma (over 30 Hz). In this paper, there have been calculated the mean, skewness, standard deviation and variance from time analysis and calculate the power from spectral analysis by using FFT [3, 4, and 7].

3.4 FAST FOURIER TRANSFORM

The FFT is an important and efficient tool for the feature extraction. FFT algorithm is involved a wide range of mathematical operation from simple real and complex numbers arithmetic to group theory and no. theory. The FFT is can compute the result $O(N \log N)$ operation.

Where N is the length of the vector

There will be the range of the N is thousand or million so that DFT is not the suitable method so we are used the FFT. The calculation is very complex and time consuming to reduce the operation time and increasing the speed by using FFT [3, 5]. FFTs are of most importance tool to a wide variety of applications, from digital signal processing and solving partial differential equations to algorithms for quick multiplication of large integers. The result of power spectrum analysis of EEG signal on the MATLAB [7].

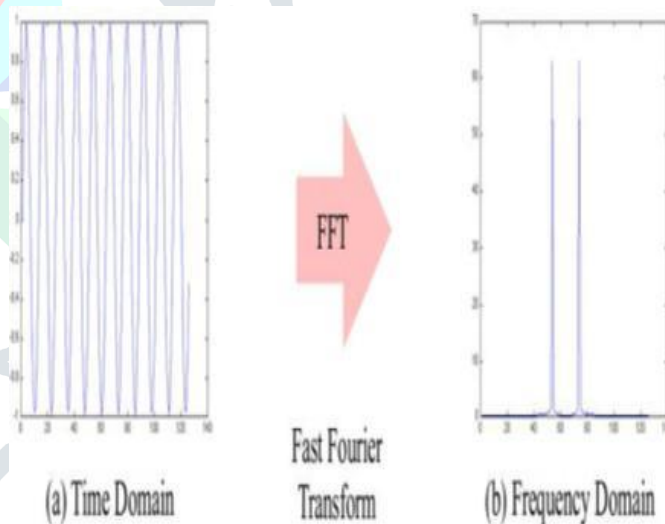


Fig.4 Fast Fourier Transform

The diagram of power spectral analysis using FFT and feature extraction in shown in fig.4

3 CONCLUSION

EEG signal is the complex signal and its analysing and information extraction is very complicated. EEG signal is consist of the very low frequency components different types of the artifacts and noises and power line frequencies are mixed with the original signal very great problems are generate so that first we are filter the signal by using the FIR Butterworth filter and extract the important information about EEG signal with the help of efficient DSP tool FFT.

REFERENCES

1. M. Teplan, "Fundamental of EEG Measurement," Measurement Science Review, vol. 2, pp. 1-11, 2002.
2. The System Research of Integrated EEG Analysis and Feature Extracting for Weak Signal Lan Li1, Lanfeng Yan2*, Lingli Tong1, Wei Wang1, Baowei Liu1, Yun Deng1, Yuerong Wang lan2008.li@gmail.com
3. Human Emotion Recognition Through Short Time Electroencephalogram (EEG) Signals Using Fast Fourier Transform (FFT) M Murugappan Campus Ulu Pauh, Perlis, Malaysia murugappan@unimap.edu.my Subbulakshmi Malaysiasubbulakshmi@unimap.edu.my
4. EEG Signal Processing and Feature Extraction for Training Neural Network to Study Mental State Deepika Verma1, Manoj
5. A Survey on EEG Based Emotion Analysis using various Feature Extraction Techniques J. Preethi, M. Sreeshakthy, A.Dhilipan,
6. Application of Lab View Software for Improving the Quality Evaluation of Electroencephalographic Parameters A. M. Gataullin1 and A. V. Ovchinnikov2* Biomedical Engineering, Vol. 46, No. 4, November, 2012, pp. 145_148. Translated from Meditsinskaya Tekhnika,]
7. EEG Power Spectrum Analysis during Mental Task Performance Plamen Manoilov International Conference on Computer Systems and Technologies - CompSysTech'06
8. Interpretation of Human Stages from EEG Signals Using LabVIEW Tina Thomas1, Mareena James2, Roshmi Rose Shaji3, Binu C Pillai Amal Jyothi India IJARCCCE Vol. 5, Issue 3, March 2016.