Malaysian Technical Universities Conference
on Engineering & Technology (MUCET) 2013

*k*NN Classification of Epilepsy Brainwaves

Mahfuzah Mustafa*, and Nor Anis Aneza Lokman

Faculty of Electrical & Electronics Engineering
Universiti Malaysia Pahang, Kampus Pekan, 26600 Pekan, Pahang, MALAYSIA.

*E-mail: mahfuzah@ump.edu.my

Key words: *k*NN; Epilepsy; Brainwaves, EEG Signals.

Abstract

Epilepsy is a disorder of the normal brain function by the existence of abnormal synchronous discharges in large groups of neurons in brain structures and it is estimated about 1% of the world's population suffers from this disease [Tzallas et al., 2009]. It has been reported that the brainwave of Epilepsy patient mostly in sharp, spike and complex wave pattern [Tzallas et al., 2009]. In addition, Epilepsy brainwaves pattern lies in wide variety of Electroencephalogram (EEG) signals in formed of low-amplitude and polyspikes activity [Vargas et al., 2011]. Generally, this disease was examined through the brainwaves or EEG signals by clinical neurulogists. An EEG is a device to record the brainwaves in term of electrical activity from the brain.

Brain patterns from wave shapes that are commonly sinusoidal and measured from peak to peak that range from 0.5 μV to 100 μV in amplitude. Moreover, the brainwaves have been categorized into four frequency bands, Beta (>13 Hz), Alpha (8-13 Hz), Theta (4-8 Hz) and Delta (0.5-4 Hz). All the frequency bands will be used to characterize the Epilepsy brainwave in terms of amplitude (voltage) and frequency [Mustafa et al., 2013].

The Epilepsy brainwaves were downloaded from http://www.vis.caltech.edu/~rodri/data.htm of Fp1 and Fp2 channels which is from rats. The brainwaves consists Epilepsy and non-Epilepsy samples. Then, the brainwaves were pre-processed to remove artefact (noise). Various methods had been introduced to detect spike-wave discharge in Epilepsy patient brainwave. Brainwave is non-stationary signal, therefore, time-frequency analysis is appropriate methods to analyse the signals [Tzallas et al., 2009, Vargas et al., 2011]. One of the most popular time-frequency analyses is Short-Time Fourier Transform (STFT). After the brainwaves were pre-processed, STFT was employed to the clean brainwaves. The STFT spectrogram was generated for four frequency bands of the samples. Figure 1 shows one of samples STFT image of Delta-band for Fp2 channel.

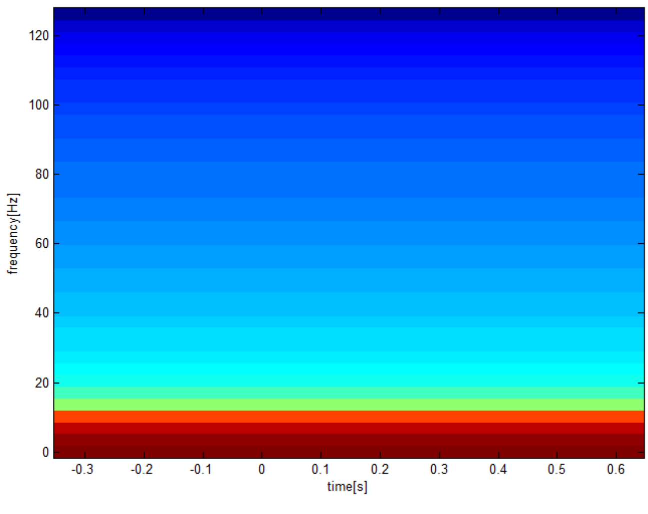

Figure 1: Delta band for Fp2 channel.

Next, Energy is extracted from the STFT spectrogram of four frequency bands for each sample. These features were input to *k*-Nearest Neighbour (*k*NN) to classify whether the brainwaves are Epilepsy of non-Epilepsy samples. The data were split into training and testing with two ratios which are 70 to 30 and 80 to 20. The *k* variable varied from 1 to 50, and the accuracy of each experiment was recorded. Figure 2 shows the result of accuracy for both ratios of training and testing 70:30 and 80:20. From the figure, the best result is from 80:20 ratio, with value of k = 1and accuracy 100%. In conclusion, Epilepsy brainwave was successful classify by using *k*NN with accuracy 100% using extracted Energy feature from STFT.

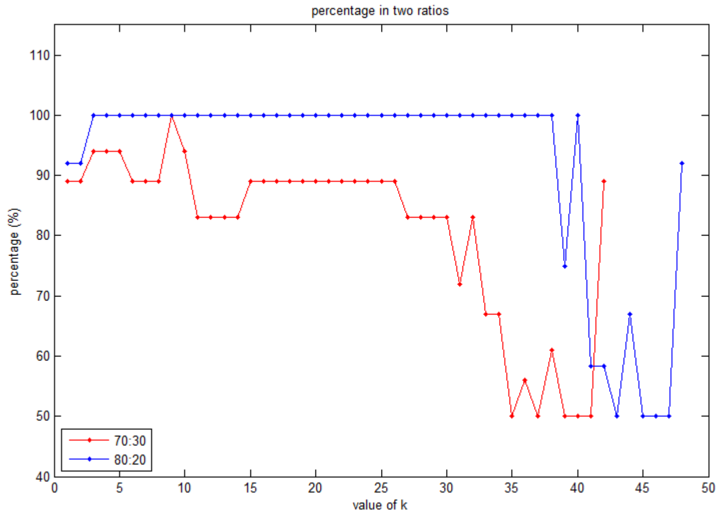

Figure 2: Comparison of accuracy of *k*NN for two ratios.

Acknowledgement: The authors thank Faculty of Electrical & Electronics and Universiti Malaysia Pahang for the Grant RDU120393.

References

Tzallas, A. T., Tsipouras, M. G., and Fotiadis, D. I. (2009). Epileptic Seizure Detection in EEGs Using Time-Frequency Analysis. *IEEE Transc. on Information Technology in Biomedicine*, 13, 703-710.

Martinez-Vargas J. D., Avendano-Valencia L. D., Giraldo E., and Castellanos-Dominguez G. (2011). Comparative analysis of time frequency representations for discrimination of epileptic activity in EEG signals, in proceedings of the *5th International IEEE/EMBS Conference on Neural Engineering*, 148-151.

Mustafa, M., Taib, M. N., Lias, S., Murat, Z. H., and Sulaiman, N. (2013). EEG spectrogram classification employing ANN for IQ application, in proceedings *of the International Conference on Technological Advances in Electrical, Electronics and Computer Engineering (TAEECE)*, 199-203.