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Title : ADVANCED SIGNAL PROCESSING OF EEG SUB-BAND FREQUENCIES IN CHARACTERIZING PSYCHO-PHYSIOLOGICAL CALMNESS

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Electroencephalographic signals or EEG signals are very closely related to psycho-physiological. At present, many types of diseases caused by the psycho-physiological have risen in the society. Early detection of psycho-physiological related problem such as stress, hypertension, depression and others has now become very important. This is due to the modern society lifestyle which contributes to major psycho-physiological problems. The existing practice to patients, who have been detected with psycho-physiological problem, used the assessment methods such as questionnaires and interviews which need expertise to handle the case and resulted in time consuming. Thus, a quick, reliable and simple method to determine the level of psycho-physiological condition is necessary during the treatments which can abridge the time needed to diagnose individuals. This study aim is to demonstrate some mental characteristics related to calmness can be grouped and categorized, hence produced EEG calmness index. To materialize this, asymmetry index was chosen as EEG feature in distinguishing unique characteristics of EEG signals from different brain behaviours named as relaxed state and non-relaxed state. The EEG signals were pre-processed through Fast Fourier Transform and were segmented before the energy spectral density (ESD) was derived. The asymmetry index was calculated using the derived ESD. The different data behaviour between relaxed state and non-relaxed state were verified by means of linear regression method to confirm the data discrepancy. In the EEG calmness categorization subtractive clustering was used to identify the total number of EEG behaviour existed within the data features. The Fuzzy C-Means (FCM) was used to place the data features into the same group and the classification was proven through k-Nearest Neighbour (k-NN). Statistical analysis was also employed to confirm the group selected by the FCM provides significant cluster selectivity. Model of Z-score was used to label the calmness indices and set the Z-value equal to 2σ as the minimum level to become EEG calmness index. From the statistical analysis and Z-score results, three indices can be proposed as calmness indices. This was supported with the k-NN performance measures which confirmed the selection for the three indices with 100% accuracy. Therefore, the number of calmness indices which could be used to represent the EEG calmness is three. The results obtained in this study also suggested that the EEG behaviour during calmness can be categorized. The chosen techniques used in the study and the calmness index have brought a novel finding in the EEG research. It is expected that the established EEG calmness index can be projected for the psycho-physiological diagnosis.