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EDAS: Emotional deficits assessment system for Parkinson's disease (PD) patients using wireless EEG signals

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Parkinson's disease (PD) has traditionally been described as a movement disorder, there is growing evidence of cognitive and social deficits associated with the disease, and particularly, in emotion-related information processing. Electroencephalogram (EEG) signals, being an activity of the central nervous system, reflect the underlying true emotional state of a person. This research focuses on machine-learning algorithms to categorize emotional states in PD patients compared to healthy controls (HC) using EEG. Twenty non-demented PD patients and 20 healthy age, gender and education level-matched controls viewed happiness, sadness, fear, anger, surprise and disgust emotional stimuli while fourteen-channel wireless EEG were being recorded. Multi-modal stimulus (combination of audio and visual) was used to evoke the emotions. In addition, participants were asked to report their subjective affect through self-assessment form (SAF). EEG signals were pre-processed to eliminate noises that occur due to eye movement/blinks and low/high frequency noises. To classify the EEG-based emotional states and visualize the changes of emotional states over time, we extracted Higher order spectra (HOS), power spectrum, wavelet packet transform (WPT), and non-linear dynamical features from the filtered signals at different EEG frequency bands, and proposed an approach to track the trajectory of emotion changes with manifold learning. Four different classifiers namely Fuzzy K- Nearest Neighbor (FKNN), K-Nearest Neighbor (KNN) Regression Tree (RT), and Support Vector Machine (SVM) were used to investigate the performance of emotion classification through the extracted features. From the experimental results, we found that :

1. HOS based feature is superior to other features
2. high frequency EEG band play a major role in emotion-related information processing in PD and HC
3. PD patients showed emotional impairments compared to HC, as demonstrated by a lower classification performance, particularly for negative emotions (sadness, fear, anger and disgust); and
4. the trajectory of emotion changes can be visualized by reducing subject-independent features with manifold learning.

Biography

M Murugappan has completed his PhD from Universiti Malaysia Perlis, Malaysia on 2010 and presently working in the same university as a Senior Lecturer in School of Mechatronic Engineering. His primary research interest is on affective computing, biosignal processing applications and human machine interaction (HMI). He has published nearly 100 peer reviewed research articles in reputed international conferences, journals and book chapter and won several medals in international/national research exhibitions for his products. He served as a guest editor on several international journals and committee members in international conferences. He guided several PhD and MSc students on various titles in biosignal processing applications.

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