Multiple Instance Learning Selecting Time-Frequency Features for Brain Computing Interfaces

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Abstract

Brain-Computer Interface is a technology which uses measures of brain activity to help people with motor disabilities. BCI applications based on Electroencephalography commonly rely on Motor Imagery paradigm. However, the estimation of motor brain patterns is affected by both variations in the signal properties over time (i.e. non-stationarity) and differences between frequency bands activations. Generally, Common Spatial Patterns is used as feature extraction. Nevertheless, its performance depends on the filter band selection and the time when the brain activity is associated with the task. A new method of time-frequency segmentation based on multi-instance learning is proposed. The spatial filters are built taking to account the obtained frequency-temporal segments where an instance selection based on Sparse Representation Classification method is developed together with a feature selection stage. The experiments are developed using a well-known dataset BCI competition IV dataset IIa that contains EEG records of nine subjects recorded from 22-electrodes mesh. The results evidencing that significant features appear at the end of MI interval and the found spatial patterns are consistent with MI neurophysiology. Furthermore, the proposed method outperforms the average classification accuracy of both CSP and SFTOFCRC for 8.21% and 1.23% respectively without deteriorating classification accuracy with statistical significance for subjects that present high accuracy with the compared methods.

Keywords: *Electroencephalography, Motor Imagery, Multi-instance, learning, Feature selection, Instance selection*