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An ANOVA-based Sequential Forward Channel Selection Framework for Brain-Computer Interface Application based on EEG Signals Driven by Motor Imagery

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Abstract : Converting the movement intents of a person into commands for action employing brain signals like electroencephalogram signals is a brain-computer interface (BCI) system. When left or right-hand motions are imagined, different patterns of brain activity appear, which can be employed as BCI signals for control. To make better the brain-computer interface (BCI) structures, effective and accurate techniques for increasing the classifying precision of motor imagery (MI) based on electroencephalography (EEG) are greatly needed. Subject dependency and non-stationary are two features of EEG signals. So, EEG signals must be effectively processed before being used in BCI applications. In the present study, after applying an 8 to 30 band-pass filter, a car spatial filter is rendered for the purpose of denoising, and then, a method of analysis of variance is used to select more appropriate and informative channels from a category of a large number of different channels. After ordering channels based on their efficiencies, a sequential forward channel selection is employed to choose just a few reliable ones. Features from two domains of time and wavelet are extracted and shortlisted with the help of a statistical technique, namely the t-test. Finally, the selected features are classified with different machine learning and neural network classifiers being k-nearest neighbor, Probabilistic neural network, support-vector-machine, Extreme learning machine, decision tree, Multi-layer perceptron, and linear discriminant analysis with the purpose of comparing their performance in this application. Utilizing a ten-fold cross-validation approach, tests are performed on a motor imagery dataset found in the BCI competition III. Outcomes demonstrated that the SVM classifier got the greatest classification precision of 97% when compared to the other available approaches. The entire investigative findings confirm that the suggested framework is reliable and computationally effective for the construction of BCI systems and surpasses the existing methods.

Keywords : brain-computer interface, channel selection, motor imagery, support-vector-machine
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