Correlation-based common spatial pattern (CCSP): A novel extension of CSP for classification of motor imagery signal

ABSTRACT

Common spatial pattern (CSP) is shown to be an effective pre-processing algorithm in order to discriminate different classes of motor-based EEG signals by obtaining suitable spatial filters. The performance of these filters can be improved by regularized CSP, in which available prior information is added in terms of regularization terms into the objective function of conventional CSP. Variety of prior information can be used in this way. In this paper, we used time correlation between different classes of EEG signal as the prior information, which is clarified similarity between different classes of signal for regularizing CSP. Furthermore, the proposed objective function can be easily extended to more than two-class problems. We used three different standard datasets to evaluate the performance of the proposed method. Correlation-based CSP (CCSP) outperformed original CSP as well as the existing regularized CSP, Principle Component Cnalysis (PCA) and Fisher Discriminate Analysis (FDA) in both two-class and multi-class scenarios. The simulation results showed that the proposed method outperformed conventional CSP by 6.9% in 2-class and 2.23% in multi-class problem in term of mean classification accuracy.