一种基于 CSP-PSO-SVM 算法的 EEG 信号特征提取与分类算法

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摘要：为了解决目前 EEG 信号特征提取困难及识别率低等问题，提出了一种基于 CSP-PSO-SVM 的 EEG 信号特征提取与分类算法。该算法首先通过小波包变换实现 EEG 信号的预处理，提取出 EEG 信号中的特定频段信号，然后通过构建“一对一”共空间滤波器对 EEG 信号进行特征提取，最后通过粒子群优化的支持向量机算法实现 EEG 信号分类识别，并选用 2008BCI 竞赛 2A 数据集进行算法分类效果校验。实验结果表明：该算法的分类准确率最高可达到 93.07%，且平均准确率高于 2008 BCI 竞赛中前两名的结果。该方法提取的 EEG 信号特征能很好的反映 EEG 的信号特征，明显提高分类识别的准确率，为脑机接口的发展与应用提供帮助。

关键词：运动想像；共空间模式；支持向量机；粒子群优化

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Research on Feature Extraction and Classification Algorithm Based on Four Types of Motion Imagination EEG Signals

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Abstract：In order to solve the problems of EEG signal feature extraction and low recognition rate, the EEG signal feature extraction and classification algorithm based on CSP-PSO-SVM is proposed. The CSP-PSO-SVM algorithm firstly preprocesses the EEG signal by wavelet packet transform, extracts the specific frequency band signal in the EEG signal, and then extracts the EEG signal feature by constructing “PW-CSP” filters. Finally, the EEG signal classification and recognition is realized by the support vector machine (SVM) algorithm optimized by particle swarm optimization, and the 2008 BCI competition 2A data set was choose for CSP-PSO-SVM algorithm testing. The experimental results show that the classification accuracy of the CSP-PSO-SVM algorithm may reach up to 93.07%, and the average accuracy is higher than the results of the top two in the 2008 BCI competition. The EEG signal features extracted by this method can reflect the signal characteristics of EEG well, and improve the accuracy of classification recognition, which may drive the development and application of brain-computer interface.

Key words：motion imagining; common spatial pattern; support vector machine; particle swarm optimization