A Novel Feature Extraction Method for Improving P300-Speller Performance

Ali Özgür Argunşah, Ali Baran Çürüklü, Müjdat Çetin and Aytül Erçil
Faculty of Engineering and Natural Sciences, Sabanci University, 34956 Tuzla, Istanbul, Turkey

A P300 speller system has a 6x6 symbol matrix whose rows and columns are intensified in random order. Thus, two evoked single trials, P300s, occur for a symbol at each repetition. One repetition is completed once all rows and columns in the matrix are intensified. The symbol to be written is determined by detecting the P300 signal, which is generated when the subject counts number of times the given symbol is intensified. Traditionally, evoked activity is extracted using binary classification with a long feature vector consisting of individual electrodes, and averaging over several repetitions. What we have done here is a novel feature extraction method for rapid classification of P300. The method does averaging not only over trials but also electrodes. The underlying assumption is as follows; every electrode in frontocentral and centroparietal region has different background EEG activity but almost similar evoked activity with some little time shift called latency. Since the latency between electrodes is at most roughly 30 ms and background EEG activities have different patterns, averaging both over repetitions and electrodes increases P300 signal to background EEG noise ratio faster using less trials than traditional approach. Traditional and proposed feature extraction methods are tested on BCI Competition III P300-speller dataset by using Support Vector Machines. Classification performance of traditional and proposed methods with 3 electrodes (Fz, Cz, Pz) and 3 repetitions was 75% and 92% respectively. Testing the method in an online P300 speller system with an online artifact rejection algorithm will be our next work.