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A Neurofeedback Learning Model Using Time-Frequency Analysis for Volleyball Performance Enhancement

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Abstract : Investigating possible capacities of visual functions where adapted mechanisms can enhance the capability of sports trainees is a promising area of research, not only from the cognitive viewpoint but also in terms of unlimited applications in sports training. In this paper, the visual evoked potential (VEP) and event-related potential (ERP) signals of amateur and trained volleyball players in a pilot study were processed. Two groups of amateur and trained subjects are asked to imagine themselves in the state of receiving a ball while they are shown a simulated volleyball field. The proposed method is based on a set of time-frequency features using algorithms such as Gabor filter, continuous wavelet transform, and a multi-stage wavelet decomposition that are extracted from VEP signals that can be indicative of being amateur or trained. The linear discriminant classifier achieves the accuracy, sensitivity, and specificity of 100% when the average of the repetitions of the signal corresponding to the task is used. The main purpose of this study is to investigate the feasibility of a fast, robust, and reliable feature/model determination as a neurofeedback parameter to be utilized for improving the volleyball players' performance. The proposed measure has potential applications in brain-computer interface technology where a real-time biomarker is needed.

Keywords : visual evoked potential, time-frequency feature extraction, short-time Fourier transform, event-related spectrum potential classification, linear discriminant analysis
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