Stockwell transform and clustering techniques for efficient detection of vision impairments from single trial VEPs

Abstract

Pattern reversal visually evoked potentials (VEPs) provide valuable information about the visual nerves pathways and is a promising field to be explored for the investigation of vision impairments. The conventional method of analysis however, is centred on the detection of amplitude and latency values from the averaged VEP responses. This paper proposes alternative method of analysis using Stockwell transform (ST) for discrimination of vision impairments using single trial VEPs. The pattern reversal VEPs for the research is collected non-invasively from 16 eyes of ten subjects. The signals are decomposed into delta, theta, alpha, beta, gamma1 and gamma2 bands, and five different features are extracted from the ST matrix. The features are weighted using feature weighting method based on clustering centres of k-means clustering (KMC), fuzzy c-means clustering (FMC), and subtractive clustering (SBC) to improve the interclass variations. Extreme learning machine (ELM) and Levenberg-Marquardt back propagation neural network (LMBP) are used to discriminate the vision impairments, and the proposed method is able to achieve a maximum accuracy of 99.95%.