EEG signal classification using Particle Swarm Optimization (PSO) neural Network for brain machine interfaces

Abstract

The brain uses the neuromuscular channels to communicate and control its external environment, however many disorders can disrupt these channels. Amyotrophic lateral sclerosis is one such disorder which impairs the neural pathways and completely paralyses the patient. Rehabilitation of such patients is possible through a brain machine interface which provides a direct communication pathway between the brain and an external device. Brain machine interfaces (BMI) are designed using the electrical activity of the brain detected by scalp Electroencephalogram (EEG) electrodes. In this paper a novel training algorithm using Particle Swarm Optimization (PSO) is proposed, the results are compared with the classical Back Propagation (BP) training algorithm, Feed Forward Neural Network (FFNN) architecture with one hidden layer is used in this study. Five mental tasks signals acquired from two subjects were studied; a combination of two tasks is used for classification. Short time principal component analysis is used to extract the features. The features are used for training and testing the neural network. Classifications of 10 different task combinations were studied for two subjects. Improved classification performance was achieved using the PSO algorithm in comparison to the B.P. Algorithm. Average classification accuracies obtained with the PSO FFNN vary from 81.5 % to 97.5 %.