Abstract

Brain Computer Interface (BCI) is a direct communication channel between the brain and an external device. BCI has the potential to bring machines to a level where living beings and machines can work side by side. BCI is one of the most promising technologies of modern times and an active area for research. It can used for rehabilitation of the quadriplegic.

This project titled **"Brain Controlled Wheelchair: Motor Imagery Classification and an Implementation"** is conceived for design and development of a cost-effective intelligent wheelchair. A non-invasive Electroencephalogram (EEG) based BCI is developed for classification of Motor Imagery (MI) as a first step.

We have done a literature survey; papers from 20 years (1994-2013 A.D.) have been studied on *Non-invasive EEG based Motor-imagery Brain Computer Interface.* Based on the survey, a network is constructed which highlights the association between the concepts of BCI with the research documents published. An architecture is proposed which exploits the features of bispectrum of EEG for MI classification. The classifier chosen is a Least Square Support Vector Machine (LS-SVM) with a Radial Basis Function (RBF) kernel.

Initial experiments are performed with EEG data taken from a publicly available dataset *BCI Competition IV Dataset IIb.* The dataset contains MI related to Left and Right hand movements from two bipolar channels viz., $C3$ and $C4$.

Band pass filter has been implemented as a pre-processor to increase the Signal-to-Noise Ratio (SNR) of the EEG signals. Statistical and High Order Statistical (HOS) features of bispectrum are also explored. To obtain an optimal feature set from the large feature space, a *Hybrid Wrapper Method* is carried out.

Upon achieving a high cross-validated classification accuracy the proposed architecture is implemented as a *Brain Controlled wheelchair.* A translation algorithm maps the classified MI into a device command that moves the wheelchair back and forth.

The proposed work can be of great value to the field of rehabilitation robotics, especially to persons suffering from spinal cord injury, or the persons incapable of motor actions.