Motor Imagery Recognition of EEG Signal using Cuckoo-Search Masking Empirical Mode Decomposition

S.Stephe, T.Jayasankar. K.Vinoth Kumar

Abstract: Brain Computer Interface (BCI) is a collaboration between a brain and device that enables the signals from the brain to done the external activity, i.e. Cursor, Prosthetic control or Wheel chair movement. The brain and object have the direct communication control by using BCI systems. Mostly the current research should be focused on non-invasive method. The array of neurons should be read by using the computer chips and programs then translate the signals in to action i.e., Motor Imagery (MI). The main objective is used to help the disable person without someone help. Mainly the BCI System should be very helpful for the people those who are affect from paralysis to write something and control the motorized wheel chair through thought alone. In Brain Computer Interfacing BCI) the Electroencephalogram (EEG) is a very challenging non-stationary signal. In this paper the preprocessing should be done by Least Mean Square (LMS) algorithm and Empirical mode decomposition (EMD) is a new method to extract the non-stationary signal should be apply on motor imagery recognition task. The features of EEG such as energy, fuzzy approximate entropy, Morphological features and AR coefficients are extracted using Masking empirical mode decomposition. The extracted features are selected by using the cuckoo search algorithm (CSA). In this paper the extracted features should be compare, with cuckoo search or without cuckoo search algorithm analyzed. After the feature selection features are classified by using the linear discriminant analysis (LDA) with respect to some parameters like Accuracy, Precision, Recall, Maximal (MI).

Keywords: Brain Computer Interface (BCI), linear discriminant analysis (LDA), Empirical mode decomposition (EMD), Cuckoo Search Algorithm (CSA), Motor imagery (MI), Least Mean Square (LMS).

I. INTRODUCTION

The interface between the brain activity and electronic device are enable by the brain computer system (BCI).The bio signal is taken as a input to the BCI system and predicts the action is suggested in [1].The corresponding brain sensorimotor areas are activated when the people imagining an action without execution and the same EEG should be generates as if the action is done in motor imagery [2,3].The main challenge in the EEG classification,the brain signals should be small in amplitude. Therefore, some events like eye movement, muscular movements, etc. should have the lower SNR value. The various techniques have been proposed to prevent the decoding system to correctly decode the user's thoughts such as temporal filtering methods, [4], feature extraction and feature selection techniques [5], and classification algorithm [6]. The several feature extraction techniques such as common spatial pattern (CSP) [7], power spectral density (PSD) [8], have been studied. Classifiers such as k-nearest neighbor (KNN) [9], support vector machine (SVM) [10], etc. have been explored for Classification of MI-EEG signals. Actually, the EEG signal is almost invariably non -linear and non-stationary [11]. To overcome this the empirical mode decomposition should be analyzed (EMD) [11]. The mode mixing and edge effect should be hardly avoided by the EMD and also it makes a sub-signal being a lower signal-to-noise ratio. The EMD is used to rectify the problem such as mode mixing and edge effect. It is also given the better classification to given the higher accuracy. In Masking empirical mode decomposition [12], the original signal should be added first and secondly it should be subtracted to get the frequency masking signal. Initially filtered the EEG using Linear mean square(LMS) algorithm and then the Intrinsic mode function (IMF)extraction should be done using MEMD technique. The required signals are selected as a mu and beta subcomponents, from these components the Energy, morphological features, and fuzzy approximate entropy auto-regressive (AR)coefficients are extracted [2]. The extracted features are selected by the cuckoo search algorithm and finally applied to the linear discriminant analysis (LDA) for classification purpose.

II. MATERIALS AND METHODS

A. *EEG Data*

In this work , the Brain Computer Interfacing competition IV data set I was given by Berlin institute of technology is used to verify the motor imagery movements of left or right hand/foot. BCI Competition is an open competition which aims at evaluating various approaches used in brain computer interfaces and comparing them on the same data set in order to obtain a reliable measurement of performance for each algorithm. It is an attempt to solve the problem of comparing BCI-related signal processing. Methods that are published, but their accuracy was verified on different data sets or they use different performance measures, which makes the relative comparison between any two of the selected methods impossible [13]. Four editions of the BCI Competition were organized and each edition

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