International Journal for Modern Trends in Science and Technology
Volume: 03, Issue No: 07, July 2017
ISSN: 2455-3778
http://www.ijmtst.com

A Novel Spatial-Spectral Signal Processing Method for Rehabilitation EEG Data Analysis of Stroke Patients

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To Cite this Article
R.Gopika Selvi and P.Prabhu, "A Novel Spatial-Spectral Signal Processing Method for Rehabilitation EEG Data Analysis of Stroke Patients", *International Journal for Modern Trends in Science and Technology*, Vol. 03, Issue 07, July 2017, pp. 45-49.

ABSTRACT

The Spatial Spectral signal processing method is a method for analyzing Motor Imagery (MI) Electroencephalography (EEG) of stroke patients. EEG analysis is used to pre-define process of the channels configuration and frequency band classifying the EEG for stroke patients. EEG analysis based data was recorded by a 16 channel. The EEG is performed heavily depends on the selection of a time interval. That pattern may have gradually changed during rehabilitation. The main issues of the EEG analysis report of stroke patients is formation of some unknown channels which is contaminated with more noisy and non stationery signals. In this paper, classical CSP based method is improved for data analysis during motor recovery motor imagery EEG patterns of stroke patients which changes that the rehabilitation training process. This is methods is based on variable preconditions and introduced a new heuristic supervisor of stochastic gradient boost strategy for training weak classifiers of the spatial spectral during rehabilitation method. Real-world datasets were collected from famous BCI competitions for training and test dataset using this method. This method has been implemented for the channel and frequency using a sliding window process and then trained the weak learners for that boosting signals. Three different datasets are tested and recorded for including the healthy people and stroke patients. The test accuracies are obtained for each subject in Brain Computer Interface (BCI) competition of the competing tests are PSD, SR, CSP, RCSP, SBCSP, CSSP, and CSSSP. This new method has been evaluated for its performance benchmark based on the session to-session transfer rate. The experimental results using various simulations show that the proposed algorithm is outperformed with conventional systems as well as reducing the computational complexity.

KEYWORDS: *EEG analysis, Brain Computer Interface (BCI), Rehabilitation, Spatial spectral signal, Motor Imagery.*

I. INTRODUCTION

The Brain-Computer Interface BCI that a direct communication pathway for a human brain and an external device. The BCI allows stroke patients to use for that brain signals for communication and control. The BCI has been widely used in resorting motor functions in stroke patients, for a rehabilitation tool. Electroencephalogram EEG is one of the most processes of brain signals in BCI due to its low cost and non invasive patterns. Motor imagery EEG has been widely performed of its property and inexpensive processing. The EEG is a recording of electrical activity along the scalp. The

ionic current flows within the neurons of the brain. It is to classify the given EEG signal to right hand or right foot. The spatial filter provides signals so that easy to classify that environment. It is to design the spatial filters that lead to optimal variances for the discrimination of EEG related to right hand and right foot motor imagery.

II. Related Works

Research in any field requires literature review. A literature review is a written document that presents a logically argued case founded on a comprehensive understanding of the current state of knowledge about a topic of study. This case establishes a convincing thesis to answer a study's question. It will also give readers the necessary background to understand the research work.

Distinguishing what has been done from what needs to be done. Discovering important variables relevant to the topic. Synthesizing and gaining a new perspective. Identifying relationships between ideas and practice. Establishing the context of the topic or problem. Rationalizing the significance of the problem. Enhancing and acquiring the subject vocabulary. Understanding the structure of the subject. Relating ideas and theory to applications. Identifying the main methodologies and research techniques that have been used. Placing the research in a historical context to show familiarity with state-of-the-art developments.

J. Satheesh Kumar and P. Bhuvaneswari. Has explained that Human brain consists of millions of neurons which are playing an important role in controlling the behavior of human body with respect internal/external motor/sensory stimuli. These neurons will act as information carriers between human body and brain. Understanding cognitive behavior can be visualized in terms of motor and sensory states such as eye movement, lip movement, remembrance, attention, hand clenching etc.

S. Deivanayagi et.al. Discussed that the Hypnotherapy is a powerful alternative for an array of neurological disorders, patients should be willing to be hypnotized and convinced that hypnosis works. For the successful treatment, it is absolutely essential for the hypnotherapists to ascertain that the patient is properly hypnotized, and therefore require a reliable method to find the mental state of the patient. Even among the hypnotic researchers.

Felicity Bright.et.al. Discussed that the barriers and Facilitators to engagement in Rehabilitation for people with stroke. There is limited knowledge of the factors that may help or hinder engagement in stroke rehabilitation. The systematic principle and aimed to explore what is currently known about the perceived barriers and facilitators to engagement in stroke rehabilitation. EBSCO, SCOPUS and Google scholar databases and reference lists were searched for papers that provided insight into the process of engagement or disengagement in stroke rehabilitation Themes included goal setting, therapeutic connection, personalized rehabilitation, paternalism versus independence, patient-centered practice, knowledge is power, and feedback and achievement. None of the papers identified, however, explicitly sought to investigate the complexities of engagement in rehabilitation specifically within the stroke population.

Liqing Zhang. et.al. Tensor – based scheme for stroke patients that the motor imagery for EEG analysis in BCI-FES rehabilitation training. Stroke is one of the most common disorders among the elderly. The stroke rehabilitation system is how to separate that the motor imagery patterns from electroencephalographic (EEG) recordings. The classical algorithms are such as Common Spatial Pattern (CSP), are directly applied to stroke patients. A tensor based scheme to detect motor imagery EEG patterns in spatial-spectral-temporal for multidimensional EEG constructed by wavelet transform method. These motor imagery EEG patterns are obtained by Fisher score strategy. The most contributed channel groups and frequency bands are selected from these patterns and utilized as prior knowledge for the motor imagery tasks. We evaluated that scheme based on the EEG datasets recorded from stroke patients.

Leigh A Hale. Community-based or home-based stroke rehabilitation of confusion or common sense. The stroke rehabilitation is trained the people with stroke will become progressively more community-based, with less time spent on in-patient rehabilitation. The current literature on stroke rehabilitation in the community and debates the issue it is truly community-based or just merely an extension of care. The stroke rehabilitation in the community significantly improves personal and extended activities of daily living and does not result in functional deterioration. This model of service delivery may result in greater career stress. It is suggested that

community-based programs may result in different outcomes to home or domiciliary-based programs.

III. Research Methodology

The training data pool by adding copies of the incorrect-classified problems and the number of copies is declared by the local classification error. It is not only conjoins randomness brought by stochastic gradient, it is also increases incorrect classified samples for selected but decreases the probability is classified being chosen. The first two datasets, whose motor imagery related spatial and spectral model for known, and evaluated its performance in comparison with that of seven popular algorithms. The spatial and spectral properties were not specifically identified.

3.1 Algorithm: Common Spatial Pattern (CSP)

CSP increases the signal variance for one condition minimizes the variance for other condition.

- To improve the discrimination of two types of the signal processing. The spatial filters are in the way of maximizing variance for signals to the first condition at the same time spatial are minimize for that second condition.
- The two commonly used motor imagery tasks for (e.g. left versus right hand movement). It can be used for two classes that only explained for SSVEP experiments or the discriminative information is in the variance of the signal conditions.

3.2 Common Spatial-Spectral Boosting Pattern:

- The CSSBP algorithm including solving the problem for modeling and model learning methods.
- The four stages of EEG measurements processing is multiple spatial filtering and band pass filtering, the weak classifiers trained the CSP organizing features for the pattern recognition using a combination model.

A. Data Acquisition

The effectiveness and robustness is to evaluate the algorithm. Motor imagery based datasets are assembled from BCI for two competitions that are one self-collected stroke patients EEG were used this method formulation.

- Brain is activated using the EEG signals; it is represented by the muscle process of parameters.
- The thumb expression has also measured the person for an upright position. The thumb is supported by an arm. It is moving to 3 positions.
- It is triggered by the synchronization pulse. The pulse is worked on the seconds to calculate. The period is having the 20% of movement, the rest is 80% on stay position.
- The sensed motions are recorded on a tape and stored in PC. The thumb expression is based on the processing of video sequences.
- The EEG signals and video sequences are using the signal processing method for the brain activity based signal processing.

B. Data Preprocessing

The EEG data is to improve the low signal ratio for the extraction of the preprocessing method. It is to be removed from eye and muscle movement. These are like only that types (1) Dipole-like scalp, (2) EEG like spectra form, (3) EEG for temporal structures. The EEG is to transform the tensor for the spatial spectral-temporal domain and the structural information is in the EEG spectrums. The band passes filtered is in a specific frequency band is involving in the imagery pattern for a motor process. The frequency band varying the healthy people to visit the two rhythms. The filtered path is in the range of 8-30 Hz. Raw data in the dataset is filtered in the ranged from 5 to 40 Hz.

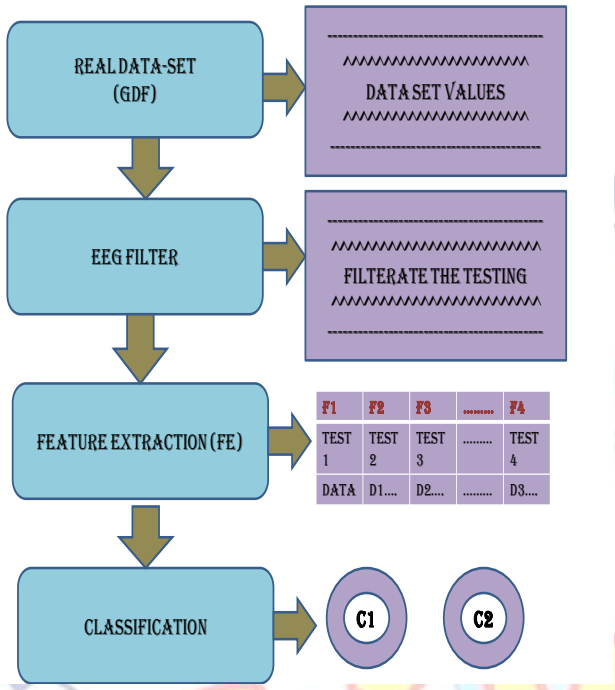
C. Classification and Validation

The (SVM) Linear Support Vector Machine is obtained the top-level performance are conducted for classification. Cross validation is used to choose the suitable SVM parameters for that prediction method. All the algorithms are in the right part gives the details of the box plots. Each method is a variation of the feature method and it is determined to the training performance. That training performance cannot be improved for that the CSSBP. It is reached both the highest median and mean accuracy for the CSSBP and the CSP in 7% mean classification accuracy and by almost 6% for the median classification accuracy performance method.

3.3 Data-Set Designing Process:

A Linear Support Vector Machine (SVM) is in the top level performance of many applications is conducted for classification. These are denoted the

form of real data set values to provide, filtrate the testing pattern, classification is also calculated for designing process.



Competing algorithms PSD, SR, CSP, RCSP, SBCSP, CSSP, CSSSP and the proposed algorithm is CSSBP

IV. Experimental Evaluation

This research work has been implemented for plotting of functions, data, and creation of user interface. It is widely used in academic and research institutions as well as industrial enterprises.

V. Result and Discussion

The results were mainly given in two aspects of illustration of the classification accuracy and visualization of the obtained spatial-spectral filters. The patient will be an improvement for that treatment of the 7 tests. The trainer will take the rehabilitation training for that the stroke patient. The EEG test can be approved for the patients will be cured and that the hand and legs are moved frequently to both sides.

The previous papers only having the brain competition are tested. The motor patterns are only defined that the face, lip movement, and other parts are only not working in the human body. It is only the feature discussion for that the paper.

VI. Conclusion

A spatial-spectral boosting algorithm for EEG classification is proposed on that work similarly. It can be the channel and frequency for using a sliding window and then the trained weak classifiers for the gradient boost conditions. The channel groups and the frequency bands related to the motor imagery patterns for all of the effective instructions for CSP. The effectiveness of the proposed algorithm is compared with the original CSP and some other CSP based algorithms on three different datasets recorded from diverse populations with the healthy people and stroke patients. The results demonstrated its superior classification performance. It is also observed that the discriminative frequency bands, leading to a time-consuming tuning process in order to achieve the optimal performance. Addressed this problem and can easily achieve satisfactory results. The CSSBP is also very well suited to EEG analysis into a general framework that can be easily used in the other BCI based problems. That CSP is only one special method embedding in the framework for EEG analysis. Just replace CSP with the other corresponding methods in algorithm without change of the framework.

VII. Feature Enhancement

The rapid advancements in biomedical technology for analyzing biomedical signals are an important research area. The brain potential in order to help the disabled people and obtain an accurate diagnosis of diseases. EEG records brain waves with respect to specific frequency by placing metal electrodes on the scalp. The spectral analysis of EEG during hypnosis shows the frequency bands in theta and alpha range is expected. The analysis can be the frequencies of other than that work like beta and gamma frequencies. Six channel EEG amplifiers instead of four channel amplifier will be helpful to acquire the data. For comparison, seven states of the art algorithms are listed Power spectral density (PSD), Phase synchrony rate (SR), the original CSP, regularized CSP (RCSP), the sub-band CSP (SBCSP), CSSP and CSSSP, were utilized the feature extraction. Fast Fourier transforms to compute power spectral density values. For RCSP, Weighted Regularization was chosen. The 4-class motor imagery classification task in Dataset II, the CSP- based methods employed the one-versus-rest (OVR) strategy. After feature extraction, a Fisher score strategy was used to select relevant features, as more features cannot improve the training accuracy.

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