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Analysis of FMRI Data Based on Prediction of Neural Response Using MVPA

Mrs.Nagalakshmi B Naik[1], Mrs.Deeksha [2], Mrs.Deepthi Dayanand[3]
[1,2]Department of Electronics and Communication Engineering, Srinivas Institute of Technology, Valachil, Mangalore, India
[3]Department of Electronics and Communication Engineering, Sahyadri college of Engineering and Management, Mangalore, India

Abstract: *FMRI data is an emerging approach that shows all the information of the brain that is represented in the subject of the brain at a particular point in time. Multi-voxel pattern analysis (MVPA) is gaining interest in the neuro imaging because it allows Cognitive states to be modeled as distributed patterns of neural activity. The MVPA approach allows to several cognitive state of brain reading. In order to relate the neural actions to cognition in fMRI information Multi-voxel sample examination is used. The intend of this project is to construct a classification model. When the quantity of features (voxels) exceeds the total quantity of data scrutiny, it creates replica over fitting. For this reason it is significant to choose informative voxels previous to constructing a classification model. This project mostly deals with two methods that are MI and partial least square regression (PLS). By using these two techniques effective feature assortment is done. Based on the degree of association to the stimulus circumstances informative voxel index must be created. The proposed work is evaluated by determining the performance of standard classification algorithms. The results obtained from the proposed work which is based on PLS and MI method improves the classification accuracy.***
Keywords: *fMRI,PLS,mutualinformation,MVPA,VT cortex.*

I. Introduction

Functional magnetic resonance imaging also known functional MRI (fMRI) is a neuroimaging process. This technique uses MRI technology .The activities of the brain is measured using MRI technology which in turn determines the changes related with blood flow. The most important type of fMRI uses the blood-oxygen-level dependent (BOLD) signal, which is obtained by interaction of blood flow and changes in the neural activity.Multivoxel pattern analysis(MVPA) approach is used for studying the relationship between brain activity and cognition .Since the hemodynamic response of neural activity is very slow the observed BOLD signal change, is modeled by canonical response function and estimated by a single value. The objective of MVPA is to build a pattern classification model of BOLD signals at informative voxels to know cognitive representation related to experimental conditions. Functional magnetic resonance imaging that is fMRI was developed in the 1990 by Seiji Ogawa. It is a neuroimaging procedure which uses oxygen metabolism and blood flow to estimate the brain activity. The fundamental driving Force behind fMRI is to extend MRI to confine functional changes in the brain caused by neural activity. Brain is scanned by MRI scanner which uses a strong static magnetic field ,this magnetic field is used to align nuclei in the brain region. The changes in the blood flow is related to the neural activity in the brain .As the blood flow to the brain region increases neurons become active. Voxels also called as volume elements, the region in a tissue slice that corresponds to a pixel in an image. Voxels are small 3-D square shaped image .Each activity related to a voxel shows how closely it matches the time-course of the signal. In order to estimate the degree of association of cognition, BOLD responses is taken from the whole brain region with the experimental condition in Multi-Voxel Pattern Analysis (MVPA).

Multi-voxel patterns are considered in the ventral temporal (VT) cortex In response to various groups of visual stimuli. To identify the hidden information in the multivariate patterns a multivariate statistical measure that is Partial Least Square Regression is used for the selection of informative voxels. It is also used to identify the prioritized voxels in the VT cortex. In this work we propose a computational frame work for mvpa to identify the prioritized voxels in the region of interest ,which are associated with object level representation .

II. Proposed System

Generally fMRI data depends on univariate statistics in which each location in brain is considered independently. MVPA approach is commonly used to perform cognitive state decoding into discrete stimulus condition. MVPA entails three steps:

1) Feature Extraction
2) Feature selection

3) pattern classification

In feature removal method time related BOLD responses are characterized to a incentive at voxel The general approach is to approximate the magnitude of fMRI response for each stimulus event or a hemodynamic response function convolved with box-car regressor in the general linear model(GLM).

The reliant variable with autonomous variable is predicted by GLM. The general linear model can be expressed as

$$Y=XB+U \quad (1)$$

Where Y is a matrix consisting of series of multivariate measurements. X is a design matrix. B is a matrix of parameters to be estimated. U is a noise matrix. Across the measurements, the uncorrelated errors are unspecified and pursue a multivariate standard distribution.

III. Results and Discussion

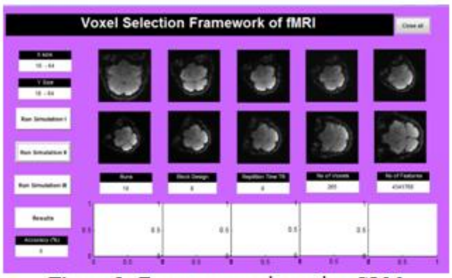

Figure 1: Feature extraction using GLM

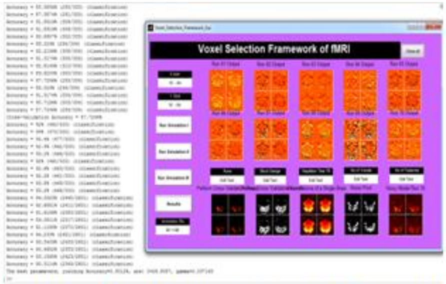

Figure 2: Total no of features are extracted from loaded brain data set

From the figure 1 we can observe that after simulating the ten rounds of operation with respect to eight block design for the same image, the number of voxels considered are 265. And from the simulation 4341760 features are calculated.

IV. Conclusion

In this work we planned a prioritization and assortment of voxels from dissimilar experimental environment that ranked the voxels with respect to the degree of their association . Two methods based on MI and PLS regression are proposed Before building a classification model in MVPA. we established the utility of impact of feature selection on classification accuracy with three linear classifiers: LR, SVM, and GNB using fMRI dataset. From the results it was observed that the use of MI and PLS as importance indexes successfully improved overall classification performance The planned assortment strategy assured inclusion of the best selection of useful voxels which will be used in classification model limiting the set of voxels below consideration to a functional anatomic distinct region.

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