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INDEPENDENT COMPONENT ANALYSIS FOR BCI SYSTEM

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Abstract— **The field of Biomedical research and development has been focusing primarily on neuroprosthetic applications. When performing MRI analysis, physicians have to often deal with considerable amount of artifacts that may make impossible the extraction of valuable information therein. The artifacts resemble the neural responses leading to misinterpretation of resulting data. The recent research onartifacts identification in MRI recording using ICA has been reported.The application of ICA here, is used to identify the changes in the brain MRI images of the deseased brain when compared to a normal brain. This change is further analysed to check whether or not the change is genuine or just an artifactand then it can be easily analysed further as to what problem is the person under diagnosis facing.**

Index terms- **Independent Component Analysis(ICA), Brain Computer Interface(BCI), Magnetic Resonance Imaging(MRI).**

I. Introduction

A. Definition of ICA:

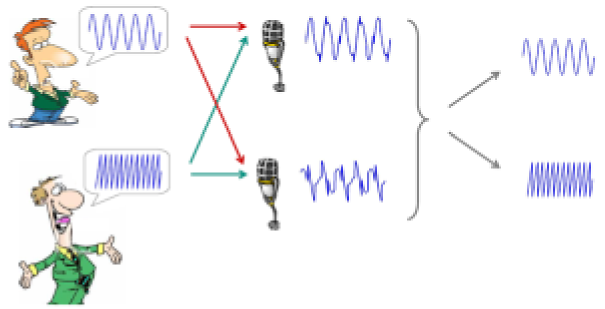
Independent component analysis (ICA) is a method for separating a multivariate signal into subcomponents, supposing the mutual statistical independence of the non-Gaussian source signals. It is a case of blind source separation or blind signal separation.

B. Cocktail Party Problem:

Imagine that you are in a room where two people are speaking simultaneously. You have two microphones, which you hold in different locations. The microphones give you two recorded time signals, which we could denote by x1(t) and x2(t), with x1 and x2 the amplitudes, and t the time index. Each of these recorded signals is a weighted sum of the speech signals emitted by the two speakers, which we denote by s1(t) and s2(t). We could express this as a linear equation:

$$x1(t) = a11s1 + a12s2$$
$$x2(t) = a21s1 + a22s2$$

Where a11,a12,a21, and a22 are some parameters that depend on the distances of the microphones from the speakers. It would be very useful if you could now estimate the two original speech signals s1(t) and s2(t), using only the recorded signals x1(t) and x2(t). This is called the cocktail-party problem. For the time being, we omit any time delays or other extra factors from our simplified mixing model



Independent component analysis was originally developed to deal with problems that are closely related to the cocktail-party problem. Since the recent increase of interest in ICA, it has become clear that this principle has a lot of other interesting applications as well.

II. OBJECTIVE

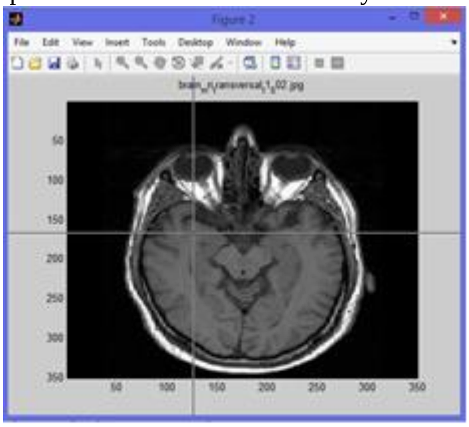
Multichannel processing of the electromagnetic field emerging from neural images of the brain generate large amount of data. A fundamental problem in neural network research as well as in many other disciplines is finding a suitable representation of multivariate data , so a suitable feature extraction method will be useful to facilitate the representation and interpretation of data .The independent component analysis is an efficient tool for artificial identification and extraction of Functional Magnetic Resonance Imaging (fMRI) data .The objective of our project is to develop a tool that is an efficient tool for the identification of changes in fMRI images.

III. METHODOLOGY

When performing MRI analysis, physicians have to often deal with considerable amount of artifacts that may make impossible the extraction of valuable information therein. The artifacts resemble the neural responses leading to misinterpretation of resulting data. The recent research on artifacts identification in MRI recording using ICA has been reported. The application of ICA here is used to identify the changes in the brain MRI images of the diseased brain when compared to a normal brain. This change is further analysed to check whether or not the change is genuine or just an artifact and then it can be easily analysed further as to what problem the person under diagnosis is facing.

SELECTING INDEPENDENT COMPONENTS:

The MRI images of normal non-affected person's brain are saved in the database. The option 'Mark-Features' in the GUI enables the user to select the parts of the brain which are to be analysed. The user has to mark 3 points in the displayed image and then the region between these 3 points gets selected. This region of the image acts as the independent component which will further be analysed.



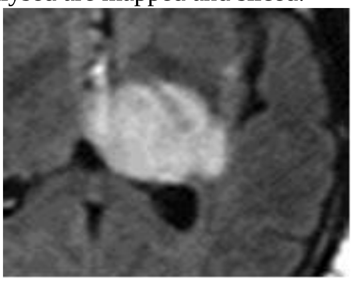
Feature Marking of the Image

ANALYSIS OF SLICED COMPONENTS:

The images of the brain of the person under diagnosis are considered for further analysis.

MRI Image of the Patient

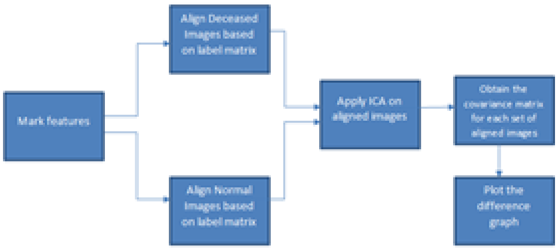
The features and dimensions of the selected regions of normal images are stored in a newly created file called the labels.mat file. Then accordingly the test images which are to analysed are mapped and sliced.



Sliced Component

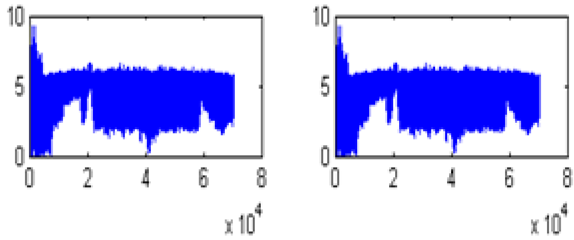
Later the ICA algorithm is applied on the component where a matrix is formed and its covariance is calculated and hence analysed.

IV. BLOCK DIAGRAM



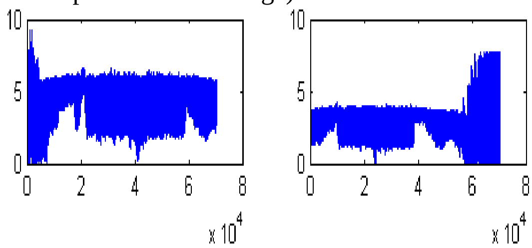
V. INTERPRETATION OF RESULTS

The results of this analysis are interpreted graphically. If the MRI image of the person under diagnosis does not contain any disorders, den according to the mapping of the patients brain image done with the normal image in the database, similar graphs are displayed.



Results for Non-diseased person

But on the contrary, if the person is affected with some disease or a tumour then it also reflects in the MRI scanned image. Therefore after the analysis, as a result the graphical representations of both images(ie, normal brain image and patients brain image) come out to be different.



Results for Diseased person

VI. PLATFORM

For the last several years, the MATLAB software developed by The MathWorks, Inc. has established itself as the de facto standard for numerical computation in the signal-processing community and as a platform of choice for algorithm development. There are several reasons for this development, but one most important reason is that MATLAB is available on practically all computing platforms. For several years the expensive Professional Version of MATLAB was the only version available on the market. The advent of an inexpensive Student Edition has now made it possible to use it in classrooms. Recently, several textbooks in DSP have appeared which generally provide exercises that can be done using MATLAB. However, for students (and for practicing engineers interested in DSP) there are no "how-to" references for selective use of MATLAB in DSP.

REFERENCES

[1] V. D. Calhoun, T. Adali, L. K. Hansen1, J. Larsen1, J. J. Pekar, ICA of Functional MRI Data: An Overview.

[2] Muhammad Siddiq, Sheikh Kashif Ra_at, Farhan Sha_q, Department of Computer Science IT, Federal Urdu University of Arts, Sciences and Technology, Karachi, Pakistan

[3] An information maximisation approach to blind separation and blind deconvolution, Anthony J, Bell and Terrence J Sejnowski, Computational Neurobiology Laboratory ,The Salk Institute.

[4] [4Independent Component Analysis: Algorithms and Applications, Aapo Hyvrinen and Erkki Oja, Neural Networks Research Centre , Helsinki University of Technology.

[5] MASTER OF TECHNOLOGY IN VLSI DESIGN AND EMBEDDED SYSTEM BY SASMITA KUMARI BEHERA.

[6] Automatic Conversion of Floating Point MATLAB Programs into Fixed Point FPGA Based Hardware Design, P. Banerjee D. Bagchi, M. Haldar, A. Nayak, V. Kim, R. Uribe.

[7] Independent Component Analysis of fMRI Data by Denise Miller.