PATTERN –BASED WITH SURFACE-BASED MORPHOMETRY SURVEY ON BRAIN CHANGES

R.Keerthana¹, M.Babu², S.R.Sridhar³

¹PG Scholar (M.E), Department of Computer science, Knowledge Institute of Technology, Salem, Tamil Nadu, India
²Assistant Professor, Department of Computer science, Knowledge Institute of Technology, Salem, Tamil Nadu, India
³Assistant Professor, Department of Computer science, Salem, Tamil Nadu, India

Abstract

Morphometry is identifying and characterizing differences and correlations between brain shapes among population. Study of brain shape has drawn attention among many researchers on different diseases counting Schizophrenia, dyslexia, autism, Alzheimer and turner’s syndrome. Many approaches have been proposed for computer-assisted diagnostic taxonomy. Several significant progressive brain changes occur during aging. Pattern-Based morphometry is a robust application for measuring the change in brain parametric mapping. By reason of bias featuring in image along with the algorithm, have a penalty term and inverse consistency that are necessary to oversight the change in non-biological structure. Morphometric analysis forces a pact between the sensitivity and specificity that has drawn reporting or increasing attention in the field of biological science. A novel technique illustrating the brain tissue aging survey with surface-based and multivariate pattern of morphometric brain change To keep the robustness and specificity contributed by the spatial term and cortical analyses, while maintaining the localization and sensitivity Experimental results propose a greater inter variability within normal aging as well as the generation of more sensitive based morphometry in brain survey.

Keywords: Image registration, Multivariate analysis, Cortical analysis, Pattern based morphometry (PBM), Surface based Morphometry (SBM).

1. INTRODUCTION

Medical Imaging with Biomedical Engineering has become an important component in our day to day clinical applications. A survey on detecting change in non–biological structure is a challenging task which can be either longitudinal or cross-scale[4]. Estimations of survey are dependent by many factors. Some factors are with the images and others with its methods. There are different forms of analysis of brain such as Single-photon emission computed tomography (SPECT), Computed tomography (CT), positron Emission Tomography (PET), and Magnetic resonance imaging (MRI), in which it is widely used for analysis. These are used to detect abnormality localization in patients. They are subjected to noise while segmentation. The major difficulty in brain change detection is to model change in terms of deformation at region boundaries from the boundary-based method. Morphometry of whole brain to detect abnormalities has approaches like Voxel-based to quantify mass-univariate or multivariate analyses and Tensor-Based Morphometry (TBM) [1] obtained from registration to measure the amount of deformation to measure the anatomical features of the subject. The TBM deals with the sensitivity and specificity with reference to the brain changes. Deformation varies in different ways (i.e.) the amount of deformation depends on the morphology of the subject.

In this paper we will exploit a new technique Pattern-Based Morphometry (PBM) which a data driven technique. It uses sparse dictionary learning algorithm that is used to identify the differences globally. This is done along with another method Surface-based Morphometry (SBM) [4] which measures from geometric models of cortical surfaces.

2. RELATED WORK

The specificity of region-based approach along with the boundary-based approach were used to combine the localization and sensitivity advantages. By using TBM we can find the volume changes typically that appear at tissue
boundaries in homogenous brain regions[1]. Brain registration is also one of the tools used for studying morphometry. Registration can be difficult depending on anatomical variability and complexity in structures. Log-jacobian images of such warps should be uniformly close to zero[1].

Multiple atlases of brain MRI is collected across subjects and computed. For atlases OASIS (Open Access series of Imaging Studies) database is used that range from 18 to 96[15].

**Fig-2** Atlases across different ages for subjects in the OASIS data set.

The atlases compute sharpness and features of image to higher degree. A method to overlay the images from their source and the manipulation of their transparency attributes or by assigning them to different color channels.

Image fusion can be performed at three different levels 1.Pixel/data level, 2.Feature/attribute level and 3.Symbol/decision level. These are done to serve for different purposes. Fusion rule is being used here to determine the fusion results[12].

**Fig-3** Overlaying monochrome images using different color channels.

Multistructure deffeomorphic registration approach to approve accuracy and robustness[2]. Many Group-based Neuroanatomical studies is the extraction of morphometric features that can be used for characterization of anatomical variability across or within groups. This study has approaches like voxel-based and tensor-based. Voxel-based morphometry computes the changes in volume due to registration[6]. It generates specific hypothesis about brain changes overtime. It is a automated technique that has grown in popularity. It uses statistics to identify difference in brain anatomy between collections of subjects, which in turn can be used to assume the presence of atrophy or, less normally, tissue development in subjects with disease.

3. METHOD

Methods used to analyse are pattern-based and surface-based. Pattern-based morphometry (PBM) is a data driven approach. It uses a dictionary learning algorithm to extract global patterns that characterize group differences. Surface-based analysis derives morphometric measures from geometric models of the cortical surface.


3.1 Step-1 Changes in Synthetic Images

Large set of different images is generated by subtracting an image in Group 1(G1) from its neighbor Group 2 (G2), G1 contains set of images M={a1….am} and G2 contains set of images N={b1….bn}, then the image is generated as

\[
\text{GOI} = M - N \quad \text{(for all am & bn images)}
\]
Any image generated by subtracting an image in Group 1 from its neighbor in Group 2 can be expressed as a straight combination of a dictionary of image patterns that extricate the two groups. It is done to discover this dictionary of image patterns.

3.2 Step-2 Surface Extraction

Layer of cortical surface is being measured and extracted. The cortical surface has the grey matter, white matter and CSF (cerebrospinal fluid). Many manipulations are applied to the surface.

3.3 Step-3 K-Singular Value Decomposition

It solves a matrix decomposition problem to extract a dictionary of k patterns from X which is taken from by Aharon, M., Elad, M., and Brukstein et.al. Along with this SVD approach thickness and weight of brain is being measured using the surface based analysis. The K-SVD approach here extracts the grey matter volume, white matter volume and CSF (cerebrospinal fluid) volume.

3.4 Step-4 Reconstruction

Image is being smoothed by the moving average smoothing technique and the image is being reconstructed.

3.5 Step-5 Group Analysis

Once the reconstruction has been computed, a group analysis is performed across AD control groups with the following 1. White matter 2. Grey matter 3. Cerebro Spinal Fluid 4. Thickness 5. Weight and ranked accordingly with pattern of images which is compared with age and gender of the control groups.

4. EXPERIMENTAL RESULTS

It is done to discover this dictionary of image patterns. The identification is done using MAT lab.

The time taken to identify single image is 8.765559 seconds.

The cortical surface has the grey matter, white matter and CSF (cerebrospinal fluid) as in fig. 6.

5. CONCLUSIONS

The technique of PBM with SBM measures both volume and surface of MR images and computes the inverse consistency of it and identifies across five control groups leaving the penalty term. Sensitivity has been increased along specificity and localization. Results are to be analyzed Future result can be on 3D brain images.

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