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Integration & Segmentation of Pet & Mri Images For Brain Studies

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Abstract - This project is to develop fusion algorithm for the integration of medical images obtained from Magnetic Resonance Imaging (MRI), Positron Emission Tomography (PET). This integration has been ongoing research topic for the last two decades. This paper gives recent developments of the combined scanned images of PET & MRI. Even after integration, fused images needs to segment for recovering raw images. Presently, PET/MRI instruments with fusion designs are just beginning to enter clinical use and their efficacy and results are unclear. Hence, we are providing an algorithm for fusion and segmentation using Discrete Wavelet Transform & Level Set Segmentation. It can be expected that they would be useful for brain pathology (stroke & tumors) and for whole body oncologic applications. Major benefits of PET/MRI are the reduction in radiation dose compared with PET/CT scans.

Keywords: MRI, PET, Matlab, Level Set Segmentation, Discrete wavelet Fusion.

I. INTRODUCTION

Image transformation plays an important role in the fields of medical diagnosis. There are many factors in the process of the physician's diagnosis. Firstly, the physician's diagnosis is subjective, because the diagnosis' result is affected by the doctor's experience and ability; Secondly, the physician's diagnosis tends to omit some tiny changes that the human eyes can't find; thirdly, different physicians would get the different diagnosis conclusions for the same medical image. Comparing to the physicians, the computer has major benefits in the aspect of avoiding the incorrect diagnosis results. This is done by Image processing on MATLAB.

II. DESCRIPTION

- MEDICAL IMAGES

As the project's main objective is to fuse medical images, the first and foremost need is the input to the algorithm, i.e., medical images (MRI & PET). Here, fusion is done on medical images obtained from Magnetic Resonance imaging (MRI) scans. Among different types of MRI scans like whole body scan MRI, Brain MRI& PET, images taken here are taken from www.ida.loni.usc.edu[1]. MRI shows the static brain, through the use of magnetic fields which works by measuring the hydrogen atoms in water. The hydrogen nuclei are exposed to strong magnetic fields and line up like tiny magnets. This produces a signal that can be measured. Compared with CAT scans, MRI provides a better contrast between grey and white matter .Positron Emission Tomography (PET) is a type of diagnostic imaging that is used to identify tumorous growth in specific types of tissue. Depending on the tissue of interest different tracers may be used, however the most common radio isotopic tracer is 2-fluoro-2-deoxy-D-glucose (FDG). This extended response task specifically looks at how PET scanning works and its role in the diagnosis of lymphomas. Positron Emission Tomography (PET Scans) technique is able to show the active brain by following the movement of a radioactive substance that has been injected into the brain.

This project mainly focuses on creating an algorithm for classifying brain images especially and detecting any abnormalities in brain like tumor. Therefore, the images which are given as input to the algorithm are of two types:

1. MRI images (Fig.2.1) and
2. PET images (Fig.2.2)

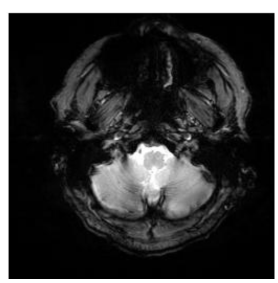
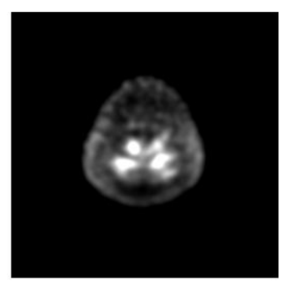



Fig. 2.1 Fig.2.2
MRI Image PET Image

III. IMAGE FUSION

Medical images obtained from multiple imaging modalities such as MRI/PETare used to integrate into single medical image for diagnosis and assessment of medical problems. Fusion algorithms are improved for diagnosis decisions based on obtained medical images. Image fusion of two images are converted to single grey level image and those converted image gets retrieved as a processed image with mean approximation of detail coefficients and decomposition level.It has a trending innovation for image processing in near future.

XFUS=fusimg(MRI,PET,WNAME,LEVEL,AFUSMETH,DFUSMETH) which returns the fused image XFUS obtained by fusion of the two original images MRI and PET.

IV. IMAGE SEGMENTATION

Segmentation is the process of separation of small boundaries within a medical image. First and foremost, the brain anatomy itself shows major modes of variation. Furthermore many different modalities (CT, MRI, PET and SPECT) are used to diagnose medical images. The result of the segmentation can then be utilized for further assessment of diagnosis. Some applications are detection of organs, tumor, neural imaging cell counting, or simulations based on the extracted boundary information.

The general formula of Level Set for multiple phase is,

$$\Omega_i = \bigcap_{k=0}^{n-1} \mathbf{x} \in \Omega : (1-c_k)\cdot \phi_k \quad \text{(Eq. 4.1)}$$

which is a function related to evolving surface characteristics (e.g. curvature, normal direction, etc.) and image characteristics (e.g. gray, gradient). When applied into image segmentation, the design of F depends on the information of image and the ideal value is zero on the edge of the target (i.e. the bigger value of the gray gradient).

In medical imaging, for example, one might want to segment the tumor or the white matter of a brain from a given MRI image. Mathematically, given an image

u: □⊂□R^2(or R^3) $\leftrightarrow R^+$, we want to find closed sets □satisfying

$$\boldsymbol{\Omega} = \cup_{i=1}^{N} \Omega_i,$$

And

$$\cap_{i=1}^{N} \Omega_i^{(0)} = \emptyset, \quad \text{(Eq. 4.2)}$$

such that F (u, □) = 0, where F is some functional that denotes the segmentation goals. Here, □(0)denotes the interior of □. As in the example of finding area of interest, typically, N is taken to be 2, and □$_1$ is taken to be the region corresponding to the interest, while □$_2$ contains everything else.

V. RESULTS

Here the original cluster and processed resultant images are sorted below.

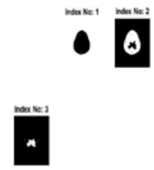
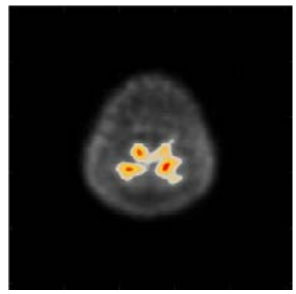


Fig 5.1 Cluster Image



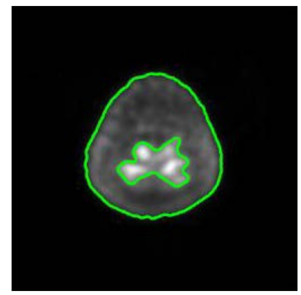


Fig 5.2 Fusion Fig 5.3 Segmentation

VI. CONCLUSION

In this paper, two images are fused using discretewavelet transform with decomposition base level approximation of mean coefficients (Fig 5.2). Then the fused images are segmented for detection of abnormalities in the processed image (Fig 5.3). It is useful for better diagnosis of MRI/PET image scans and will be implemented in scan equipment's.

VII. REFERENCES

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