Proposal of Final Project

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1 Abstract

In image registration filed people used to use quantify methods to evaluate the results. Usually these methods are difficult to give feedback to improve the registration method for it cannot reflect the differences between different methods. We propose a visualization method on image registration. This method is easy for us to check the results and figure out the weak points of the registration method.

2 Introduction

Image registration is an important field in medical image processing. There are several methods to evaluate the results, such as overlap between outcomes and ground truth[1], or based on point set[2], based on contours manually annotated[3][4].
Basically all of these methods are focus on quantity of comparison results. Here we plan to introduce a visualization way to compare image registration results directly, especially for MRI images.
There are several advantage for our method than the quantity methods. Firstly, we can check registration results for different scale. The error in structure of images and error in the details should not be considered as the same. Secondly, it is more convenient to find out the differences between results and ground truth. If the result only has one pixel shift for the ground truth, we can see it easily from visualization, which is difficult for quantity methods.

3 Data preprocessing

In our data set we have MRI brain images and fMRI brain images which are from the same person and scanned at the same time. Unfortunately they are not matched. The MRI data has the matrix size 256×256, 170 slices and voxel size is 1.0×1.0×1.0 mm. And the fMRI data has the matrix size 64×64, 48 slices, and 140 volumes, voxel size is 3.3125×3.3125×3.3125 mm. Besides these we also have a canonical template whose gray matter is separated as 120 zones. Our purpose is to registration the fMRI with this template.

We use SPM12 for fMRI image preprocessing. We begin with discarding the first 10 fMRI image volumes for magnetization equilibrium[5]. Then the procedures of slice timing, motion correction are applied[6]. Then spatial normalization is followed[7]. Basically in this step we don't match fMRI with template directly, instead we match MRI image and the fMRI and use it as a middle step because MRI image has higher resolution. After registration of MRI image and fMRI image, MRI image is registered with the template and generate the transformation matrix. Then we use the same transformation matrix on fMRI to match fMRI data and the template.
So at the end each volume of fMRI image, MRI image and the template are matched, and all of them have the matrix size 91×109, 91 slices, voxel size is 2.0×2.0×2.0 mm. What we need to check at here is the matching between fMRI and MRI, MRI and the template, and fMRI and the template.

4 Visualization method

The template are separated as 120 zones. What we want to know is after matching the corresponding zones on fMRI and MRI are correct or not. Because we don't know the exact zone for each fMRI and MRI, what we can do is visualize the same place of the template, one of fMRI volume and MRI. If for the same zone, MRI and fMRI image have the same structure as the template, then we think the matching is correct.
The software we will use is VTK. The visualization goal we want to achieve is after loading three images: MRI image, fMRI image, and the template, when we selection one zone of template, the corresponding part of MRI and fMRI will show, the other parts will be transparent. And also we need the corresponding part of MRI and fMRI images show with different properties, such as half transparent so we can see the structure of both of them, and in different color so we can distinguish them.
Basically we can separate our method as three parts. First is loading images via vtkDICOMImageReader. This part is kind of easy. The second part is select the corresponding zone, which can be done by using intersection oper-

ation on these three images[8]. The third part is set properties for different parts, such like the whole brain should be transparent except the selected zone, different color and levels of transparent for MRI and fMRI zones.

5 Development plan

Because our method can be separated as three parts, we can set the deadline for them accordingly. We can implement our first part and second part in one week, and for the third part we need two weeks to find out which vtk filter we should use to set the properties, and what is the best property settings for our method.

6 Reference

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