DiffeomorphicDemonsRegistrationWithMaskFilter

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Abstract

Diffeomorphic demons registration was widely used for medical image registration. This document describes the addition of mask processing mode with spatial objects for itkDiffeomorphicemonsRegistrationFilter when just considering the deformation field at the region of interest.

Contents

The DiffeomorphicDemonsRegistrationFilter implements the demons deformable algorithm that register two images by computing the deformation field which will map a moving image onto a fixed image. This filter provides an efficient non-parametric diffeomorphic image registration algorithm based on Thirion demons algorithm [1]. However, the registration result would not be satisfied when the images include unexpected region. This is the motivation of the proposed filter which can deal with this condition by adding mask processing.

1 Description

The new DiffeomorphicDemonsRegistrationWithMaskFilter also use non-parametric diffeomorphic registration algorithm. It takes two ImageMaskSpatialObjects as the fixed and moving mask input. Then it calls

(a) fixed image and its mask

(b) moving image with its mask

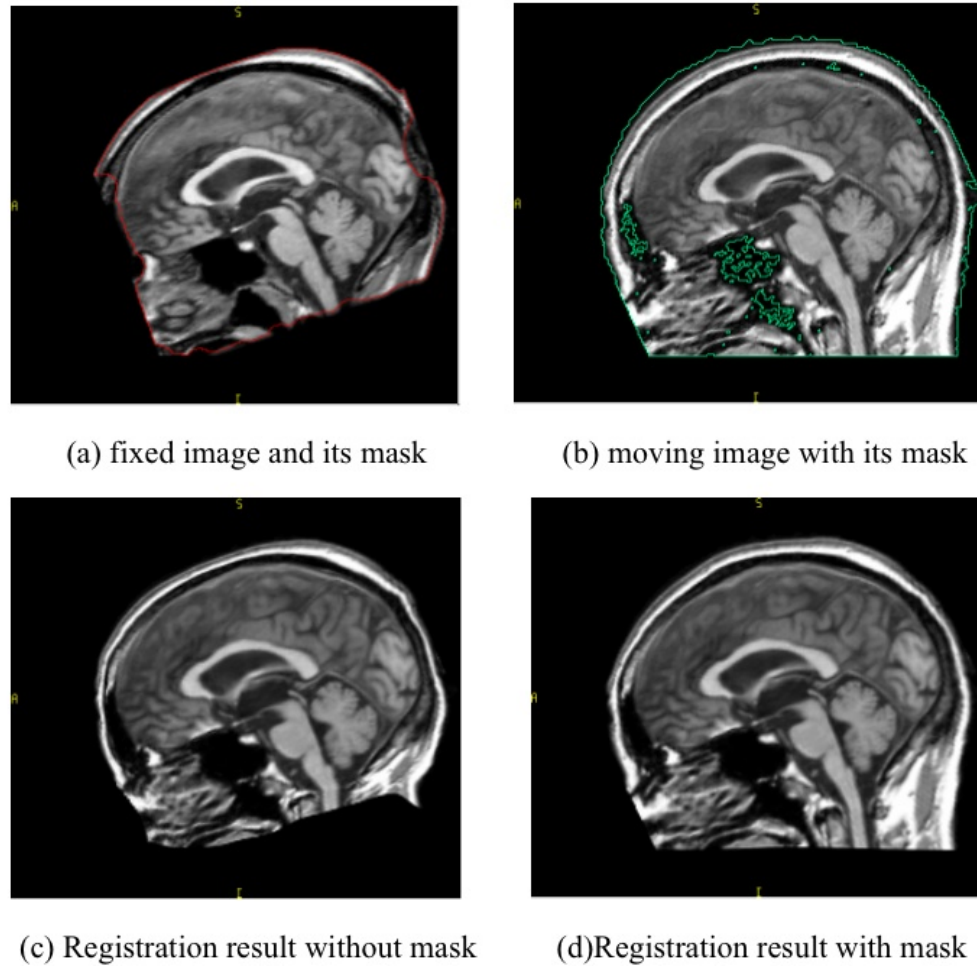(c) Registration result without mask

(d)Registration result with mask

Figure 1: The registration images and results.

its registration function (itkESMDemonsRegistrationWithMaskFunction) to compute the update field of the moving image only at intersection region between these two spatial objects. Meanwhile, the moving mask is also deformed like moving image by WarpImageFilter at each iteration. The proposed filter without masks input is same as DiffeomorphicDemonsRegistrationFilter.

2 Experiment

Experiment was conducted to test the effectiveness of the proposed filter. The masks in red and green line in Figure 1 (a and b) were defined using a otsu forground and hole filling algorithm. It is obviously that the proposed filter gives more reliable and valuable result from Figure 1 (c and d). The skull of the brain was kept very well as it is out of the intersection of two masks. The deformation fields at different direction in Figure 2 also show the improvement from the proposed filter.
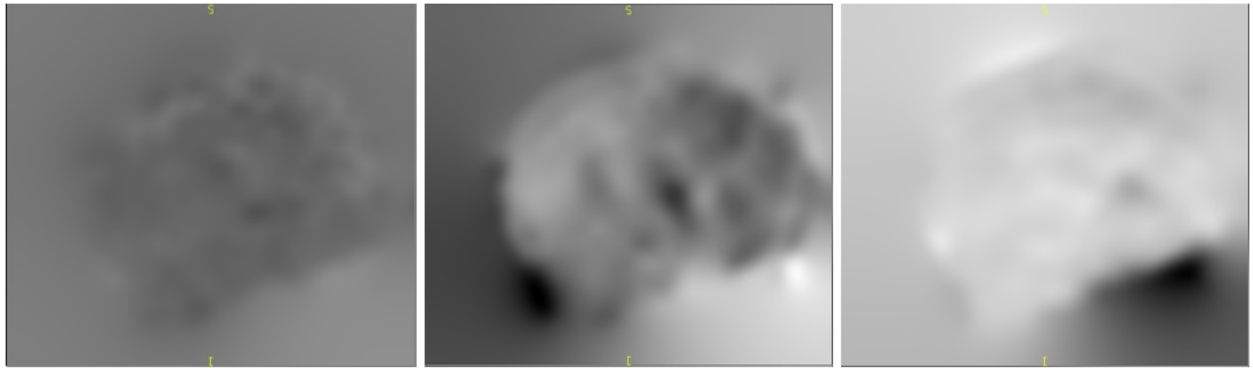
Deformation field obtained from DiffeomorphicDemonsRegistrationFilter
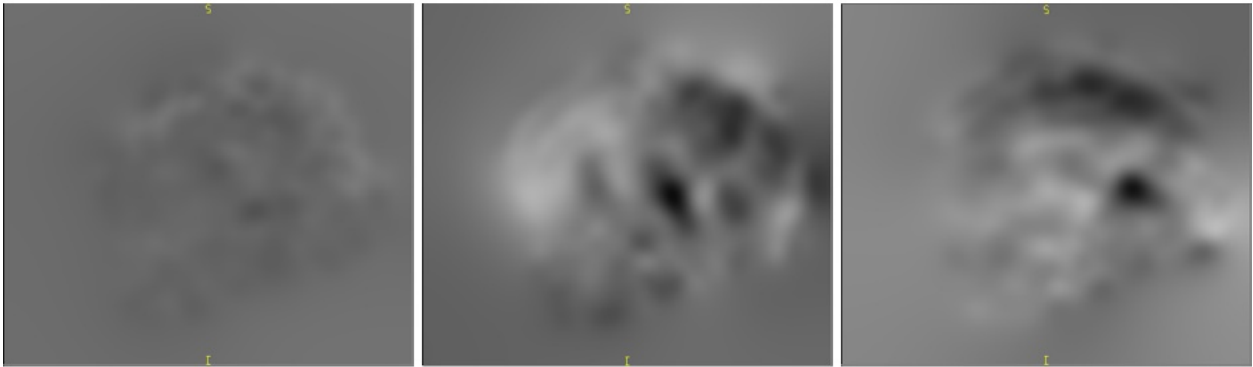
Deformation field obtained from DiffeomorphicDemonsRegistrationWithMaskFilter

Figure 2: The deformation field at different direction. From left to right: *X,Y,Z*

3   Usage

The filter is really easy to use. It is instantiated like DiffeomorphicDemonsRegistrationFilter in ITK, i.e.,

```
Typedef itk::DiffeomorphicDemonsRegistrationWithMaskFilter
      <FixedImageType,MovingImageType, DeformationFieldType > FilterType;
FilterType::Pointer filter = FilterType::New();
filter->SetFixedImage(fixedImage);
filter->SetMovingImage(movingImage);

//Setting mask, the mask should be ImageMaskSpatialObject
filter->SetFixedImageMask(fixedMask);
filter->SetMovingImageMask(movingMask);
...   //Set other parameters like DiffeomorphicDemonsRegistrationFilter

filter->Update()
```

Acknowledgement

References

[1] Tom Vercauteren, Xavier Pennec, Aymeric Perchant, Nicholas Ayache, *Diffeomorphic demons: Efficient non-parametric image registration*. NeuroImage 45(1):61-72, 2009. (document)