Feature based Matching of CT & MRI Brain Images

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Abstract- Multimodal image matching calls or demands for feature based or object based matching. Feature used in matching can be edges, ridges, blobs, valleys etc. Feature based matching is considered as less tedious and low level image processing task whereas object based matching is consider as high level image processing task and complex.

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I. Matching

While integrating two multimodal and mono modal images, first step is matching (geometrical matching) and second step is fusion (combined display of data involved). In this paper we will concentrate on first step. Matching of CT and MRI images is useful in radiation therapy planning. This type matching is also used in skull base surgery and epilepsy surgery.

II. Difference Between CAT And MRI Scans

CAT scans are a specialized type of x-ray. The patient lies down on a couch which slides into large circular opening. The x-ray tube rotate around the patient and computer collects the results. These results are translated into images that look like a slice of a person. CT is very good for imaging bone structure. “Fig.” 1 shows CT slice.

MRI scan uses magnets and radio waves to locate the images. The patient lies on the couch that looks very similar the ones used for CT. they are then placed in a very long cylinder. The machine will produced a lot of noise and examinations typically run minutes. MRI does not do very good job to bones but its advantage is ability to change the contrast of images. Most MRI machines can produced images in any plane. CT can not do this. “Fig.” 2 and 3 are axial images whereas “Fig” 4 is coronal image.

III. Ridges

For matching of CT and MRI brain images we select skull ridge because nature of skull is in deformable. In “Fig” 5 CT slice is shown. In “Fig.” 6 landscape of same depicted which is also called intensity landscape. “Fig.” 7 shows the intensity of same CT slice but now smoothed by convolution with Gaussian. There are no. of geometrical invariants that extract ridges in a variety of images. Definition of Lvv[3,4] measure of 2D images

\[ L_{vv} = \frac{1}{||\nabla||^2} (\nabla \cdot \nabla)^2 L, \]

(where \( \nabla \) is the nabla operator \( (\frac{\partial}{\partial x}, \frac{\partial}{\partial y}) \)) and \( v \) is a right handed normal).

And the generalization of a 3D images by lvv operator can be found in[4]. When applying lvv operator to the CT set the resultant image show skull ridge. Then this ridgeness image is superimposed on to the original
CT slice to construct the 3D volume. “Fig.” 8 shows ridged CT image. Similar example can be done in MRI image. “Fig.” 9 shows a MRI image. “Fig.” 10 shows the ridged MRI image (also called troughed image as in MRI image the skull area is dark).

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### IV. Registration Method

Now we need to register the feature volume. The technique used is cross correlation\[5\] since the two images have different physical realities. By using the grey values directly \[1\], avoid segmentation our feature images.

The correlation value \( c(t) \) of CT feature volume \( L_1 \) and MR feature volume \( L_2 \) over all rigid transformations \( t \), where \( c(t) \) is defined as:

\[
    c(t) = \sum_{(x,y,z) \in L_1} L_1(x, y, z) L_2(t(x, y, z)).
\]

Here next level is formed by maximizing the trough images or minimizing the ridge images. This method is also called multi resolution correlation [2,6]. The disadvantage of this approach is high computational effort required. “Fig.” 11 shows resultant image after CT and MR volume matching using ridgeness correlation.
V. Conclusion

The terms matching and registration are both used to denote the process of determining a transformation that relates the contents of two images in a meaningful way. The registration of MR and CT images was one of the first applications of medical image registration. Furthermore, the applicability of MR-CT registration is restricted primarily to the head. MR-CT registration is likely to become more widely used in future.

References Références Referencias


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