Global Journal of Medical research
Neurology and Nervous System
Volume 13 Issue 2 Version 1.0 Year 2013
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4618 & Print ISSN: 0975-5888

Feature based Matching of CT & MRI Brain Images

By Ayush Dogra
Punjabi University, India

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.

GJMR-A Classification : NLMC Code: WI 368

FEATUREBASEDMATCHINGOFCTMRIBRAINIMAGES

Feature based Matching of CT & MRI Brain Images

Ayush Dogra

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.

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.

Figure 1 : A CT slice

MRI scan uses magnets and radio waves lo 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.

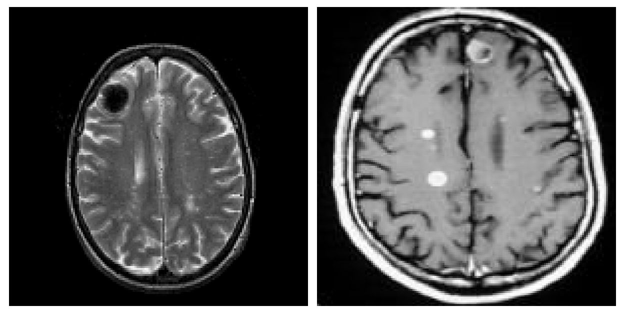

Figure 2 & 3 : Axial Images

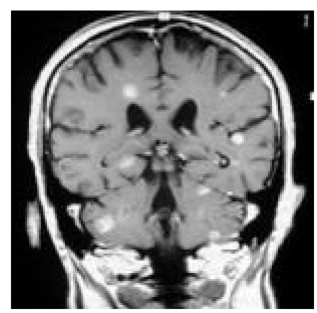

Figure 4 : Coronal Image

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

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

(where ∇ 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

Author: Ucoe, Punjabi University, India.
e-mail: ayush13579@yahoo.com

Global Journal of Medical Research (A) Volume XIII Issue II Version I Year 2013

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).

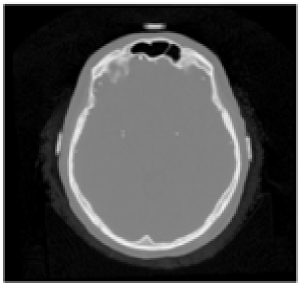

Figure 5 : CT slice

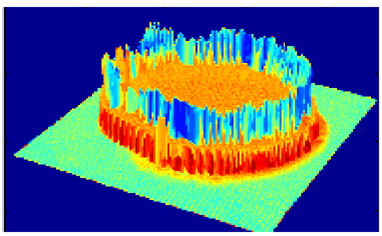

Figure 6 : Intensity landscape

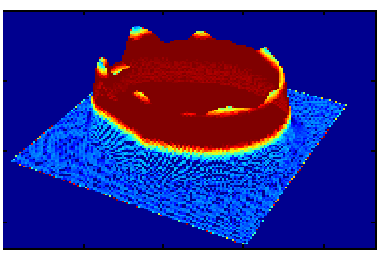

Figure 7 : Blurred by Gaussian Convolution

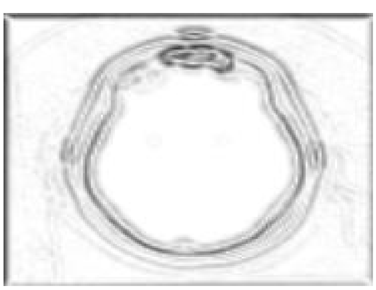

Figure 8 : Ridged CT image formed by superimposing the ridges on to the CT slice

Figure 9 : MRI image

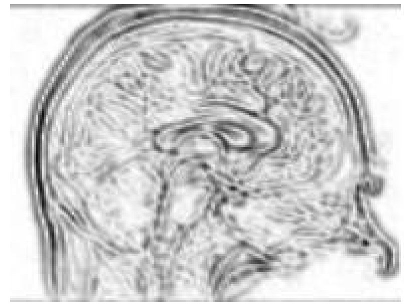

Figure 10 : Ridged MRI image

Feature based matching of CT & MRI brain images

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 L1 and MR feature volume L2 over all rigid transformations t, where c(t) is defined

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

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.

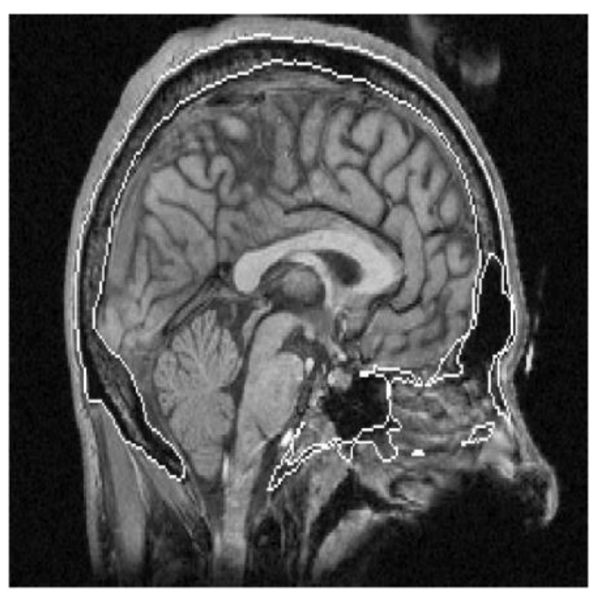

Figure 11 : CT and MRI matching using ridgeness correlation

Global Journal of Medical Research (A) Volume XIII Issue II Version I Year 2013

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 application of medical image registration. Further more 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

1. P. A. van den Elsen, E. J. D. Pol, T. S. Sumanaweera, P.F. Hemler, S. Napel, and J. Adler. Grey value correlation techniques used for automatic matching of CT and MR brain and spine images. In Visualization in Biomedical Computing, Proc. SPIE. SPIE Press, Bellingham, WA, 1994. in press.
2. P. A. van den Elsen. Multimodality matching of brain images. PhD thesis, Utrecht University, Netherlands, 1993.
3. P. A. van den Elsen, J. B. A. Maintz, E. J. D. Pol, and M. A. Viergever. Image fusion using geometrical features. In R. A. Robb, editor, Visualization in biomedical computing, volume 1808 of Proc. SPIE, pages 172{186. SPIE Press, Bellingham, WA, 1992.
4. J. B. A. Maintz, P. A. van den Elsen, and M. A. Viergever. Evaluation of ridge seeking operators for multimodality medical image matching. *IEEE Transactions on pattern analysis and machine intelligence*, 18(4):353–365, 1996.
5. P. van den Elsen, J. Maintz, E-J. Pol, and M. Viergever, "Automatic Registration of CT and MR Brain Images Using Correlation of Geometrical Features," *IEEE Trans. Medical Imaging*, vol. 14, no. 2, pp. 384–396, June 1995.
6. P. A. van den Elsen, J. B. A. Maintz, E.J.D. Pol, and M. A. Viergever. Automatic registration of CT and MR brain images using correlation of geometrical features. *IEEE Transactions on medical images*, 14(2):384–398, 1995.

This page is intentionally left blank