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# CERTIFICATE OF PRESENTATION

This is to certify that

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## A Novel Scheme for Segmentation of T1-Weighted Brain Magnetic Resonance Images

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# A Novel Scheme for Segmentation of T1-Weighted Brain Magnetic Resonance Images

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## Introduction

Automatic brain segmentation is widely used for brain volume analysis and disease progress/remission assessment (Bandyopadhyay, 2011; Ahirwar, 2013). Some researchers attempted to employ medical brain atlases as a priori shape information to handle segmentation uncertainties (Fonov et al., 2011). The most well-known and frequently-used method in this category (employed in the SPM toolbox) was proposed by Ashburner and Friston (2011). They performed full brain segmentation by registering T1-weighted MR images with a probabilistic atlas (so-called TPM) consisting of separate gray-matter (GM), white matter (WM), CSF, bone, soft tissue, and air regions (see Fig. 1). Ashburner's method may fail for brain images with neurodegenerative diseases, such as Alzheimer disease (AD), for sensitivity to brain morphological changes. To tackle the above problem, we should primarily compensate brain deformations by increasing the similarity between the brain image and TPM atlas.

## Methods

According to the block diagram of the proposed scheme shown in Fig. 2, we primarily register the brain image with the ICBM152 atlas (Fonov et al., 2011) by using the rigid and non-rigid image registration algorithms suggested by Saadatmand-Tarzjan et al. (2016) and Sarani and Saadatmand-Tarzjan (2013), respectively. Then, the transformed

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brain image (through the obtained rigid and non-rigid transformations) is given to Ashburner's method for brain segmentation. Finally, the resultant segmented image is transformed back to the spatial space of the patient's image.

**Results**

Fig. 3 illustrates four slices of four brain MR images with AD. As shown in Fig. 4, our approach provided better segmentation results for all benchmark images, compared to those obtained by Ashburner's method.

**Conclusion**

In this paper, we proposed a new scheme to tackle major difficulties of Ashburner's method in segmentation of T1-weighted MR images by using rigid and non-rigid registration algorithms. Experimental results demonstrated superior performance of the suggested method.

**References**

[1] Ahirwar, A. (2013), 'Study of techniques used for medical Image segmentation and computation of statistical test for region classification of brain MRI', Journal of Information Technology and Computer science, vol. 5, no. 5, pp. 44–53.

[2] Ashburner, J., Friston, K. J. (2005), 'Unified segmentation', NeuroImage, vol. 26, no. 3, pp. 839-51.

[3] Ashburner, J., Friston, K.J. (2011), 'Diffeomorphic registration using geodesic shooting and Gauss–Newton optimization', NeuroImage, vol. 55, no. 3, pp. 954–67.

[4] Bandyopadhyay, K.S. (2011), 'A survey on brain image segmentation methods', Journal of Global Research in Computer Science, vol. 2, no. 2, pp. 4-7.

[5] Fonov, V.S., Evans, A.C., Botteron, K., Almli, C.R., McKinstry, R.C., Collins, D.L., Brain Development Cooperative Group, (2011), 'Unbiased average age-appropriate atlases for pediatric studies', NeuroImage, vol. 54, no. 1, pp. 313–27.

[6] Saadatmand-Tarzjan, M., Etemadi, S., Moghimi, A. (2016), 'A novel automated method for early diagnosis of Alzheimer disease by using T1-weighted magnetic resonance images', in Proc. 5th Basic and Clinical Neuroscience Congress.

[7] Sarani, V., Saadatmand-Tarzjan, M. (2013), 'A new deformable model for medical image registration', in Proc. 21st Iranian Conf. Electrical Engineering.

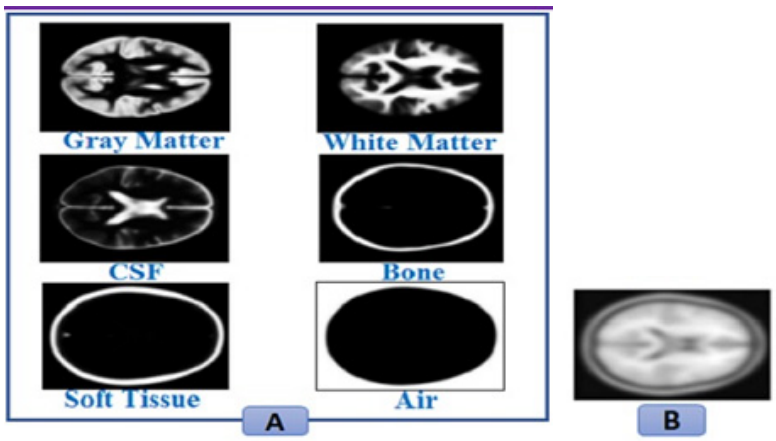


Fig. 1. Sample slices of the (A) TPM atlas (including gray matter, white matter, CSF, bone, soft tissue, and air) and (B) ICBM152.

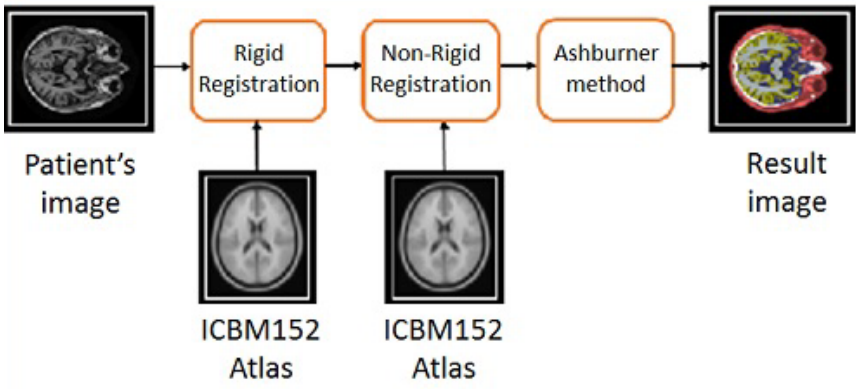


Fig. 2. Block diagram of the proposed scheme.

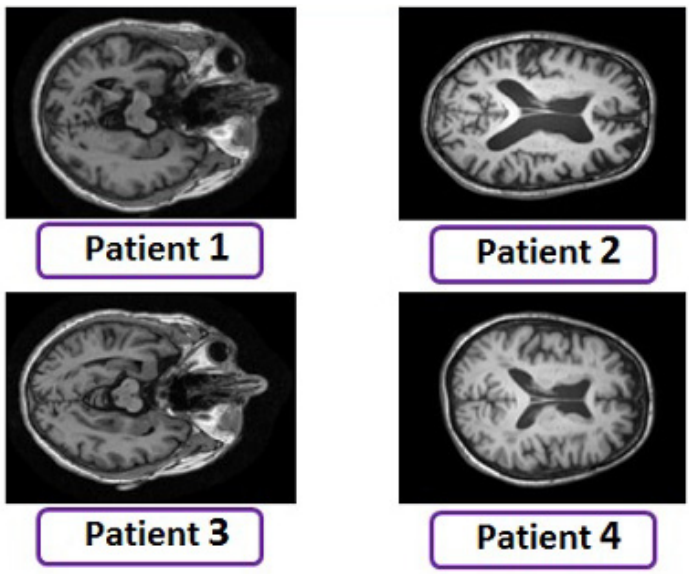


Fig. 3. Sample slices of four benchmark brain T1-weighted MR images.

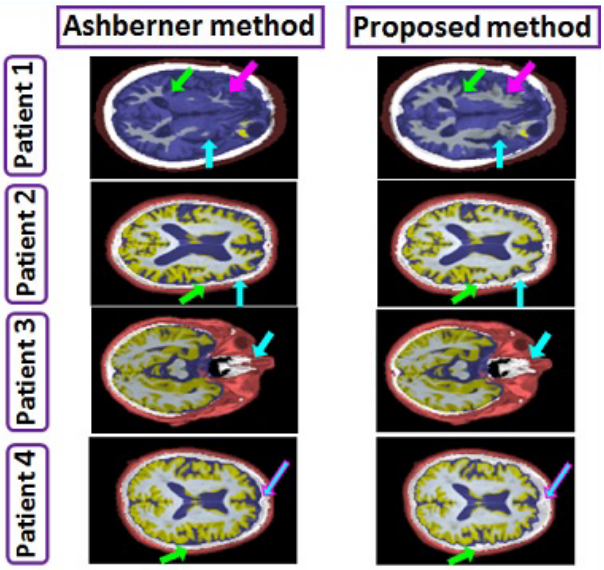


Fig. 4. Comparing the segmentation results of the proposed method with those obtained by Ashburner's algorithm.