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Multi-Atlas Segmentation Based on Dynamic Energy Model: Application to Brain MR Images

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Abstract : Segmentation of anatomical structures in medical images is essential for scientific inquiry into the complex relationships between biological structure and clinical diagnosis, treatment and assessment. As a method of incorporating the prior knowledge and the anatomical structure similarity between a target image and atlases, multi-atlas segmentation has been successfully applied in segmenting a variety of medical images, including the brain, cardiac, and abdominal images. The basic idea of multi-atlas segmentation is to transfer the labels in atlases to the coordinate of the target image by matching the target patch to the atlas patch in the neighborhood. However, this technique is limited by the pairwise registration between target image and atlases. In this paper, a novel multi-atlas segmentation approach is proposed by introducing a dynamic energy model. First, the target is mapped to each atlas image by minimizing the dynamic energy function, then the segmentation of target image is generated by weighted fusion based on the energy. The method is tested on MICCAI 2012 Multi-Atlas Labeling Challenge dataset which includes 20 target images and 15 atlases images. The paper also analyzes the influence of different parameters of the dynamic energy model on the segmentation accuracy and measures the dice coefficient by using different feature terms with the energy model. The highest mean dice coefficient obtained with the proposed method is 0.861, which is competitive compared with the recently published method.

Keywords : brain MRI segmentation, dynamic energy model, multi-atlas segmentation, energy minimization
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