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SEGMENTATION OF STRUCTURES IN 2D MEDICAL IMAGES

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ABSTRACT

Medical image segmentation is one of the most actively studied fields in the past few decades. As the development of modern imaging modalities such as magnetic resonance imaging (MRI) and computed tomography (CT), physicians and technicians nowadays have to process the increasing number and size of medical images. Therefore, efficient and accurate computational segmentation algorithms become necessary to extract the desired information from these large data sets. Moreover, sophisticated segmentation algorithms can help the physicians delineate better the anatomical structures presented in the input images, enhance the accuracy of medical diagnosis and facilitate the best treatment planning.

However, due to the specific and complex requirements of biomedical image segmentations, general image segmentation algorithms are either not applicable or need to be revised for accomplishing this image analysis task. Combining the medical knowledge with the techniques from modern mathematics, physics and biomechanics, researchers have proposed various algorithms to handle the segmentation problem. Many of the proposed algorithms could perform well in certain medical image applications.

Our work aims to present a state-of-the-art review of the algorithms to segment 2D medical images. Compared with 3D medical images, 2D images have simpler anatomical structures, easier implementation, lower computational complexity, and reduced memory requirements. In certain applications that order real-time speed, like neurosurgical planning, technicians could apply 2D methods sequentially to the slices of 3D images.

We will survey the current effective segmentation algorithms used for 2D medical images, explaining their principles, discussing their applications, enumerating their main advantages and disadvantages, classifying them to the corresponding categories referring to the taxonomy introduced in [1, 2]. Through analyzing the requirements in the medical applications, such as the left ventricle extraction and the cerebral cortical segmentation, we illustrate the special requirements in biomedical applications and describe the most suitable models for performing each task, discussing their current

achieved effects and the remained bottlenecks. Possible solutions will be proposed after each application.

Among these reviews, we will focus on the deformable models, which are capable of operating in the continuous spatial domain and have the potentiality of achieving sub-pixel accuracy, emphasizing their merits for performing the segmentation tasks and their important roles in medical image processing. Also, we will illustrate the differences between general image segmentation and medical image segmentation through several substantiations of applying the deformable models. New proposed deformable algorithms, like the one in [3], that are based on statistical study, neural networks, statistics and prior knowledge will be addressed, together with the discussion of their improvements compared with the old ones discussed extensively in [2] and [4]. New effective techniques for general 2D image segmentation will also be mentioned and discussed, concerning to their possible applications in medical image segmentation.

We will present several numerical experiments to demonstrate the effectiveness of certain algorithms or to illustrate the differences among the effects of different methods. In the end, a discussion will be concluded for the future work on designing algorithms for 2D medical image segmentation.

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