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Deep-learning-based Image Segmentation of Small Volumes in CT Images of the Brain[1] JIANXIN ZHOU, University of Illinois at Urbana-Champaign, MASSIMILIANO SALVATORI, Kymamed Srls, Italy, DANIELE DELLA LATTA, Terarecon Inc., United States, ANGELA DI FULVIO, University of Illinois at Urbana-Champaign — Treatment planning in external radiation therapy is based on the acquisition of planning images, such as CT scans, which are used to outline the target volumes and organs at risk. This process is called "segmentation" and can be aided by deep learning (DL) algorithms to improve the segmentation accuracy and streamline the workflow in radiation therapy. In this work, we have developed a general-purpose V-Net algorithm to segment 3-D CT brain images. Although the segmentation of most organs is satisfactory, the segmentation of small volumes remains challenging. We used three different approaches to improve the segmentation accuracy of small volumes, the lens of the eye as relevant case studies. We found that the optimization of the image pre-processing parameter and the V-Net segmentation parameter significantly improved segmentation accuracy of the lens of the eye. After the optimization of these parameters, we used an additional DL algorithm to predict tight bounding boxes surrounding the eyes before segmentation and used the V-Net to segment the lens of the eye in the bounding boxes. This approach yielded the best small-volume segmentation results, which are improved by approximately 20% compared to the general-purpose V-Net results.

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