

A Framework of Left Atrium Segmentation on CT Images with Combined Detection Network and Level Set Model

Yashu Liu, Kuanquan Wang¹, Gongning Luo, Henggui Zhang

Harbin Institute of Technology
Harbin, China

Aims: Left atrium (LA) segmentation on CT is a fundamental step for computer-aided diagnosis. However, it is still a challenging task for accurately segmenting LA owing to the majority unrelated background and similarity tissues, such as left ventricle. To address this issue, we proposed a framework of LA segmentation with a combined detection network and level set model.

Methods: The proposed method consists of two steps:

(1) Firstly, we trained a Faster RCNN to generate a detection box for LA. The obtained detection box can remove unrelated regions to reduce the interference of background and similarity tissues. After evaluating the performance of different feature extractors for Faster RCNN, and considering the accuracy and time cost, we designed a five-layer convolutional feature extractor for this task.

(2) Secondly, we utilized a self-adapted threshold on the detection box to get the initial contour for the level set model, which is nearer the LA and more robust than the random and fixed initialization. And then, we proposed a gradient distance regularized level set evolution model (G_DRLSE) based on DRLSE for the LA segmentation. A gradient energy term is incorporated into the DRLSE, which overcomes the shortcoming of the old model and can guide the evolution direction to the correct object boundary wherever the initial contour inside or outside the object.

Results: The framework was trained and evaluated on MICCAI 2013 LA segmentation challenge including 30 CT volumes (25 training volumes and 5 testing volumes). The detection network achieved the score of Recall, Precision, and Accuracy of 74.00%, 87.97%, and 82.34% respectively, which removed almost 95% unrelated pixels. The G_DRLSE achieved the Dice score of 85.58%. Comparing to the DRLSE, it achieved a 2% improvement on the Dice score.

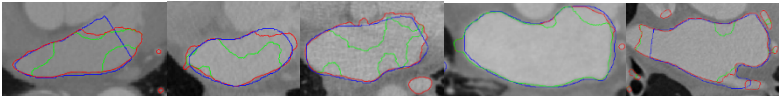


Fig.1 Examples of the segmentation results on five testing volumes based on the detection boxes. The blue, red, and green contours are corresponding to the ground truth, the results of G_DRLSE (proposed), and DRLSE.

Conclusion: The experimental results demonstrate that the proposed framework achieves satisfactory performance and efficiency.

¹ Corresponding author.