Deep Learning Based Object Detection and Semantic Segmentation in Biomedical Imaging

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Object detection and semantic segmentation are classical problems in computer vision. In recent years there are great successes of implementing convolutional neural networks (CNNs) in this field. In medical imaging deep learning techniques have been extensively used for computer-aided detection and diagnosis (CADx) such as pulmonary nodule analysis. However, many reported studies utilized hybrid methods, where CNNs are used as a part of the pipeline, and the whole system still needs traditional image processing modules. We have developed a fast and fully-automated end-to-end solution that can efficiently segment lung nodule contours from raw thoracic CT scans. Our system has three modules: 1) faster regional-CNN (R-CNN) based candidate nodule detection, 2) candidates merging, and 3) fully connected neural network (FCN) based segmentation of nodule boundaries. The entire system has no human interaction or database specific design. The average runtime is about 16 seconds per scan on a standard workstation. The nodule detection accuracy is 91.4% and 94.6% with an average of 1 and 4 FPs per scan, and the average dice coefficient of nodule segmentation compared to the ground truth is 0.793.

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