Accurate Segmentation of Medical Images via Deep Networks

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The rapid development of deep learning technology has greatly promoted the development of medical image segmentation. In this talk, I will introduce the research results of my research lab, designing deep convolutional neural networks for high-precision medical image segmentation. Two aspects of the research will be introduced. They are pulmonary opacity segmentation in CT images and blood vessel segmentation in fundus retinal images. In terms of pulmonary opacity segmentation, we designed a double-branch deep network that can learn appearance and geometric information, and a multi-scale attention mechanism network. Both methods can segment six typical opacities of diffuse lung diseases with state-of-the-art precision. In addition, we performed a domain adaption-based segmentation method to successfully apply a network trained on images taken by one CT scanner to images taken by another CT scanner. In addition, we will also introduce our research results in the computer-aided diagnosis of COVID-19 with CT images. In the field of fundus retinal image segmentation, a number of research results will be introduced. A semantics and multiscale aggregation network was designed to aggregate the semantics and multi-scale information for better segmentation of retinal vessels. A recursive semantics-guided network was proposed to boost connectivity in retinal vessel segmentation. Local-region and cross-dataset contrastive learning was designed to enhance the capacity of traditional U-Net, while only adding few parameters for training. A deep semantics and multi-scaled cross-task aggregation network was introduced to jointly extract retinal vessels and their centerlines. These works have achieved the state-of-the-art performance on the segmentation of retinal vessel image. All of the research results reported in this talk have been published in leading international conferences and journals, such as MICCAI, ICASSP and IEEE JBHI. All these works were supported by the national natural science foundation of China (NSFC) and fundamental research funds for central universities of China.