Robust Medical Image Recognition and Segmentation

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Abstract

In recent decades, with increasing amount of medical data, clinical trials are designed and conducted to explore whether a medical strategy, treatment, or device is safe and effective for humans. In clinical trials, different types of patient data are collected. Due to the large variance and limited golden standard training samples, designing a robust and automated algorithm or framework is still challenging and active field of research. In this talk, I will discuss two fundamental and key modules (image recognition and segmentation) in medical image analysis.

The image recognition is formulated as a classification problem to identify the body section from which the image is taken. The problem is solved by a patch-based convolutional neural network. The proposed method can utilize the image-level label to discover discriminative local patches without local annotations and train classifier using these local features. Its performance in our application is superior to conventional models using ad-hoc designed features. Accurate and efficient image recognition serves as a reliable initialization module for anatomy segmentation algorithms.

In medical image segmentation, precise labeling usually relies on prior knowledge due to misleading intensity distributions of different anatomies and between-subject variance. We use Gaussian Mixture Model and Markov Random Field to model the appearances and spatial relationships of voxels in medical image. To finely utilize the prior knowledge from training atlases (medical image and its corresponding label image), we design an adaptive statistical atlas based method to segment new subjects which could be very different from the training samples. The method is shown robust and accurate in brain segmentation and can be easily applied in other applications.

Defense Committee: Prof. Dimitris Metaxas (Chair), Prof. Kostas Bekris, Prof. Konstantinos Michmizos and Prof. Xiaolei Huang (Lehigh University)