The Chinese University of Hong Kong
Department of Biomedical Engineering

Graduate Seminar – PhD Oral Defence

Student	***:***	Miss FANG Yuqi (Department of Electronic Engineering)
Supervisor	***:***	Prof. Raymond Tong
Date	***:***	28 August, 2020 (Friday)
Time	***:***	9:30 am
Zoom Link	***:***	https://cuhk.zoom.us/j/5538644095?pwd=VnlnMVVmOUNscnFqMitCcHdjOHcwUT09
Meeting ID	***:***	553 864 4095
Password	***:***	590446

Title: Deep Collaborative Learning for Semantic Segmentation in Medical Images Diagnosis

The computer-aided diagnosis in medical imaging computing has been a long-standing topic, in which the segmentation of abnormal regions plays an important role. Their accurate recognition and delineation can greatly assist the clinicians in early screening, grading, and monitoring of the disease. With the availability of the massive amount of data, deep learning has become a de facto standard approach in various medical image diagnosis applications. However, most deep learning methods adopt the single-task learning strategies, in which each task is learned in isolation and easily trapped in a single image feature space. To tackle this problem, we in this thesis present four novel collaborative learning strategies that exploit the more general and informative image representations across multiple correlated tasks to address the abnormal region segmentation problems. The conducted comprehensive experiments demonstrate the effectiveness of the proposed collaborative methods.

In the first part, we focus on the delineation and segmentation of colorectal polyps in colonoscopy video sequences. The proposed network is comprised of a shared encoder and two collaborative decoders targeted for simultaneous polyp area and boundary segmentation. Furthermore, a novel boundary-sensitive loss is proposed to model the interdependencies between the area and boundary branches, based on which the information of the two branches are reciprocally propagated and constrained, yielding a significant improvement in segmentation accuracy. For the second part, we study the segmentation task of four different types of diabetic retinopathy fundus lesions. To exploit multi-scale image information, we propose a collaborative network architecture that comprises of a contextual branch and a local branch. An attention mechanism is designed to fuse feature maps from all decoding layers in order to effectively and fully combine informative features from the two branches. Moreover, an auxiliary classification task with a novel supervision scheme is introduced to jointly train the network, thus the problem of overfitting can be significantly reduced. In the third part, we investigate the tumor segmentation of histopathology images. In this work, we present a novel hybrid neural network for hepatocellular carcinoma (HCC) segmentation on H&E stained whole slide images (WSIs). Three task-specific branches are integrated to train the network, which enlarge the feature space, thus the network is able to learn more general features of both tumorous and normal tiles. To the best of knowledge, this is the first work on pixel-wise HCC segmentation with H&E stained WSIs. The training of deep learning based methods requires a large amount of annotated data, and the labeling task is an extremely time-consuming process for human annotators. Therefore, we in the fourth part propose a semi-automatic annotation method in order to reduce the annotation burden. The method is comprised of two cooperative subnetworks, a pixel-wise segmentation network and a polygon-based annotation network. Our method integrates human annotators into the prediction loop, allowing to iteratively refine the predictions according to the suggestions from human annotators. We demonstrate the effectiveness of the human-network collaborative annotation, and achieve promising labeling results.

***** ALL ARE WELCOME *****

For enquiries, please contact Ms. Joyce Chan, Department of Biomedical Engineering at 3943 8278