香港浸會大學理學院
HKBU Faculty of Science

DEPARTMENT OF COMPUTER SCIENCE

PhD Degree Oral Presentation

PhD Candidate:	Ms. LYU Fei
Date	26 July 2023 (Wednesday)
Time:	3:30 pm – 5:30 pm (35 mins presentation and 15 mins Q & A)
Venue:	1) DLB637, 6/F, David C Lam Building, Shaw Campus 2) ZOOM (Meeting ID: 931 1934 3517) (The password and direct link will only be provided to registrants)
Registration:	https://bit.ly/bucs-reg (Deadline: 6:00 pm, 25 July 2023)

Annotation-Efficient Deep Learning for Medical Image Segmentation via Synthetic Data

Abstract

Automatic medical image segmentation plays an important role in assisting clinicians in timely disease diagnosis. In recent years, deep learningbased approaches have achieved promising performance on various medical image segmentation tasks. However, these state-of-the-art methods heavily rely on large-scale well-annotated datasets, which are difficult to acquire in many medical applications. Annotation-efficient learning methods have attracted more attention, because they are able to handle the challenging scenario where large datasets with high-quality labels are not available. Existing research works have been conducted from different angles for annotation-efficient deep learning, and we mainly investigate the approach based on synthetic data. Synthetic data is cheap to collect without requiring human labelling, and it is fully controllable. In this thesis, we attempt to study three important topics in annotation-efficient deep learning by leveraging synthetic data, including: 1) Pseudo-Healthy Synthesis for Weakly Supervised Liver Tumor Segmentation; 2) Synthetic-to-Real Unsupervised Domain Adaptation for Liver Tumor Segmentation; and 3) Synthetic Data Augmentation for Semi-Supervised COVID-19 Pneumonia Infection Segmentation.

First, we propose to use Couinaud segment annotation as an alternative source of supervision to train convolutional neural networks for liver tumor segmentation because Couinaud segment is widely used by radiologists when recording liver cancer-related findings in the radiology reports. A novel CouinaudNet is developed to estimate pixel-wise supervision from weak Couinaud segment labels following the idea of pseudo-healthy synthesis, which can significantly reduce the manual annotation effort.

Then, we propose a synthetic-to-real domain adaptation approach based on test-time training for liver tumor segmentation. An auxiliary two-step reconstruction task is added to provide self-supervision to help adapt the trained model to each test sample, which can effectively reduce the domain gap between synthetic training images and real test images.

Finally, we propose a new perspective from pseudo-label guided image synthesis for semi-supervised COVID-19 pneumonia infection segmentation. The key idea is to keep the pseudo-labels unchanged but to synthesize additional images to match them, and the quality of synthetic pairs is less affected by inaccurate pseudo-labels. Additional synthetic pairs behave like expanding the training data, thus leading to better segmentation performance.

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