Biomedical Informatics Grand Rounds

Wednesday, April 14, 2021 3:00 pm – 4:00 pm

In Search of Effective and Reproducible Clinical Imaging Biomarkers for Population Health and Oncology Applications of Screening, Diagnosis and Prognosis

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Remote Access

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Meeting ID: 956 1719 7636 Passcode: 924293

Bio: Le Lu received a PhD in 2007 from Johns Hopkins University. During his first six years at Siemens, he made significant contributions to the company's CT colonography and Lung CAD product lines. From 2013 to 2017, Dr. Lu served as a staff scientist in the Radiology and Imaging Sciences department of the National Institutes of Health Clinical Center. He then went on to found Nvidia's medical image analysis group and he held the position of senior research manager until June 2018. Since then, he has been the Executive Director at PAII Inc., Bethesda Research lab, Maryland, USA which has become one of the leading industrial research labs in medical imaging. He was the main technical leader for two of the most-impactful public radiology image dataset releases (NIH ChestXray14, NIH DeepLesion 2018). He won NIH Clinical Center Director Award in 2017, NIH Mentor of the year award in 2015, and won numerous best paper awards in MICCAI and RSNA from 2016 to 2020 (over 10000 citations). In 2021, He was elected into IEEE Fellow class cited for his contribution to machine learning for cancer detection and diagnosis, and MICCAI society board member (MICCAI-Industry Workgroup Chair). He is currently an Associate Editor for IEEE Trans. Pattern Analysis and Machine Intelligence and IEEE Signal Processing Letters. He has served as an Area Chair for recent MICCAI, AAAI, CVPR, WACV, ICIP and ICHI conferences for 14 times.

Abstract: This talk will first give an overall on the work of employing deep learning to permit novel clinical workflows in two population health tasks, namely using conventional ultrasound for liver steatosis screening and quantitative reporting; osteoporosis screening via conventional X-ray imaging and "AI readers". These two tasks were generally considered as infeasible tasks for human readers, but as proved by our scientific and clinical studies and peer-reviewed publications, they are suitable for AI readers. AI can be a supplementary and useful tool to assist physicians for cheaper and more convenient/precision patient management. Next, the main part of this talk describes a roadmap on three key problems in pancreatic cancer imaging solution: early screening, precision differential diagnosis, and deep prognosis on patient survival prediction. (1) Based on a new self-learning framework, we train the pancreatic ductal adenocarcinoma (PDAC) segmentation model using a larger quantity of patients (≈1,000, four institutions), with a mix of annotated/unannotated venous or multi-phase CT images. Pseudo annotations are generated by combining two teacher models with different PDAC segmentation specialties on unannotated images, and can be further refined by a teaching assistant model that identifies associated vessels around the pancreas. Our approach makes it technically feasible for robust large-scale PDAC screening from multi-institutional multi-phase partially-annotated CT scans. (2) We propose a holistic segmentation-mesh classification network (SMCN) to provide patient-level diagnosis, by fully utilizing the geometry and location information. SMCN learns the pancreas and mass segmentation task and builds an anatomical correspondence-aware organ mesh model by progressively deforming a pancreas prototype on the raw segmentation mask. Our results are comparable to a multimodality clinical test that combines clinical, imaging, and molecular testing for clinical management of patients with cysts. (3) Accurate preoperative prognosis of resectable PDACs for personalized treatment is highly desired in clinical practice. We present a novel deep neural network for the survival prediction of resectable PDAC patients, 3D Contrast-Enhanced Convolutional Long Short-Term Memory network (CE-ConvLSTM), to derive the tumor attenuation signatures from CE-CT imaging studies. Our framework can significantly improve the prediction performances upon existing state-of-the-art survival analysis methods. This deep tumor signature has evidently added values (as a predictive biomarker) to be combined with the existing clinical staging system.

Educational Objects: Upon completion, participants should be able to:

- Introduction of the development of novel quantitative imaging biomarkers to quantify Osteoporosis scores using conventional X-ray images of patient.
- Introduction of the development of a highly effective pelvic/chest X-ray trauma medicine computer-aided detection system covering multiple radiological findings with a clinical user study.
- Introduction of the development of effective pancreatic cancer screening using non-contrast CT imaging, and computerized precision differential diagnosis and patient management of patients with pancreatic cysts.
- Introduction of the development of cancer prognosis method using multiphase CT imaging or OPSCC using 3D PET imaging.

Disclosure Statement: In compliance with the ACCME Standards for Commercial Support, everyone who is in a position to control the content of an educational activity provided by the School of Medicine is expected to disclose to the audience any relevant financial relationships with any commercial interest that relates to the content of his/her presentation.
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