Physics

Physics-I *Machine Learning in MRI: design, acquisition, and analysis*
(3 speakers, 90 min)

Physics-II *Chemical Exchange Saturation Transfer: signal origin, animal model, and human applications*
(3 speakers, 90 min)

Physics-III *Diffusion MRI: from basic principles to advanced applications*
(3 speakers, 90 min)

Physics-IV *Quantitative MRI: from parametric mapping to multi-parametric application*
(2 speakers, 60 min)

Physics-V ***Novel MRI modalities***
(2 speakers, 60 min)

Hsiao-Wen Chung, PhD
鍾孝文 教授

Time Table

Sunday, May 22, 2022
Room 205

Time	Topics	Speakers	Moderators
14:30-15:00 (30mins) (Hong Kong time 14:30-15:00)	Low-cost and Shielding-free MRI Technologies for More Accessible Healthcare	Ed X. Wu	Wen-Chau Wu Yen-Ting Chen
15:00-15:30 (30mins)	Deep Learning-enhanced Ultra-low-dose PET/MR Imaging	Kevin Tze-Hsiang Chen	Wen-Chau Wu Yen-Ting Chen

Novel MRI modalities

Organizer:: Hsiao-Wen Chung

Overview:

For over 40 years of developments, MRI is now a relatively mature imaging modality available at least in major medical centers for routine diagnosis. Nevertheless, novel advancements that escaped from the conventional MRI system design, or the use of MRI to assist cross-disciplinary imaging modalities, are still emerging. This session demonstrates two such examples. One uses a low-cost and shielding-free design, incorporating artificial intelligence to improve image quality, to aim for widened access for the patients. The other utilizes the morphological information from MRI to assist PET reconstruction at radiation doses two orders of magnitude lower than clinical routine. Be sure not to miss these excellent lectures.

Low-cost and Shielding-free MRI Technologies for More Accessible Healthcare

- Chair and Lam Woo Professor of Biomedical Engineering, Hong Kong University
- Fellow, International Society for Magnetic Resonance in Medicine
- Fellow, Institute of Electrical and Electronic Engineers
- High-field multi-modal MRI and neuromodulation approaches for understanding brain structures

Ed X. Wu, PhD, Hong Kong

Low-cost and Shielding-free MRI Technologies for More Accessible Healthcare

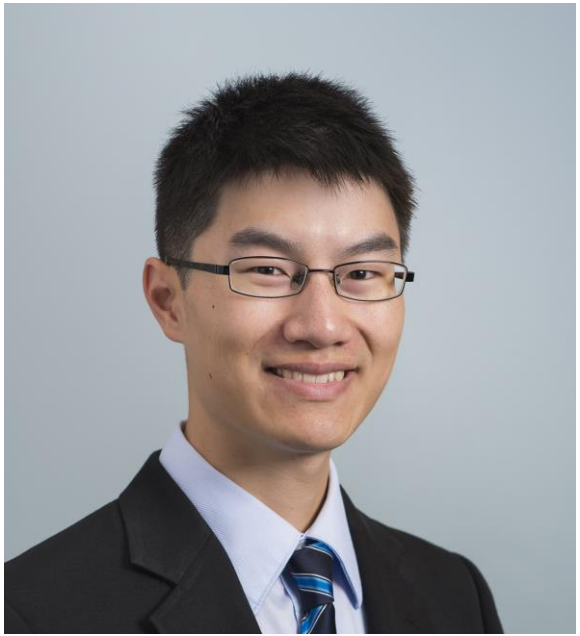
- **Synopsis:**

- MRI is a key diagnostic tool in modern healthcare, yet it can be cost-prohibitive given the high installation, maintenance and operation costs of the machinery. Of all MRI scanners, over 90% are concentrated in high-income countries. We describe an ultra-low-field brain MRI scanner that operates using a standard AC power outlet and is low cost to build. Using a permanent 0.055 Tesla Samarium-cobalt magnet and deep learning for cancellation of electromagnetic interference, it requires neither magnetic nor radiofrequency shielding cages. The scanner is compact, mobile, and acoustically quiet during scanning. We implement four standard clinical neuroimaging protocols (T1- and T2-weighted, fluid-attenuated inversion recovery like, and diffusion-weighted imaging) on this system, and demonstrate preliminary feasibility in diagnosing brain tumor and stroke. Such technology has the potential to meet clinical needs at point of care or in low and middle income countries.

- **Key References:**

- Liu Y, Leong ATL, Zhao Y, Xiao L, Mak HKF, Tsang ACO, Lau GKK, Leung GKK, Wu EX. A low-cost and shielding-free ultra-low-field brain MRI scanner. Nature Communications 2021;12:7238.

Deep Learning-enhanced Ultra-low-dose PET/MR Imaging



Kevin Tze-Hsiang Chen, PhD, Taiwan

- Assistant Professor of Biomedical Engineering, National Taiwan University
- Leveraging the advances in artificial intelligence and MRI to optimize the reconstruction of positron emission tomography to enhance understanding of dementia

Deep Learning-enhanced Ultra-low-dose PET/MR Imaging

- **Synopsis:**
- Deep learning allows incorporation of MR information for the denoising of PET images. PET image quality depends on collecting a sufficient number of coincidence events. However, the injection of radiotracers will subject those scanned to radiation dose; motion during the data acquisition will also lead to inaccuracies in PET radiotracer quantification. Thus, reducing collected PET counts either through radiotracer dose reduction or shortening scan time while maintaining image quality would be valuable for increased use of PET/MRI. In one example, Chen et al. have shown that diagnostic amyloid PET images can be generated using deep learning methods from ultra-low-dose PET/MRI data.

- **Key References:**

- Chen KT, Gong E, de Carvalho Macruz FB, Xu J, Boumis A, Khalighi M, Poston KL, Sha SJ, Greicius MD, Mormino E, Pauly JM, Srinivas S, Zaharchuk G. Ultra-Low-Dose (18)F-Florbetaben Amyloid PET Imaging Using Deep Learning with Multi-Contrast MRI Inputs. Radiology. 2019;290:649-656.
- Chen KT, Toueg TN, Koran MEI, Davidzon G, Zeineh M, Holley D, Gandhi H, Halbert K, Boumis A, Kennedy G, Mormino E, Khalighi M, Zaharchuk G. True ultra-low-dose amyloid PET/MRI enhanced with deep learning for clinical interpretation. Eur J Nucl Med Mol Imaging. 2021;48:2416-2425.